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Project-based environmental module for indigenous students in Malaysia

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ABSTRACT

The removal of forests has become a major challenge for indigenous students in Malaysia called *Orang asli*. The younger generations of *Orang asli* need to equip themselves with relevant knowledge to deal with changes within their living environment. However, they faced difficulties during learning such as irrelevant curriculum, lack of materials and inappropriate approaches. A project-based environmental module is constructed which employs the analyze, design, develop, implement and evaluate (ADDIE) instructional model with three projects: the construction of habitat, soil acidity and infiltration of pesticides. This study aimed to develop this module and assess its suitability to inculcate scientific attitudes and noble values among the *Orang asli* primary six students. The data were collected through validation questionnaires that were given to three validators. The data obtained are further analyzed to identify their improvement towards the module. The validation results show that the module is very feasible (85.83%) to be used. Many opine that this module creates a learning experience for them through scientific reasoning, inquiring, cooperating, and decision-making so that they find the relevancy of knowledge in the *Orang asli* context. The enhancement of this module provides useful educational guidance to learn environmental knowledge from a scientific perspective.

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1. INTRODUCTION

Orang asli in Malaysia are the indigenous people who inhabit their ancestral land and they comprise approximately 0.6% of the population [1]. Most of the *Orang asli* settle near the forest and rely heavily on the forest through farming, hunting and collecting forest products to sustain their life [2]. Rapid resource exploitation has increased their vulnerability to extreme weather conditions and natural disasters, which further impact their capability to cope and adapt to climate change [3]. Recognizing this, the indigenous community itself is in critical need of developing social responsibility and a positive attitude to governing their living environment.

Education plays a vital role in enhancing the quality of life and creating more opportunities for the *Orang asli* communities. They need more knowledge of biodiversity conservation, flood adaptation strategies, and advanced farming techniques [4]. In various parts of the world, the traditional knowledge and lifestyles of indigenous peoples are often well-aligned with environmental conservation and natural resource management [5]. They serve as significant stakeholders in environmental stewardship, utilizing their ancestral ecological wisdom and perspectives. Nevertheless, the expertise and insights that indigenous peoples offer regarding forest management are sometimes dismissed as irrelevant or unscientific [6].

Diansyah *et al.* [6] went on to say that integrating scientific knowledge with natural and social science will guarantee resilient social-ecological systems and the sustainable utilization of their natural resources.

To reduce the disparity between rural and urban schools, the Malaysia Educational Blueprint seeks to advance educational equity [7]. The state of affairs currently indicates that, despite the teacher having access to curriculum and training, there are few pedagogies and content that are in line with the indigenous culture [8]. Indigenous students face difficulty in understanding the importance of the syllabus, feel lost during study and display low independence in looking up information during study.

In science learning, indigenous students have also faced several difficulties. In addition to the challenges posed by the scientific curriculum, the educational circumstances faced by indigenous students have exacerbated their negative attitudes and perceptions of science. Their knowledge base is weaker than that of mainstream students due to their greater dropout rate at all educational levels, from preschool to higher education [9]. Indigenous people lack enthusiasm for science courses as a result of inadequate resources, gaps in their textbooks, and life experiences [10]. It is also challenging to develop the mindset that students need to succeed in science when teachers are unable to master the newest teaching techniques and integrate science into everyday life [11]. It suggests that to determine how a teacher might modify a lesson to fit the needs of today's indigenous kids, a more thorough investigation is required.

Meanwhile, Wahab *et al.* [12] contend that training materials tailored to the needs of the indigenous population must be employed to impart this knowledge to them. The purpose of this is to ensure that the information is appropriate for them and does not deviate too much from what they already know. Eight approaches to aboriginal learning, according to Yunkaporta [13] involve teaching in an "aboriginal language." It explains how knowledge should be imparted to indigenous populations through practical, real-world experiences that will help them understand the value and significance of what they are learning. Many research also suggest different content and ways of educating the *Orang asli* students. In terms of content, Wahab *et al.* [14] suggests the utilization of elements in the forest such as herbs, handicrafts and tools for forestry. The delivery of flexible curricula is not limited to classroom instruction, and enjoyable learning encourages the application and integration of forest aspects [15], [16]. In terms of method of delivery, story-telling, group activities and kinesthetics learning styles are preferable [17]. The project-based learning (PjBL) model is also frequently used in designing the indigenous students lesson [18], [19].

Therefore, the primary concern is the necessity of practical pedagogies and instructional activities that are recommended depending on *Orang asli* context [20], [21]. To meet their actual needs, professional educators and teaching volunteers should also acquire knowledge about and prepare themselves with a range of teaching techniques and resources [10], [22]. Different teaching approaches should be taken into consideration since their exposure and foundational knowledge may differ from that of traditional schooling.

However, published research on science learning among indigenous students in Malaysia is scarce. A more appropriate and relevant lesson could help the indigenous pupils change their attitudes towards learning science. Hence, the purpose of this study was to create an environment-related PjBL module for Malaysian indigenous students. It acted as a guide for educators in imparting scientific knowledge and instilling scientific attitudes and noble values within the *Orang asli* context. Through hands-on learning, the children will be able to expand their understanding of science, particularly in comprehending environmental challenges such as soil acidity and pesticide infiltration. Furthermore, the purpose of this study was to determine whether the module's content, integrated approach, learning impact, and other aspects are appropriate for the Indigenous community. The module's appropriateness is determined via expert validation, and the experts' recommendations are used to improve this module.

2. RESEARCH METHOD

2.1. Research design

Research and development (R&D) design is the type of research design used. It comprises the process of developing and certifying educational resources, products, or instruments [23]. This study uses the ADDIE instructional approach as a systematic learning design model [24] which consists of five steps, namely analysis, design, development, implementation, and evaluation. It was chosen in this study because the ADDIE paradigm promotes reflection and iteration to generate feedback-focused continuous improvement through evaluation [25]. Quantitative analysis is used in this research to collect validation data. The details of each stage are elaborated in Table 1.

2.2. Project-based environmental module

Analyzing the needs of the children through site visits and pre-interviews with teachers in indigenous schools was the first step in the module construction process. Niana *et al.* [26] study's interview construct for teachers was used to facilitate the discussion. The teacher's result served as a framework for the module's material and a source of ideas for issues that the indigenous students encountered. Next, the

"Canva" app is used to construct the forest chemistry module. It is an online application for creating graphics and visual content for graphic design. This lesson uses the notion of the story to describe three primary topics—deforestation, soil acidity and pesticide infiltration—that could pose hazards to the environment. Additionally, three projects would be completed by the students to apply the scientific knowledge they have learned throughout the course to address the environmental issue.

Table 1. The application of ADDIE for the PjBL environmental module

ADDIE	Description of activities
Analysis	The needs of the *Orang Asli* students were identified through a review of literature, site visits and pre-interviewing of the indigenous teachers. The data gained were analyzed and integrated into the module. i. Previous literatures were reviewed to serve as the foundation for content analysis. The real environmental issue including the removal of forest for plantation was delivered in the form of storytelling, followed by a discussion of the impact on soil and the ecosystem around the forest. The scientific concepts related to environmental issues were studied from the year 6 science textbook according to the national curriculum. ii. A site visit is done by observing their scientific attitudes and noble values displayed during their science lesson. Small group projects were conducted with the *Orang Asli* with the same purpose. iii. Their teachers were interviewed using the interview construct for teachers adopted from the study by Niana *et al.* [26] and the questions include: – Can you explain the family background of *Orang Asli* living here? – Can you explain the *Orang Jakun's* culture? – What is the preferred learning style of *Orang Asli* students? – What are the challenges they face while learning science? – Could you identify what are the scientific attitude and noble values that are considered important to your students and justify the reason?
Design	The analysis was used to identify the learning outcomes and objectives. The three projects and the module's overall structure were created with these goals in mind. During this phase, comprehensive lesson plans, resources, and assessment systems were also developed. The integration of the eight ways of Aboriginal framework by Yunkaporta [13] and PjBL by Farouck [27] into this module helps to provide a relevant learning experience for them. The module is designed according to the following steps: – Step 1. Designing PjBL course: when creating the module, teachers should consider the needs of the indigenous learners and appropriate learning styles. The pupils would next receive a briefing on the learning objectives and activities. In this step, the Yunkaporta 'landlinks', 'story sharing' and 'symbols and images' were used by incorporating living things and forest environment in a story. – Step 2. Informing students of project tasks: the project scope and available resources are disclosed together with the project tasks. Teachers will also assist students in determining driving questions and detecting issues. – Step 3. Selecting driving question: students then gather background data and discuss choosing driving questions as their project objectives. In this step, the Yunkaporta 'learning maps' are used for students to understand the scope and objectives of their learning. – Step 4. Preparation of tools: the teacher can assist in setting up the necessary equipment and materials and guide how to use them. – Step 5. Communicating information and designing the project: this is the most important step in the construction process of the project. Students begin to conduct experiments and gather data. In this process, students expand their knowledge following the driving questions they have selected. Additionally, they align their projects with their prior knowledge. In this step, the Yunkaporta 'deconstruct reconstruct', 'non-verbal' and 'community links' were used. The activities were designed to allow students to view the environmental problem as a whole and then be infused with scientific knowledge to allow them to reconstruct new knowledge. Students used observation to observe the changes that happened within their living area and understand how their decisions impact the environment. – Step 6. Developing and revising presentation: they work on the projects and prepare a presentation that explains how they plan to address the problem and present what they have known throughout the learning process. In this step, the Yunkaporta 'non-linear' is used to provide teachers and students with opinions on the project that they have done. Then, they would assimilate new inputs and view their work from a different perspective. – Step 7. Presenting final project: in this step, students are allowed to edit their presentations before presenting their findings.
Development	This step involved the actual creation of the module. Worksheets, instructional guides, and multimedia tools were created as educational resources. The content was designed with the *Orang Asli* students' cultural context and level of engagement in mind. Experts in the relevant field validated the module to ensure its suitability to be applied to the target students.
Implementation	After that, the module was implemented in a classroom environment. Teachers received training on project facilitation and module integration into their current curricula. Pilot testing was done to find any problems and make the required corrections.
Evaluation	A panel of experts evaluates the PBL teaching module's applicability. The module is validated by four experts in relevant fields. The construct of validation questions includes content and integrated approach, the impact of the module and other aspects of the module. The feedback and the result of validation are used to improve the module.

A validation form is used as a tool to validate the PjBL module by experts in science and indigenous community. In this study, a minimum of three experts are used for the content validation endeavor [28]. The experts have to fulfil the criteria [29], [30], such as the teachers have been teaching science for at least five

years and the teachers know the national education curriculum for chemistry or science. The module is validated using Google Forms following seven criteria [30], [31], namely quality of content, language, accuracy of the content (suitability), integrated approach, time allocation, impact of the module, and appearance. The scale used for validation has been slightly modified from Serevina *et al.* [29] and is shown in Table 2. The obtained scores are added up and the percentage is calculated by dividing the total score gained. The scores are calculated into percentage scores using (1). The experts' interpretation of this instructional module was ascertained by utilizing the Likert scale interpretation shown in Table 3.

$$v = \frac{total\ score\ obtained\ from\ all\ experts}{4 \times No.of\ experts} \times 100\% \quad (1)$$

Table 2. Score indicator

Answer	Score
Very good	4
Good	3
Fair	2
Not good	1

Table 3. Interpretation of the Likert scale result

Percentage (%)	Interpretation
0-25	Very unfeasible
26-50	Unfeasible
51-75	Feasible
76-100	Very feasible

3. RESULTS AND DISCUSSION

This section presents the validation results from the validators according to different constructs. Other comments from the validators will also be discussed in this section.

3.1. Demographic of respondent

The validators consist of 2 males and 1 female. Each of them has 7-18 years of teaching experience. Two of them teach science subjects for year 5 and 6 students in national primary schools in Malaysia. The other validator is a lecturer at a national university in Malaysia, and his expertise includes chemistry and teaching indigenous students. Two of the validators have Master's degrees while the other has Ph.D. academic background.

3.2. Validation results

The validation results were collected in three sections. Each section consists of 2-3 constructs with 6-7 questions. The detail of each question and their score obtained through the Likert scale were tabulated in Table 4. Further discussion about the results and comments are recorded in the next section.

3.2.1. Discussion for content and integrated approach

This section discusses the suitability of the content and the integrated approach. Among these questions, all validators agree that the integration of real-world issues is relevant. The issues used in this module include the habitat for living things, soil acidification and infiltration of pesticides. Students can relate to these issues by observing the impact on the other elements of the ecosystem, which is more meaningful and relevant to their lives [14]. By using the process of observing the problem, reasoning behind the problem and finding solutions, student's logical thinking can be enhanced. This can be shown by the score of 91.67% that the project's arrangement is logical. In addition, the use of PjBL and eight ways of aboriginal learning framework also achieved 91.67%, indicating that it is suitable to be used to deliver science activities among indigenous students. The findings match the earlier studies that PjBL was effective in promoting students to explore and inquire about scientific phenomena and, at the same time get their scientific skills trained [18], [32]. Using Yunkaporta's eight ways model in science also promotes effective teaching strategies, meanwhile encouraging the ancient wisdom and knowledge can be transferred to the next generation effectively [33].

However, the suitability of the chemistry knowledge incorporated in the activities achieved 75%, which is lower compared to other questions. It was supported by additional comments by the validators saying that the chemical knowledge is quite complicated. Another validator comment that the words need to

be simplified or transformed into graphics and visuals. This result ties well with the study by Zainuddin *et al.* [34] highlight that presenting knowledge using simple and clear visual aids helps to draw the indigenous students' interest. As such, the module is simplified especially in the part explaining how chemical compounds can infiltrate through the soil to underground water, and its impact on the food chain. This effort not only helps the students to have better visualization and understanding, but it also brings empirical implications to teachers who face difficulties in explaining abstract chemical concepts to indigenous students.

Table 4. Questions for validation

Sections	Constructs	Question	Score
Content and integrated approach	Suitability of the content	1. The projects designed are sufficient and suitable	83.33
		2. The module is suitable for indigenous students age in Year 6	75.00
		3. The integration of real-world issues is aligned and relevant to the content	100.00
		4. The application of chemistry knowledge is relevant to indigenous students	75.00
		5. The teaching and learning activities arrangement is suitable and logical.	91.67
	Integrated approach	1. The use of PjBL is suitable and compliance with stages	91.67
		2. The use of the 8 ways of aboriginal learning framework is suitable for indigenous students	91.67
Impact of the module	Quality of content	1. The implementation method through the story and projects of the module is satisfactory	91.67
			91.67
		2. The organization of teaching and learning activities are logical	83.33
		3. The module is easy to use for indigenous students	91.67
		4. The content in the module can attain the purpose of the module's objectives	
	Impact of the module	1. The module can inculcate scientific attitudes among indigenous students	83.33
		2. The module can inculcate noble values among indigenous students	91.67
Other aspects of the module	Language	1. The language used is direct and easy to understand	75.00
		2. The language used is appropriate for indigenous students	75.00
	Time allocation	1. Time allocation to implement the module is sufficient	83.33
		2. The allocation of time for teaching and learning activities is sufficient	83.33
	Appearance	1. The layout and format of the module are consistent	83.33
		2. The graphics used are suitable	91.67
		3. The font and font size of the text are suitable	83.33

3.2.2. Discussion on the impact of the module

The next section discussed the impact of the module in terms of its content and ability to instill scientific attitudes and noble values among the indigenous students. The validators rated all the questions with a score of 3 (good) and 4 (very good) in this section. Specifically, the delivery of scientific knowledge through stories and hands-on activities is suitable for them. The findings are in line with past research highlighting the culture of knowledge is passed down from their ancestors through verbal explanation and active exploration of their surroundings [35]. These allowed students who lived near water sources or forests can reflect on what they've learned and recognize how human activities negatively impact the environment. At the same time, they can apply their knowledge to make responsible decisions. Hence, the environmental problems, activities, reasoning process and solution were articulated in a series of challenging, yet interesting stories that are beneficial to the *Orang asli* students.

The ability of this module to inculcate scientific attitudes and noble values also achieved a good score of 83.33% and 91.67%, respectively. Four scientific attitudes and four noble values are chosen to represent the chemistry and science curricula in Malaysia based on how well students can relate to the topic and the surrounding context. The scientific attitudes include Interest and curiosity about the environment, flexibility and open-mindedness, collaborate diligence and persistence when carrying out a task. The noble values include: be responsible for the safety of oneself, others, and the environment, appreciate the contributions of science and technology, appreciate and practice clean and healthy living, and realize that science is a means to understand nature. Giving students scientific mindset leads to "scientific-mindedness," which is the way a student chooses to solve problems and make decisions [36]. Furthermore, noble values in science allude to a comprehensive way of living that is composed of honorable and civilized traits that uphold high culture in our day-to-day interactions [37]. This result serves as useful for the indigenous students to learn in line with the Malaysian education aspiration. If such attitudes are considered while delivering knowledge, they could utilize their knowledge more responsibly and critically.

3.2.3. Discussion for other aspects of the module

The last section evaluates the module based on its language, time allocation and appearance. While the time allocation for activities and the module achieved a positive response of 83.33% to 91.67%, the

language used only achieved up to 75%. This result indicates that some of the word choices are difficult to understand by the indigenous primary students. This also accords with the earlier study, stating that the Malay Language is not their mother tongue, and they only learn the Malay language in school, without familiarizing it in their daily life [38]. It has also become one of the barriers for them to understand the learning content [39]. One of the validators also provided additional comments that the sentence and words should be simplified and changed to be more straightforward to ease their understanding. This result should be taken into account when considering the method of presentation and delivery of the knowledge, to raise their interest and reduce their biases on learning science is too difficult for them.

4. CONCLUSION

This study has provided a comprehensive analysis of the essential aspects of constructing a PjBL module in delivering scientific knowledge to the *Orang asli* students in Malaysia. Valuable insights are gained through rigorous research and critical examination of the suitable content and approach or pedagogies suitable to be used in delivering science knowledge to indigenous students. Taken together, these findings suggest the importance of utilizing real-world problems (the impact of soil acidification and pesticide infiltration due to agricultural activities) happening around their living area in their study. The current findings add substantially to our understanding of the suitable method of content delivery including PjBL, hands-on activities, storytelling, and usage of simple wordings and visual aids to provide a better learning experience for *Orang asli* students. The insights gained would shed new light for the indigenous teacher to have ideas for designing science lessons for their students.

Several limitations need to be noted. First, this module was constructed according to the background of *Orang asli* of the *Jakun* tribe, who lived near the forest and depended their life on forestry products and plantations. Meanwhile, a preliminary study has been done and it was found that the students can speak and understand simple Malay language. This module might not be effective if the *Orang asli* students are not familiar with Malay Language. Hence, more attention should be taken when identifying the needs of the students, as this will affect the real-world issues used in the story and the way of presentation. A further study could assess the suitability of utilizing this teaching module among the primary six *Orang asli* students in Malaysia and examine how it helps to improve scientific attitudes and noble values. This effort not only helps to raise awareness of the importance of scientific knowledge among the indigenous younger generation, but it also provides indigenous educators with wider opportunities to create more interesting lessons.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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Nor Hasniza Ibrahim	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Johari Surif	✓			✓			✓			✓	✓	✓		
Abdul Halim Abdullah		✓		✓		✓			✓					
Corrienna Abdul Talib		✓		✓					✓					

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies under UTM and has been approved by the Ministry of Education.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [NHI]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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