

## The Development of Oil-Fueled Gas Steam Stove as a Learning Media to Enhance Students' Curiosity

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### Abstract

*This study aims to develop learning media in the form of gas steam stoves fueled by oil and describe the validity and effectiveness of the products being developed. This development and research are summarized in a study entitled the development of learning media in a gas-fired gas stove to increase students' curiosity in applied physics subjects. This study uses a media development research method known as Research and Development (R&D). From the research carried out, the following data were obtained: the results of media validation obtained very good categories, and validation test by media experts found very good category. In the curiosity test, which was initially limited to active students, the scores were very good. The results of the initial average curiosity test for the field test were obtained in the low category, and after the use of the media was tested again, and the average score was obtained in the very good category. It can be concluded that the use of an oil-fired gas steam stove in the form of a Pertamina stove as a learning medium can increase students' curiosity about learning applied physics material.*

**Keywords:** Learning Media, oil-fueled gas steam stove, curiosity, creativity

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### INTRODUCTION

At this time, fuel is an important requirement for humanity. These interests are used to facilitate daily needs activities; from this, fuel can be produced energy that can help human life. The fuel itself has various types, including oil and gas nature; petroleum fuels are used as gasoline, diesel and kerosene; meanwhile, natural gas is usually turned into LNG and LPG. It has been the last few years the price of 3kg LPG has increased in price. LPG is a type of Natural gas which Indonesian

people widely use because of its reasonable price, cheap and easy to get, but over time the price of 3kg LPG too increased and quite difficult to find (Sari, 2020).

Three kg LPG fuel is one of the most vital needs for the community, especially the poor, subsidized by the government through PT. Pertamina, so that the government has determined the selling price to the public. People should quickly get this 3 kg LPG HET price and comfortable. However, in reality, the price received by the community is

more than the price that has been determined (Effendy, 2019). This situation continues to change, where subsidized LPG gas is difficult to obtain by the community, which causes the price to soar. The problem with the emergence of a supplier that takes all cylinder gas. The irresponsible elements of hoarding cylinder gas also add to the existing problem. The most severe cases found were gas mixed from 3 kg cylinders to 12 kg, and the use of subsidized gas was not targeted for the poor. In this situation, the government is currently planning to remove subsidies and divert the use of cards that can be used only to the public and SMEs (small and medium enterprises) entitled to LPG gas at low prices. The problem of scarcity of LPG gas and the planned increase in the price of 3 kg of subsidized LPG gas due to the removal of subsidies are serious problems that the community will face according to the government's conditions. Subject to change and have different prices in the market. This situation was exacerbated by an increase in the price of goods needed by residents.

On the other hand, in physics education, there is a course taught about applied physics, which is an essential subject as it requires students to produce applied products. In theory, this course teaches how to apply and teach the physics sciences in a feasible physics product ready to be used. However, in teaching and learning activities in class, students tend to have a low level of creativity and curiosity, so that students' products and ideas are limited. Additionally, most of these ideas are of little use in physics, especially in society. Curiosity is considered a strong motivator of learning. At the same time, Scientific interest in curiosity has persisted for decades. Only recently has empirical work shown that curiosity is associated with better learning outcomes (Wade, 2019). In real-life situations,

learning is often self-motivated, driven by intrinsic curiosity in a particular topic, rather than by external reward (Gruber & Ranganath, 2014).

Curiosity should be considered as a pre-requisite for creativity, as creative people are curious by default. Like fine red wine, curiosity/creativity is best when decanted - to give enough time to breathe and reflect. Creativity is related to imagination, it is an act of creating new ideas, new possibilities, so it should be considered a process and not a product. Different studies mentioned that creativity is crucial for designing products and enabling innovation (Pusca & Northwood, 2018). The ability to think creatively is a requirement to create an idea or an alternative solution to resolve problems that occur in life daily (Faelasofi, 2017).

These two problems contain a very critical meeting point, where there is a need for a learning medium. This learning medium should be truly beneficial directly to society in the current situation. Also, the media must be able to change and enhance students' creativity and curiosity to improve student learning outcomes. One of the learning media that will be developed is an oil-fuel gas stove. This development is summarized in research to develop learning media for gas stoves from fuel oil steam to increase students' creativity and curiosity in applied physics material. Specifically, this research aims to develop learning media for gas steam stoves with oil as the fuel and increase students' creativity and curiosity in applied physics material.

The designed stove is an oil-fueled gas steam stove that has a low evaporation point. The selection of tests for various types of fuel aims to use the resulting stove for more than one type of fuel. As a result, both students and the public can use it according to each fuel's respective selling prices. In principle, this stove converts oil as the fuel into

gas vapour by flowing warm air into the fuel. The formed gas is then burned in the stove head. The stove fire from the burning results is more stable, efficient, and most importantly, the fuel price is lower and very easy to obtain. From this media can also be taught the concepts of physics concepts of heat, pressure and energy.

The concept of heat from a gas stove to the heating value of a fuel, which depends on its composition, strongly affects burner performance. Using the same gas stove to burn natural gas with various heating values is inappropriate and hazardous due to the possible occurrence of incomplete combustion (i.e. a great increase of CO emissions and/or soot formation), liftoff, flashback and inadequate heat input (Changko, 2003). Through this media, students will be able to understand the kinetic theory of gases better. The kinetic theory of gases is one of the physics topics studying gas on a macroscopic scale in terms of its microscopic properties, such as the gas particles' behaviour (Wildan, 2018).

Several studies relevant to the research conducted include Fatmi Nuraini with the title *Increasing Student Creativity in Using Basic Physics 1 Simple Practicum Tools at the FKIP, Malikussaleh University*. This study's results indicate an increase in creativity and curiosity in the use of fundamental physics practicum tools 1, student responses when using basic physics lab tools one (Nuraini, 2018). Furthermore, by Berda with the title *Utilization of Recycled Material Media to Increase the Creativity of Pg-Paud Undergraduate Students of Nahdlatul Ulama University Surabaya*. Researchers use recycled material media (used materials) which can still be used as an APE (Educational Game Tool) or can be used as an early childhood work, as a strategy to increase creativity in students. The results of this study also show an increase in creativity

(Berda, 2019). Then similar research was carried out by Mandaris. With the title *Characteristics of a Gas Stove Fueled by Dme (Dimethyl Ether) Based on Sni 7368: 2011*. In testing a gas stove's performance, one of the most important parameters is heat intake and efficiency of gas consumption (Mandaris, 2013). As well as research conducted by Kurniawan with the title *Characteristics and Efficiency of Radiant Burner Stoves Using Ethanol Fuel*. The conventional gas stove is one type of gas stove. Burning on a burner on a conventional stove has a flame-free burning characteristic (Kurniawan, 2017). From the four studies results, compared with the research conducted, the fundamental difference is the gas stove from petroleum steam fuel. Developed as a medium and used to increase students' curiosity in applied physics material.

In the end, this research is expected to increase students' creativity and curiosity in understanding the importance of applied physics, which can be further applied to help people meet their needs, which involved household fuel use.

## **METHOD**

This research was conducted in the Physics Education Study Program, Teaching and Education Faculty, Tadulako University. This research and development was carried out for eight months, from March to October 2020. The research subjects consisted of undergraduate physics education students who were undergoing applied physics courses. Subjects were selected using the purposive sampling technique. Changes measured are the validation values of research and development of learning media from respondents consisting of experts and students. To determine the increase in students' curiosity due to the application and use

of the developed media, a curiosity test and an N-gain test were conducted.

This research is a Research and Development (R & D) research that refers to the type of research capable of producing certain products and tests the effectiveness of these products. In research and development, learning media development consists of the following ten steps (Sugiyono, 2019), as shown in Figure 1.

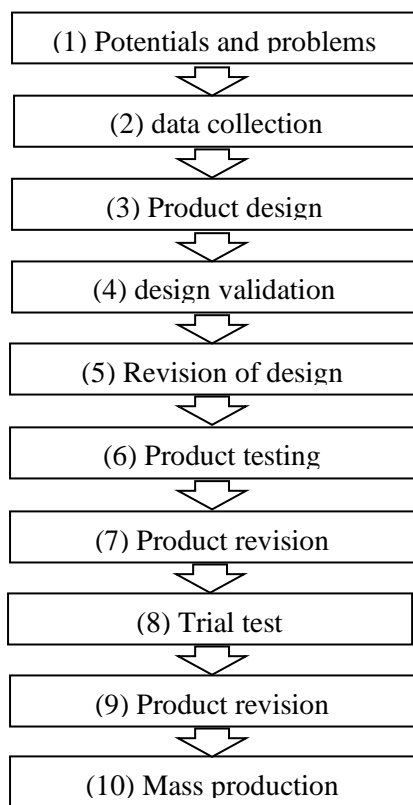


Figure 1 Ten Steps of development

The design of the stove learning media, consists of (1) Fuel: The fuels used consisted of fuels with low evaporation points, such as ethanol, methanol, gasoline, and *pertamax*; (2) Air generating electrical system: The electrical system is a system that works to flow cold air or the air at room temperature into warm air, which will be flowed into the fuel. This system is equipped with fire safety; (3) Gas-phase fuel: Warm air, which is flowed into the fuel, will result in the evaporation of the

fuel into the gas phase, and the gas which is formed flows into the head of the stove; and (4) The burning fuel: The gas from the fuel is ignited and used for cooking stably and efficiently inside the stove head. Figure 2. The Blueprint of the Stove Design.

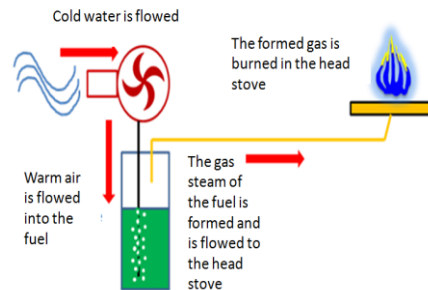


Figure 2 The Blueprint of the Stove Design

The data techniques used and validated are as follows: (1) Questionnaire. In this study, a close-ended questionnaire with a Likert scale type on a scale of 1 to 4 is carried out. The scale indicators consisted of: very good (VG) is worth 4, good (G) is worth 3, poor (P) is worth 2, and very poor (VP) is worth 1. Close-ended questionnaires contain answers and do not provide respondents with opportunities to add additional information (Endang, 2011); and (2) Observations are made when the learning took place.

The analysis technique used to analyze the validation result data is the calculation of the average value. To determine the final score rank for each item in the research questionnaire, the number of scores obtained is divided by the number of respondents who answered the assessment questionnaires. The Likert Scale category is displayed in the following Table 1 (Widoyoko, 2016).

Table 1 Likert Skale Category

Final Scores	Interpretation
$3.25 < X \leq 4.00$	Very Good (VG)
$2.50 < X \leq 3.25$	Good (G)
$1.75 < X \leq 2.50$	Poor (P)
$1.00 \leq X \leq 1.75$	Very Poor (VP)

The analysis of the student respondent data is similar to that of the product assessment quality. The average score obtained from the questionnaire responses was then converted into a qualitative format, as seen in Table 2.

Table 2 Category of Each Criteria of Student Responses

Final scores	Interpretation
$3.25 < X \leq 4.00$	Strongly Agree (SS)
$2.50 < X \leq 3.25$	Agree (A)
$1.75 < X \leq 2.50$	Disagree (D)
$1.00 \leq X \leq 1.75$	Strongly Disagree (SD)

For additional analysis in examining the changes in students' curiosity, gain analysis was carried out. The category of the N-gain score is as follows: High:  $g > 70$ ; medium:  $30 \leq g \leq 70$  dan low:  $g < 30$  (Meltzer, 2002).

**RESULT AND DISCUSSION**

This gas steam stove uses a standard SNI (Indonesian National Standard) gas hose and a small clear gas hose at the input. The use of an SNI gas hose at the output reduces the danger of leakage and burning of oil vapour before it reaches the stove head. This gas steam stove is equipped with an input air control tap and an output oil gas regulating tap. These two taps are essential to regulate how much air can enter the tube and how much oil gas can burn. If too much air entered the tube, incomplete combustion occurs, or the gas burns excessively.

This oil-fueled gas steam stove uses a tube made of 3 in 4 mm thick tubes. The selection of this thickness is to withstand excessive pressure and ensure storing oil safely. The air pump machine used in this stove is low power of 15 watts, while for high pressure, a 25-watt air pump engine can be used. This is adjusted to using the stove with a gas tap setting as both input and output. As for the fuel, the user can choose to use

*premium, pertalite, and Pertamina.* However, it is advisable to use *Pertamax* for this type of fuel as *Pertamax* is a non-government subsidized fuel and easy to get. Stoves and the use of stoves developed can be seen in Figure 3 and Figure 4.



Figure 3 Gas Stove



Figure 4 Gas Stove is Ignited using The Pertamina Fuel

After the gas stove is set and ready to use, a validation test and a limited test are carried out. Before the limited trial was carried out, media and material experts validated it; media aspects that become indicators are: Appealing media display, attractive media colours, the position of components accordingly, practical props, the teaching aids are easy to use in learning, teaching aids are comfortable to use in learning, props can describe the original event. For the material aspects, the indicators are:

Material truth, the suitability of material with competence, conformity with learning objectives, material wrapping/systematics, the proportion of material for each sub-chapter, the text supports the method explanation steps, gallery according to the material, summary according to the material, the layout does not interfere with the material, pictures support explanation, ease of understanding, coherent navigation, the suitability of material with user characteristics. The results of the validation can be seen in Table 3.

Table 3 Validation Result

Validation	Value	Category
Media expert	3.68	very good
Material expert	3.37	very good

From the validation results, several improvements were made to the gas stove as a learning medium so that limited testing and application could be carried out. Some suggestions for the media validator are improvements to the gas tap, strengthening the thickness of the gas cylinder, and adjusting the colour to the LPG cylinder for the material validator to provide input so that the material's depth is increased.

After the validation test, a limited test was carried out on the undergraduate students, and an average score of 3.44 was obtained. It was categorized in the very good category. Apart from the limited test, a curiosity test was also carried out, which affected students' creativity. This test is intended to see how much change could be observed in the student's curiosity and obtained the results according to table 4.

Table 4 Test Analysis Result

Validation	Value	Category
The initial average test analysis (pretest)	2.50	low
The last average test analysis (Posttest)	3.39	very good
N-gain	38	moderate

After this limited test was carried out and observing these good results, the gas stove media's improvement was still carried out by replacing several components, such as replacing the end of the stove head nozzle and the gas input hose. This was done with the purpose to make the combustion better.

After a limited test is carried out, the next step is to conduct a field test with direct application. This test's target is the respondent's response, which can be obtained from both applied physics students and the general public. From the results of student and community respondents in the field, after application both as a learning medium and as a direct application, most responded quite well to gas steam stoves with oil fuel. This can be seen from the increase in student curiosity. From respondents, information can also be obtained that students' curiosity to learn applied physics is because the media developed provokes creativity and students' curiosity to be able to solve problems in the field, especially gas scarcity. In terms of media, the use of instructional media can increase curiosity and creativity; this is in line with previous research studies where media development can increase curiosity, as evidenced by test results and validation (Silmi & Millati, 2017). Also, the use of media can also increase creativity (Nuraini, 2018).

From this research, it is hoped that it can be further developed so that more students experience an increase in curiosity about the material being taught, especially about applied physics when integrated as a learning medium. Meanwhile, if applied in the field, more people will help overcome gas scarcity in the field through mass production.

## CONCLUSION

It was developing an oil-fired gas steam stove as a learning medium. The use of oil-fired gas steam stoves in the

form of Pertamina stoves can help increase curiosity about the topic of applied physics. From the results of the material validation test, it was found that the score was very good. Meanwhile, from the validation test conducted by media experts, the score is a very good category. Limited examinations conducted on undergraduate students obtained an average score which was categorized as very good. Meanwhile, for the curiosity test, the initial average score was obtained in the low category, but after learning media, the average score was obtained in the very good category, and the N-gain value was sufficient. This research has an impact on changes and an increase in student curiosity in learning applied physics material in the community

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