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Green Technology Kit: A Development Learning Media with AI for SDGs

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Abstract
Learning is currently experiencing a shift from conventional learning in the classroom to internet-based virtual learning via mobile devices, artificial intelligence and outdoor class. Furthermore, cases of environmental pollution due to used cooking oil in Indonesia are quite high, reaching 3.8 million tons every year. In these cases, needed a technology that can be a solution for recycling use cooking oil waste into product with positif value which is biodiesel. The aim of this research is to develop learning media and technology that can process used cooking oil waste into products with positive value, one of which is biodiesel. This type of research is research and development with a Borg & Gall model which involves ten steps. The subjects of this research were residents of Getaspejaten Village, Kudus Regency with a sample of twenty residents. The data in this research includes assessment data from validators and field trial. Data collected using a product feasibility assessment questionnaire with the help of Google forms. Data analysis was carried out using the Rasch Model assisted by the Ministep application. This research resulted in a technology called GT KIT: Green Technology KIT which is feasible to use as a learning media, seen from the analysis of field test data which shows the raw variance explained with a measurement value of 36% so that it can be said that the GT KIT was developed to meet the eligibility criteria. The development of the GT KIT product was accompanied by the development of AI technology in the form of a fast-messaging service called 'GT KIT BOT' to make it easier for anyone to get solutions or responses to problems that might come up. With the GT KIT as a technology that makes it easier for students understanding the concept of environmental pollution and to process used cooking oil waste themselves, it is hoped that environmental pollution can be reduced and an alternative substitute for diesel fuel in the form of biodiesel can be created.

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Introduction

Learning is currently experiencing a shift from conventional learning in the classroom to internet-based virtual learning via mobile devices, artificial intelligence and outdoor class. Indonesian people generally use palm cooking oil for frying and other production processes, so the consumption rate of palm cooking oil in Indonesia is quite high. Based on data from the Central Statistics Agency (2021), consumption of palm cooking oil in Indonesia in 2018 reached 10.79 liters/capita/year. Consumption of palm cooking oil in 2019 and 2020 increased by 11.09 and 11.38 liters/capita/year respectively. This high consumption of cooking oil produces cooking or processing residue in the form of used cooking oil or cooking oil waste. Used cooking oil waste is included in the domestic waste category which currently ranks quite high in environmental pollution status in Indonesia, with a total amount of 3.8 million tonnes annually from various parties (Ariyanta et al., 2023).

Used cooking oil contains various dangerous substances that can threaten the health of our bodies and the environment (Olu-Arotiowa et al., 2022). Used cooking oil that is reused after several frying processes will cause several diseases such as cholesterol, blocked blood vessels, heart disease, etc. (Haryono et al., 2010). Meanwhile, if the disposal of used cooking oil is carried out haphazardly, it can cause environmental pollution and have a bad impact on life, such as blockage of water channels because the discarded oil hardens at low temperatures, water pollution causing damage to aquatic ecosystems, even soil pollution causing drought and reduced nutrients. in groundwater, and the death of soil ecosystems (Damayanti, 2018). However, unfortunately, Indonesian people, especially housewives, do not pay enough attention to this matter, as evidenced by the presence of puddles of oil in several drainage channels.

In other cases, the use of petroleum as vehicle fuel has increased rapidly along with the widespread use of private and public transportation (Kalghatgi et al., 2018). Indonesia currently still depends on the availability of energy sources using fossil-based fuels. Data obtained by the Department of Energy and Mineral Resources shows that with crude oil supplies in Indonesia of around 9 billion barrels, and with average production of 500 million barrels per year, this supply will run out in 18 years. One way to reduce dependence on petroleum and meet global environmental needs is to develop environmentally friendly alternative fuels. Demand related to the availability of fuel oil has increased, because in 2019 it is estimated that diesel fuel use in Indonesia will reach around 34.12 billion liters and this figure will continue to increase every year.

Considering the large amount of used cooking oil waste from industry and households, as well as the high consumption of petroleum, a solution is needed in the form of recycling technology for used cooking oil into a positive value product, namely biodiesel, which can overcome these two problems. Processing used cooking oil into biodiesel products requires the development of innovative technology in the form of Green Technology KIT (Wang et al., 2019).

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This research aims to produce used cooking oil waste processing technology that is environmentally friendly and suitable for application in everyday life. This green technology does not only focus on biodiesel production, but aims to reduce environmental pollution due to used cooking oil. Green Technology KIT aims to support and make sustainable development a success in every region, even throughout Indonesia.

Research Method

This type of research is research and development, namely research to produce a product. The product produced is Green Technology KIT, which is a set of tools and materials that connect scientific (biological) concepts with environmental science.

Procedure

This research and development step uses the Borg & Gall development model (Borg & Gall, 1983). R&D is a process used to develop and validate educational products. The steps in this process are generally known as the R & D cycle, which consists of: reviewing the results of previous research relating to the validity of the components of the product to be developed, developing it into a product, testing the designed product, and reviewing and correcting the product based on test results. This is an indication that the findings from the development activities carried out have objectivity (Borg & Gall, 1983). The reason for choosing this model is based on systematic and sequential steps and is quite clear in explaining each step.

The location of this research is Getaspejaten Village, Jati, Kudus, Central Java, Indonesia. The research subjects who are the data source are residents of Getaspejaten village who are also the population of this research. Determining the sample in this study used a random sampling technique, consisting of twenty residents who were randomly selected from the research population, namely Getaspejaten Village, Jati, Kudus, Central Java, Indonesia. The data in this research includes data from the results of filling out a questionnaire with the help of Google form regarding the feasibility of this GT KIT, apart from that, this research data also includes validation results from the validator, namely the Tadris Biology lecturer at IAIN Kudus.

Data Analysis

In developing a learning media, several criteria for media suitability are required. Media eligibility criteria refer to a combination (Kustandi, 2011), (Wahono, 2006), and (BSNP 2008). Data collection was carried out using a product suitability assessment questionnaire sheet with the help of Google forms. After trying to use the environmentally friendly technology KIT developed by researchers, respondents were asked to fill out a questionnaire with several question instruments to assess the suitability of the product developed based on Edy Priyono's criteria (Hwyward et al., 2017). Apart from that, researchers also collected data from respondents regarding input on this series of environmentally friendly technologies. Data analysis was carried out using the Rasch Model assisted by the Ministep application. Research data analysis was carried out by looking at the Unidimensionality table, namely by looking at the raw variance value explained by the feasibility measure referring to the explanation in table 2 in the results and discussion section in this article, namely the Raw variance table explained by measures criteria.

Results and discussions

This development research procedure refers to the ten R&D procedural steps of the Borg & Gall model. Borg and Gall (1983) propose a series of stages that must be taken in this research, namely 1) Research and information collecting, 2) Planning, 3) Develop preliminary form of product, 4) Preliminary field testing, 5) Main product revision, 6) Main field testing, 7) Operational product revision, 8) Operational field testing, 9) Final product revision, and 10) Dissemination and implementation". These ten steps were then adapted and modified into five steps due to time, cost and energy limitations. The five steps are as follows: 1) Research and Information Collecting, 2) Develop preliminary form of product, 3) Main field testing, 4) Final product revision, and 5) Dissemination and implementation.

These five steps are the result of modifications due to several limitations. However, limitations can be overcome by field trials and product revisions obtained through demonstrations of the Green Technology KIT product to the Getaspejaten village community in the meeting hall which was attended by a number of young people and housewives who use cooking oil. Several stages in this research are as follows:

Research and Information Collecting

The implementation of this preliminary study was carried out by researchers assisted by a team of field assistants by conducting a literature review regarding the importance of using technology in the era of society 5.0 to maintain a green environment from waste, reduce waste production, reduce petroleum consumption and how used cooking oil waste should be processed using technology, so that there is no contamination accompanied by arguments. As previously explained, palm oil consumption in Indonesia is quite high every year. Referring to data from the Ministry of Industry, domestic palm oil consumption has increased over the last six years. In 2017, domestic palm oil consumption reached 11 million tons. Consumption continues to increase, in 2018 palm oil consumption was 13.4

million tonnes, then increased to 16.7 million tonnes in 2019, increased again to 17.3 million tonnes in 2020, then increased to 18.4 million tonnes in 2021, until 2022, palm oil consumption increased to 20.9 million tons. Based on that much domestic palm oil consumption, it certainly produces quite a lot of residue or processing waste.Awogbemi et al. (2019), stated that cooking oil waste generated from domestic consumption of palm cooking oil amounted to 3.8 million tons in that year. If this is linked to studies which state that consumption of palm cooking oil increases every year, the used cooking oil produced has also increased. With such large amounts of used cooking oil spread across Indonesia, it can cause environmental pollution.

At this stage the researchers analyzed the potential pollution of used cooking oil waste in the environment referring to or in accordance with the attached data and the average consumption of palm oil and the potential for used cooking oil produced on the Central Bureau of Statistics website in 2022. Not only related to palm oil consumption, the potential for it to decrease the availability of diesel oil in the next few years is also a preliminary study in developing this product. Researchers obtained study results that consumed diesel oil.

Develop Preliminaly From of Product

At this stage the researcher was assisted by a team of field assistants to determine the necessary supporting data and prepare a set of used cooking oil processing technologies. The researcher made a plan to design a green technology product that would be developed, namely the Green Technology KIT product, starting from its appearance, the barcode of the materials, and a set of material tools inside. During the production process, researchers coordinate, check and monitor the progress of product creation.

The appearance of the 'Green Technology KIT' product is as follows:

Figure 1. Product display of 'Green Technology KIT'

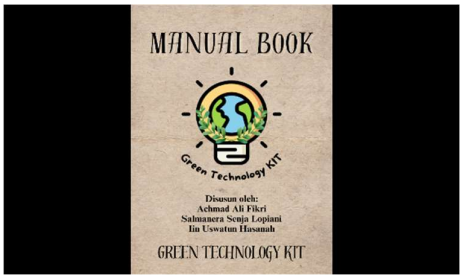

Figure 2. Display manual book of the 'Green Technology KIT'

Figure 3. Display of the 'Green Technology KIT' product along with a set of materials.

Figure 4. The barcode display contains important information related to the ingredients in the 'Green Technology KIT' product

At this stage, after the product has been successfully developed, the next step is for researchers to carry out product validation tests. Product validation tests are carried out by filling out an assessment questionnaire which consists of 2 aspects, namely; technological aspects of product design and product usability aspects. These two aspects are explained in 11 statements.

Main Field Testing.

At this stage the researcher was assisted by a team of field assistants who carried out trials using the 'Green Technology KIT' product with research subjects in the meeting hall by means of demonstrations and gave several subjects the opportunity to process biodiesel using this 'Green Technology KIT'. After the event was over, the researcher distributed the GForm link to the main field trial questionnaire sheet to the research subjects, namely several residents of Getaspejaten village, Jati sub-district, Kudus district. Following are the results of the main field trials which have been analyzed using the Rasch model.

Based on the raw variance table explained by the measurement criteria above, it can be seen that the raw variance value explained by the measurements is 36%, which means it can be fulfilled, meaning that the feasibility requirements for the environmentally friendly technology products being developed can be met and almost touch the good requirements for product feasibility (Sumintono & Widhiarso, 2014; Morris, 2016).

At this stage the validator provides assessments and also suggestions regarding product development. Some notes and input for the application are as follows: a) the process of using the product is still unclear, it is recommended to make a video tutorial and then present it in barcode form for easy access. b) The process of separating water and biodiesel oil is a little complicated. c) Processing by-products in the form of glycerol fatty acids must also be processed so that they do not become residue.

Table 1. Unidimensionality

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)

		-- Empirical --		Modeled
Total raw variance in observations	=	18.8 100.0%		100.0%
Raw variance explained by measures	=	6.8 36.0%		33.2%
Raw variance explained by persons	=	3.3 17.4%		16.0%
Raw Variance explained by items	=	3.5 18.6%		17.2%
Raw unexplained variance (total)	=	12.0 64.0%	100.0%	66.8%
Unexplned variance in 1st contrast	=	3.1 16.4%	25.7%	
Unexplned variance in 2nd contrast	=	2.3 12.1%	19.0%	
Unexplned variance in 3rd contrast	=	2.1 11.0%	17.1%	
Unexplned variance in 4th contrast	=	1.5 8.1%	12.6%	
Unexplned variance in 5th contrast	=	1.3 7.1%	11.1%	

The results show that the Raw variance in observations is 36% where this category can be fulfilled.

Table 2. Raw variance explained by measures criteria

No	Score	Description
1.	<20%	Unfulfilled
2.	>20%	Fulfilled
3.	>40%	Good
4.	>60%	Very Good

Final Product Revision

After receiving notes and input from respondents, researchers and the team then coordinated to revise and perfect the product that had been developed. The revisions made are minor revisions related to usability aspects to make it more attractive and easier to use. Researchers developed an AI chatbot called 'GT KIT BOT' with the help of the Zapier application as a question-and-answer service on usage and other information regarding the Green Technology KIT that is being developed. This technology can be used as a virtual assistant for researchers using Green Technology KIT via chat messages (Benedict, 2017). Users can interact with researchers at any time via chat and can save time for Green Technology KIT users who feel confused and want to get information (Seo, 2021). 'GT KIT BOT' will provide information that is relevant to the user's question so that there is no need to wait long to get an answer from the researcher

Before 'GT KIT BOT' was distributed to the public, especially for Green Technology KIT users, researchers had conducted experiments to measure the success of using 'GT KIT BOT'. Figure 5 and 6 are the results of the 'GT KIT BOT' experiment. Based on the results of experiments using AI technology in the form of 'GT KIT BOT', researchers found that the responses given by the AI 'GT KIT BOT' were very fast and satisfying, the responses were also relevant

to what was asked. The resulting answers can answer difficulties or problems that may arise later. The 'GT KIT BOT' service can be accessed via the following link of https://chat-app-3add98.zapier.app

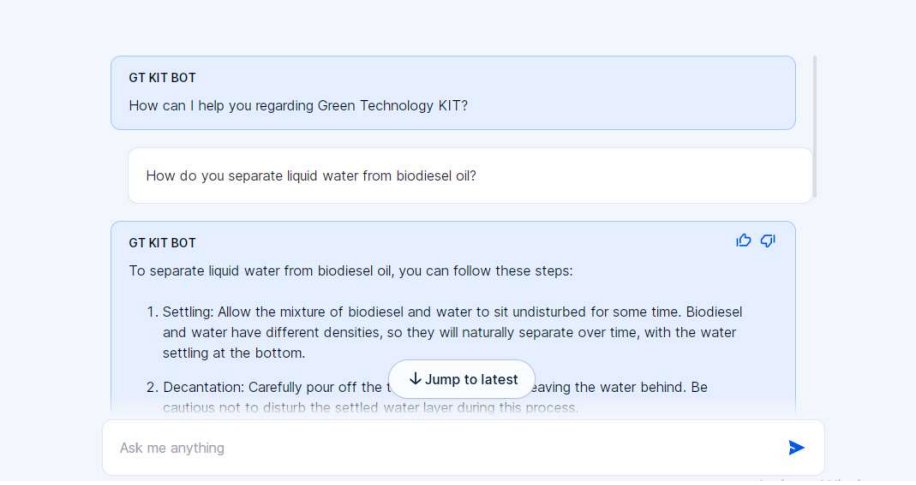

Figure 5. Display of the response from 'GT KIT BOT' to the questions submitted. response answers are very fast and complete. the level of accuracy of answers is quite high.

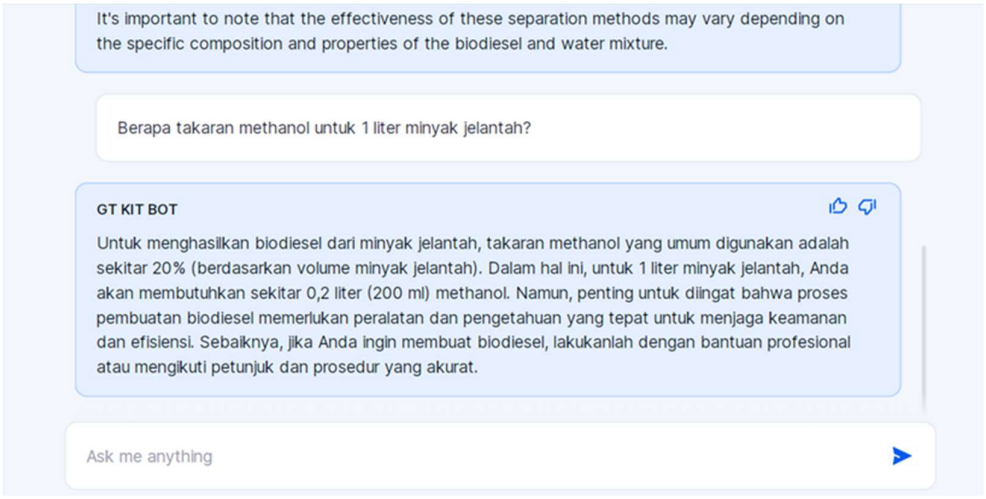

Figure 6. Display of responses from 'GT KIT BOT' to questions in Indonesian and more specifically regarding the use of Green Technology KIT.

Based on the Dissemination and implementation

After developing the AI technology 'GT KIT BOT' as a form of final revision so that Green Technology KIT users can easily get answers to the difficulties they face, researchers carried out outreach. Temporary outreach was carried out with an explanation of the use of the 'Green Technology KIT' product and outreach regarding the dangers of carelessly disposing of used cooking oil waste into the environment and information regarding petroleum reserves which are increasingly depleting in line with the high consumption of diesel fuel. For widespread application in the future, this product will be disseminated to waste disposal institutions and other institutions such as village halls and waste management institutions such as InSWA so that it can be used and utilized by the entire community to manage the cooking oil waste produced so that it can minimize environmental pollution and ultimately produce a valuable product in the form of biodiesel that can be traded so that it can increase fund income as well.

Conclusion

This research produces a green technology device in the form of a Green Technology KIT which is suitable for use by anyone to process used cooking oil waste to reduce environmental pollution and reduce consumption of non-renewable petroleum resources. Step by step it has proceeded according to the flow, referring to the research stages that have been determined, namely the ten R&D procedural steps from the Borg & Gall model which were adapted and modified into five steps and can be accounted for. In the future, this research can be further developed with waste management institutions such as InSWA so that it can be used and utilized by the entire wider community.

Conflict of Interest

This article has never been published or presented anywhere, the initial idea for developing this article came from the author and a team of assistant writers. Literature review sources are used as consideration and reading material to enrich the author's knowledge.

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