

Home fertilizer teaching module for Aborigine people

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ABSTRACT

The Aborigines of Malaysia portray limited knowledge of domestic wastes conversion into homemade fertilizer for crops which is also needed to facilitate proper home hygiene. Therefore, this study developed a Home fertilizer teaching module that applies 5E model to educate the knowledge deficient Aborigine People. The study used a qualitative research approach through the collection of open-ended data and analyzed based on themes. The research procedure was divided into: i) Development of the Home fertilizer module; and ii) Validation of the Home fertilizer module. Validation of the module was done by eight experts in teaching science and mathematics who were selected based on the purposive sampling technique according to the study aim. An open-ended questionnaire that contains ten items about the suitability of the module to be implemented among the Aborigines community, the content of the module, and involvement of STEM learning was the instrument of the study. Results showed that the content of the module is easy to understand with a clear objective and also stimulates science, technology, engineering, and mathematics (STEM) learning. Also, the module was considered a sanitary STEM module that is suitable for educating the Aborigine people on domestic waste conversion into homemade fertilizer and maintaining a cleaner environment.

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1. INTRODUCTION

Waste production and management is a vital aspect of environmental hygiene where proper mechanisms have been set up in the municipal areas. It aims to collect and properly manage solid wastes and thereby neglecting the rural communities [1], such as the Aborigine people of Malaysia which may also be referred to as Orang Asli [2], [3]. The waste generated from these homes is most often burnt in the open air [4]. Thus, the emission of gaseous pollutants may contribute to environmental problems such as global warming [5], [6].

The Aborigines are unfortunately limited in knowledge of environmental hygiene in which proper waste management is crucial [7]. Previous studies [8]–[10] on Aborigines showed that lack of proper knowledge on environmental hygiene may result in unhygienic behaviors among them. Certain kinds of diseases may erupt from poor environmental hygiene. For instance, previous researchers [9] revealed a possibility of non-communicable diseases endemics, while the risk of contracting entamoeba when proper hygiene is not maintained [10]. Therefore, based on this knowledge deficiency, education is necessary to enlighten the Aborigine people who have limited knowledge about waste management. It is important to find

ways of converting the domestic generated wastes into useful substances as well as keep their environment free from insects and rodents which might increase the risk of harboring and contracting diseases.

There have been several studies that relate to module development for Aborigines over the years. These studies are: i) Determining the effectiveness of pedagogies such as mastery learning on their knowledge acquisition [11]; ii) Determining module effectiveness on their intrinsic motivation [12]; iii) Improving their literacy [13]; and iv) Interest in learning [14]. However, literature search did not reveal any studies where module is developed regarding homemade fertilizer and corresponding maintenance of good environmental hygiene via proper domestic waste management using the engage, explore, explain, elaborate, and evaluate (5E) learning approach.

Therefore, in an attempt to bridge the knowledge gap amongst the Aborigines and propose a suitable solution to this problem, we develop a module that employs 5E model. It facilitates learning of waste conversion into fertilizer, acquisition of science, technology, engineering, and mathematics (STEM) knowledge. It also learns the importance of proper waste management for their wellbeing and protection of the natural environment. This would give a better understanding of the various steps and procedures in waste characterization [15] and proper conversion into useful compost [16]. The novel aspect of this study is considering learners' needs to develop proper knowledge that would be gained regarding the application of STEM to solve future problems. The education of the Aborigine on making home fertilizer is beneficial to them as most of them engage in crop farming. This module helps in educating the Aborigine people to see the benefit of waste or garbage based on the need to make enough compost fertilizer for their farms. It also leads to a hygienic environment, free from rodents and insects which are potential vectors for spreading diseases.

This module implemented STEM education in sanitation suitable for Aborigine People. Thus, the objective of this research was to develop a Home fertilizer teaching module using analysis, design, development, implementation, and evaluation (ADDIE) instructional model. The research also developed the 5E learning model for Aborigine People.

2. LITERATURE REVIEW

STEM education is the teaching and learning in the areas of Science, Technology, Engineering, and Mathematics [17], [18]. It is concerned with teaching students the ability to integrate science and mathematics knowledge with technology and engineering to solve real-life problems in society rather than the teaching of these fields of study distinctively [19], [20]. It also helps to nurture the creativity of students, collaboration with others, problem-solving skills and also promotes students' passion for innovation [21], [22]. Many learning organizations across the world today have embraced STEM education for their students to produce skilled and competent students who would become potential inventors [23]. STEM education back then in the United States of America was formulated to augment the number of skilled workforce in the country in the area of science, technology, engineering, and mathematics by producing creative problem solvers [18], [24]. With the importance attached to creativity in STEM education [25] towards problem-solving, efforts have been put by governmental and non-governmental organizations of countries to develop the creative minds of its citizens for sustainable development.

Aborigine people are the indigenous group of people who are the first dwellers of an area. In this context, Aborigine people in Malaysia are the first settlers in Peninsular Malaysia which are referred to as Orang Asli meaning original people in Malay [26]. About 15,000 people of Orang Asli where most of them still dwell in remote areas. They engage in a variety of occupations such as hunting, fishing, farming, gathering, arboriculture, and recently in trading of forest products [27]. Most of the Orang Asli people enroll in primary education and drop out without pursuing secondary education; only about 2% of their population continues up to the higher level of education [2]. Therefore, one of the disturbing challenges faced by these people is "the loss of income from their daily activities like farming, hunting, and fishing" [20].

The acquisition of knowledge, and perhaps the basic knowledge and skills required in reading and writing is very critical for enhancing human productivity [28]. The education level of the Aborigine people which are known to be the indigenous people of Malaysia is quite low [2], [24]. STEM education for Aborigine people particularly is an area of concern. It needs attention from relevant authorities to set up various means of enriching the most remote areas inhabited by the Aborigines with STEM education. It enable them to improve their living conditions [29]. Acquisition of an appreciable level of knowledge in STEM education by the Aborigines can improve their problem-solving skills and creativity to explore the natural endowment in their communities. It improves their occupations which may include farming, hunting, and fishing towards improving their livelihood.

The Aborigine people live in remote areas where housing is considered difficult as many of them live in housing made of bamboo and other leave materials. The low level of formal education in these communities suggests a high chance for poor waste management and an unhygienic lifestyle [16]. Improper disposal and burning of waste materials among the Aborigine people is a contributory factor towards an

unsafe environment. The incessant cutting down of trees and subsequent burning of dried leaves could impose a dangerous threat to the environment. The leftover foods and other garbage from their homes could be sorted into different types of degradable and non-degradable materials and used in recycling companies or for compost fertilizers for their farms. Alternative methods such as composting are considered an appropriate low-cost technology for organic waste recycling and organic fertilizer production [30]. Encouraging the conversion of degradable wastes from homes or farms can improve the health of the soil [31].

3. RESEARCH METHOD

This study used a qualitative research approach by administering of open-ended questionnaire to a group of eight experts in science and mathematics education to evaluate the potential suitability of the module. The experts were selected based on the purposive sampling technique to achieve the study aim. The minimum selection criteria for the samples are that each must: i) Be a qualified and certified science or mathematics teacher by the Ministry of Education Malaysia; ii) Have at least six years combined of teaching natural science or mathematics subjects at secondary school or of training science and mathematics teachers at higher education. The data obtained were manually analyzed based on the main themes: suitability of module, content of module, and STEM application in the module. This research procedure was into two stages which are the development of the Home fertilizer module and the validation of the Home fertilizer module.

The development of the module using the ADDIE Model takes about two weeks. The module constitutes an instructional plan that follows a 5E Learning Model required to deliver a learning experience. ADDIE Model is one of the teaching model that which often become a basic to teaching and practice model [32]. The Model has five phases which are analysis, design, development, implementation, and evaluation [33]. At the Analysis phase, the problem was identified to analyze the source of the problem. Next, in the Design phase design the objective, structure, theory, development of an item, teaching strategy, and media needed. After that, the development phase is where the development of the teaching module using the chosen element based on the requirements while in the Implementation phase the teaching module is completed and applied. Lastly, the evaluation phase involves evaluation by the lecturers to give comments and improvement on the module.

The module has five phases based on the 5E learning model which are the engagement phase, exploration phase, explanation phase, elaboration phase, and evaluation phase. In the engagement phase, the teacher provides the problem for students to solve. Then, students explore around the house to collect garbage and classified them in the exploration phase. After that in the explanation phase, students do hands-on activities on compost fertilizer and explain how composting process occurs. Students try on the different rapid composting processes during the elaboration phase. Lastly, the evaluation phase where students being evaluated by asking oral questions about what they have learned.

The second stage is the validation of the module by eight experts in teaching science and mathematics. They are experts in science and mathematics with 6 to 30 years of teaching experience. The academic qualification for these respondents is one of them was a Doctorate, three of them have Master degree and four of them have Bachelor's degree in science educations. The instrument that was used in this research in form of an open-ended questionnaire. The questionnaire is divided into two parts which are Part A (Demographic information) and Part B (Home fertilizer module evaluation). Part A is about the background of the validators. Moreover, Part B contains: i) 10 open-ended questions about the suitability of the module to be implemented among the Aborigine's community; ii) The content of the module; and iii) Involvement of STEM learning. The data analysis of the module is analyzed qualitatively for each theme in validation form. It is to analyze the suitability of the module to be implemented among the Aborigines community, the content of the module, and involvement of STEM learning.

4. RESULTS

4.1. Theme 1: Suitability to Aborigine people

Three things have been considered whether this module is suitable for the Aborigine people: the content, difficulty level of terms used, and the delivery materials in the Home fertilizer module. Thus, all respondents were agreed if this module were suitable for the Aborigine people. Respondent 4 (R4) and respondent 7 (R7) also added that this module was suitable for the Aborigine people in understanding the fact and it would be useful for them to use in their daily lives. However, in the difficulty level, R1 advised that some phrases required layman terms, for example, "hygienic". Although, R4 and R5 disagreed, others stated that this module was suitable for the Aborigine people, and also supported by R3 that stated some Aborigine people might have some knowledge in agriculture development and how to do home fertilizer. For the

delivery materials suitability, all respondents agreed it is suitable for the Aborigine people. However, R7 has mentioned that papers, coffee grounds, and filters might not be suitable to be used as materials in the module.

4.2. Theme 2: The content of the home fertilizer module

In the content of the home fertilizer module, several aspects have been considered: the learning objectives, content errors, and easy to understand. All respondents agree that the learning objectives were written, but R1 pointed out that the “meaning of compost” must be elaborate and stated clearly of the value for the Aborigine people. Whether the module has no errors, R1 and R3 pointed out that there are some grammatical errors and the notes can be written from the point of view.

R1: *“Some grammatical errors, but not obvious.”*

R3: *“Some notes may it can be in point view.”*

R2, R4, and R8 have stated that there is some error in the content of the module, and R7 stated that she is not aware of any content error because she is not an expert in this particular topic. Only R5 and R6 stated that the content of the module has no error. Nonetheless, all respondents agreed that the content of the module was easy to be understood by the people to apply.

4.3. Theme 3: The stem in the Home fertilizer module

As stated earlier, this module was developed based on the 5E learning model and STEM stimulate learning. There are several aspects to be considered in this theme: teaching and learning activities based on the 5E learning model, student teamwork, student inquiry learning, and STEM stimulates learning. All respondents agree that the teaching and learning activities of the module were arranged based on 5E learning model. Although, R1 stated that the module did not raise guidance questions that are necessary to direct the investigation process, and it is written in book-style cooking, step by step.

R1: *“Technically Yes, but the module does not pose guidance questions that are essential to guide the inquiry process. It is written in cooking book style, step by step procedure.”*

Furthermore, all respondents agree there is the involvement of students in team working and inquiry learning throughout the Home fertilizer module. All of them have been in agreement that the content also stimulates STEM learning. It also supported by the R7 opinion that the module achieved the Reduce, Reused, and Recycle (3R) for the greener world.

R7: *“Yes as it complied with the recycle, reuse and reduce for the greener environment.”*

5. DISCUSSION

The validation of the module aims to enhance the module in terms of suitability for the Aborigines Community, activities using the 5E learning model, and also STEM learning. In particular, respondents said that the developed module is suited to be applied among the Aborigine community. However, the module uses terms which is not familiar to Aborigine people that may cause them to have confusion. Thus, the use of common terms is good as it will increase the understanding of Aborigine people in STEM learning. This is supported by study [34] where it is stressed that students should be able to understand the terms in various sections of instructional material such as the learning outcome. The delivery materials also should be included the familiar materials around them and avoid the materials, not in their environments such as papers, coffee grounds, and filters. This is because most of the Aborigine people still bounded with forest-based activities around them and forest products [7], [35]. Previous research [36] highlighted that Aborigines of Malaysia to some extent much rely on the forest for survival. Traditional forest-based economic activities of hunting, fishing, trapping, and gathering activities are still very much a part of the Aboriginal way of life [28]. Especially, it is happened in those few areas where access to natural resources has not been diminished by overuse and industrial exploitation [36].

Regarding the respondent’s evaluation of the content of the module, it is clearly shown that all indicators measuring the characteristics of the specific objectives of the module are met to a very great extent. This is supported by previous researchers [37], [38] which emphasized the importance of stating in clear and simple terms the instructional objectives which are expected to align with assessment. The indicators or constructs presented under the module’s objectives were aimed to provide a clear direction to what the objectives entail. The result from evaluating the objectives means that the developed module is accompanied by specific objectives that are clear and easily understood, realistic, measurable, and attainable. This result is in line with a study [38] which recognized that learning objectives measurability and its role in

developing instructional modules are crucial. Having observed the cruciality of learning or module objectives, some minimal errors need to be considered to enhance the module such as grammatical errors that need to be checked.

Through last in rank, still, the majority of the respondents agreed that the developed module is acceptable to a very great extent in terms of activities that are arranged parallel to the 5E learning model. This shows that the activities presented in the module have a connection to what is expected to achieve which also implies that the activities cover what competencies should be developed for the participants and are congruent to the specific objectives (STEM learning). The outcome is supported to some extent by Schultz, Schmid, and Lawrie [39] which identifies the significance of maintaining constructive alignment amongst learning objectives, learning content, and assessment [38].

Some improvement should be done where the guidance question to the investigation process should be added in the module so that it stimulates inquiry learning throughout the discovery learning process. This is also stated by previous researchers [40] that inquiry-based learning aspires to engage students in an authentic scientific discovery process. The results of the study suggest that the acceptance of the developed module has still its space for further improvement and evaluation. According to Ganiron [41], modules are effective for improving the quality of instruction if they have been developed consistently, and if all gears of the module match with one another. Thus, this Home fertilizer module needs those improvements so that it will be effective when conducted to Aborigine people in sanitary STEM.

6. CONCLUSION

In conclusion, this Home fertilizer module is a Sanitary STEM module that integrates with the 5E learning model, is suitable for Aborigine people. The content is easy to understand with a clear objective, and stimulates STEM learning. However, it needs some improvement, such as: i) Terms should be familiar with Aborigine people; ii) Some grammatical errors in content; and iii) Guiding questions that are necessary to direct inquiry learning.

The Home fertilizer module is a module approach to educate the Aborigine community on sanitation which focuses on waste handling. It is believed that this module helps the Aborigine people in practicing a clean-living environment and STEM education. Thus, it is hoped that it helps them to upgrade their quality of life and knowledge, especially in science and mathematics.

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