IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 13, Issue 8 Ser. II (August. 2019), PP 19-22
www.iosrjournals.org

The Effectiveness of Introduction of Solar Fuel Engineering Models Towards Improvement of Community Environmental Knowledge

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Abstract: *The diesel fuel engineering model is an effort to reduce vehicle exhaust emissions for environmental control. Researchers hope that this engineering can be supported by vehicle users with diesel fuel. This study illustrates the effectiveness of the introduction of fuel engineering models in vehicle users to public environmental knowledge. Indicators of environmental knowledge that are the focus of the study are the terms, facts, processes and principles. The research method is quantitative research using descriptive statistics and the N-Gain test as a data analysis method. The target of introducing the model is 100 solar powered vehicle users in South Sulawesi Province. The results showed that an increase in the average value of environmental knowledge of vehicle users after the introduction of fuel engineering models. N-Gain test results produce an effectiveness value of 1.33 with an N-Gain value of 1.41. The results of the analysis show that the introduction of a diesel fuel engineering model for controlling exhaust emissions effectively increases public environmental knowledge.*

Keywords: *term, fact, process, principle*

Date of Submission: 15-08-2019 Date of Acceptance: 30-08-2019

I. Introduction

The increase in population accompanied by an increase in community welfare has an impact on the increasing need for transportation facilities and industrial activities. This causes the need for fuel consumption, which mostly uses fossil fuels, also increases, the petroleum supply is running low (Wang, et al). Nowadays, the world is experiencing an energy crisis, especially energy from fossil fuels. Where the remaining fuel reserves on earth can hardly meet the increasing energy demand of the community harms the environment, namely high levels of air pollution due to emissions resulting from the burning process of fossil fuels (Nabavi-Pelesaraei, et al). The number of vehicles in Indonesia is always increasing, the existing vehicle population reaches 124,348,224 units. (Soehodho, 2017).

Diesel engines are the main driving system that is widely used both for transportation systems and stationary drive. However, diesel engines have an impact on the risk of environmental pollution or the presence of smoke (soot) as a result of burning fossil fuels (Mwangi et al, 2015). To anticipate various negative impacts, the use of Jatropha additive (*Ricinus communis*) Castor oil as an effort to reduce exhaust emissions on diesel engines is one alternative solution to environmental problems (Silitonga et al, 2016). As a step to involve the community in the action of reducing vehicle exhaust emissions, the researcher gave an introduction to the diesel fuel engineering model to the public. The introduction method is expected to be effective in increasing the community's environmental knowledge.

II. Method

This research uses a quantitative research approach which is a research approach where the researcher will work with numbers as a manifestation of the observed symptoms using descriptive statistics and the N-Gain test as a data analysis method (Bryman, 2017). This research was located in the automotive engineering education laboratory, Faculty of Engineering, Universitas Negeri Makassar. The duration of the research lasted for six months.

The test result data is in the form of quantitative data which is then processed using the Microsoft Excel program and SPSS V22 for Windows (Haris R et al, 2018). Analysis for each indicator is measured using a scale of 100 where the minimum score is 0 and the maximum score is 100. The term indicator is obtained through 4 items so that each item has a score weight of 25. In fact indicators there are 5 items which means each item has a score weight of 20. The process indicators number 7 items with a weighting score of 14.3 (rounding).

Whereas the principle indicator amounts to 14 items, meaning each item has a weighting score of 7.14 (rounding off).

III. Result and Discussion

1.1 Description of Methods for Introduction of Fuel Engineering Models

The fuel engineering model is a form of application of testing the exhaust emission content in the form of a mixture of diesel fuel with castor oil, where in the test diesel fuel is mixed with several variations of the amount of castor oil that has been predetermined by a mixture of 0% castor oil (without the use of castor oil), 2% castor oil mixture, 4% castor oil mixture, 6% castor oil mixture, 8% castor oil mixture and 10% castor oil mixture. Through several mixtures of exhaust emissions (smoke) has been analyzed at several levels of engine speed that is 500 rpm, 1000 rpm, 1500 rpm, 2000 rpm and 2500 rpm.

The test results can be seen in table 1, showing the Sig. value of the variation of diesel fuel mixtures with castor oil is 0.009 smaller than 0.05 (<0.05) with an F-count value of 4.182 greater than the F-table (F-count> F- table). It is also known that the acquisition of Sig value of engine speed variation (engine Rpm) is 0.000 less than 0.05 (<0.05) with an F-count value of 360,836 greater than the F-table (F-count> F-table). Referring to the assumptions used, it can be concluded that variations in engine speed and variations in the concentration of a mixture of diesel fuel with castor oil have a significant effect on changes in the percentage of the content of exhaust emissions (smoke) (1).

Table 1. Test Results of Effect of Engine Speed and Castor Oil Concentration on Flue Gas Emissions

Dependent Variable	***Fixed Factor***	**R Square**	**Df1**	**Df2**	**F**	**Sig.**
Exhaust Emissions	Engine Rpm	0.987	4	25	360.836	.000
	Castor Oil		5	24	4.182	.009

In other words, high and low levels of exhaust emissions (smoke) is influenced by variations in the mixture of diesel fuel with castor oil and engine speed. While the magnitude of influence that can be exerted by variations in the amount of mixture (0%, 2%, 4%, 6%, 8% and 10%) and the engine rotation rate (500 rpm, 1000 rpm, 1500 rpm, 2000 rpm, and 2500 rpm) is 98.7% (R Square = 0.987) and the remaining 1.3% is influenced by other variables not analyzed in this study.

Furthermore, the fuel engineering model that has been tested for influence is contained in a training module for the use of fuel foundations given to the community. Providing insights through the training module on the use of fuel engineering the test results obtained by two data groups, namely the pre test data group results and the post test data group. The aspects studied to measure the level of public knowledge are analyzed through several predetermined indicators including: (1) terms, (2) facts, (3) processes and (4) principles.

1.2 Descriptive Test of Community Environmental Knowledge

Based on the distribution in the pre-test data group and the post-test data group that has been presented previously, then a comparison of the results of the public knowledge test on the introduction model of Solar Fuel Engineering on environmental knowledge to health is based on knowledge indicators, namely: (1) terms, (2) facts, (3) process and (4) principles and based on cumulative analysis. Furthermore, a comparison of the level of community knowledge based on the interpretation of the respondents answers as a whole in the pre test data group and the post test data group as a whole is described in table 1 as follows;

Table 2 Comparison of the level of community environmental knowledge based on the results of the Pre test and Post test

Knowledge Assessment Aspects	**Aspect of Comparative Statistics**	**Pre Test**	**Post test**
Terms	Mean	49.25	85.75
	The highest score	100.00	100.00
	The lowest score	0.00	0.00
Facts	Mean	57.60	79.80
	The highest score	100.00	100.00
	The lowest score	0.00	20.00
Process	Mean	61.14	73.28
	The highest score	100.00	100.00
	The lowest score	14.29	14.29
Principles	Mean	53.50	68.00
	The highest score	92.86	92.86
	The lowest score	14.29	35.71

Source: Primary Research Data

The results of the descriptive test in table 2 describe that there are differences before being given a treatment (pre test) and after being given a treatment (post test) namely the provision of fuel engineering utilization training modules it is known that the dominant community (respondents) have an increased level of knowledge namely (1) the term indicator describes that the dominant community has increased knowledge about the term pollutant and its impact after being given treatment in the form of a fuel engineering training module (Beloufa et al, 2017). (2) the fact indicators prove that the level of public knowledge about facts related to pollutants and their impact after being given a treatment (post test) is included in the category of being proven by the acquisition of the average value in the range 61-80. These results are higher than the acquisition at the time of the pre-test with the acquisition of the fact knowledge value of pollutants and their effects <61. Thus, it is known that the dominant community has increased knowledge about the facts of pollutants and their effects after being given treatment (Becker et al, 2018). (3) the process indicators do not really show significant differences between pre test and post test in terms of respondents' answers, but there are still differences in the level of knowledge between the processes that have been carried out. and (4) the principle indicators as well as process indicators that do not have a significant increase in knowledge.

Thus, after being given a treatment (post test) namely the provision of training modules on the use of fuel engineering it is known that the dominant community (respondents) has an increased level of knowledge. The results of this study are in line with research by Maclean et al., (2018) that the development of modules has improved the technical skills, knowledge of values and attitudes needed by the community in developing and supporting a sustainable environment. In Figure 1 Shows a comparison of increasing community knowledge in terms of the answers to all item items in the pre-test and post-test groups, as follows;

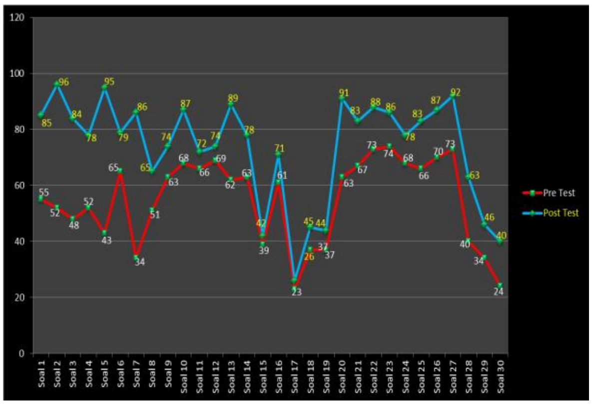

Figure 1. Comparison graph of pre test knowledge level (red line graph) and post test (blue line graph)

The picture above clearly shows that all lines in the post test group (in blue) are above the pre test points (in red), meaning that community knowledge about pollutants and their impact increases after being treated through the fuel engineering utilization module. although some of them show a comparison that is not so significant. However, the graph shows the difference between the level of public knowledge before and after being treated (Becker et al, 2018).

1.3 Effectiveness Test Introduction of Fuel Engineering Models

In this effectiveness test the assumption used to determine whether effectiveness is achieved is if the comparison between the post-test value and the pre-test ≥ 1, the effectiveness is achieved while if the comparison value is <1, the effectiveness is not achieved. Meanwhile, to determine the level of effectiveness tendency, the equation and N-Gain test criteria are used. The data tested is the cumulative mean value on the pre test results and the cumulative average on the post test results. Based on the results of the N-Gain analysis the data presentations are obtained as shown in table 2 below.

Table 2 N-Gain Test Results for the Effectiveness of the Fuel Engineering Utilization Module

Test Data	Mean	N-Gain	Effectiveness Score
Pre Test	55.40	0.41	1.33
Post Test	73.60		

Source: Primary Research Data

Based on the data acquisition in table 2, it is known that the acquisition of the effectiveness score is 1.33 with an N-Gain value of 0.41. Thus, it can be concluded that the form of treatment, namely the provision of fuel engineering utilization modules, is effective in increasing public knowledge about pollutants and their impact on health. Meanwhile, if viewed in the acquisition of N-Gain value, the effectiveness level is included in the medium category. The results of this study are also in line with research from Sengupta et al., (2017) that using module-based methods and curriculum is very effective in introducing sustainable fuel engineering. The educational needs of the fuel foundation have been focused on approaches to address current needs.

IV. Conclusion

Based on the results of research and discussion, several conclusions can be made as follows, that based on the results of the cumulative analysis pre test the level of public knowledge is dominated by the low category. While the post test results are dominated by the medium category. As for the results of the N-Gain analysis it proves that the fuel engineering utilization module is quite effective in increasing public knowledge about pollutants and their effects. This is evidenced by the acquisition of N-Gain value of 0.41 with an effectiveness score of 1.33.

Acknowledgements

Thank you to the Ministry of Research, Technology and Higher Education, Postgraduate of Universitas Negeri Makassar and Automotive Engineering Education Laboratory, Faculty of Engineering, Universitas Negeri Makassar.

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Haruna." The Effectiveness of Introduction of Solar Fuel Engineering Models Towards Improvement of Community Environmental Knowledge." IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) 13.8 (2019): 19-22.