Development of an Edu-Tourism Module Based on QR-Code Flora Diversity in Villa Tani Indonesia to Support Students' Flora Identification Skills

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ABSTRACT

Technology always develops to be adapted to human needs. One type of technology is educational technology, which is used as a special tool to facilitate the education and learning process, such as QR-Code. This research aimed to develop teaching tools in the form of edu-tour modules by utilizing QR-Code technology to support students' flora identification skills. The study used the research and development (R&D) method, with the research design referring to the 3D model (Define, Design, & Develop). The research was conducted in May 2023 – May 2024 at Villa Tani Indonesia, SMAN 5 Kota Serang, and Sultan Ageng Tirtayasa University. The feasibility test based on media experts showed a value of 97.22% with a very good category, while based on material experts showed a value of 87.18% with a very good category. The student response test from class X students of SMAN 5 Kota Serang and visitors to Villa Tani Indonesia obtained a score of 88.08% in the very feasible category.

Keywords: Edu-tourism, Flora diversity, Module, QR-Code, Villa Tani Indonesia

Introduction

Identification activities are intended to determine the identity or proper name of the identified object (Desiani et al., 2016). One example is the identification of living things; by making identification, the correct name will be known locally and scientifically, as well as its placement in the classification system (Fitriani & Wardianti, 2014). In other words, identification activities are basic skills students must master to classify and study living things according to their roles. According to Bebbington (2005), this ability can be improved by getting students to be directly involved in making observations of the surrounding nature.

In Banten, one of the edu-tourism areas that can be used to study flora diversity is the Villa Tani Indonesia edu-tourism area located in Cikerai, Cilegon. Edu-tourism Villa Tani Indonesia is a clear example of agribusiness educational tourism based on agro-agriculture and animal husbandry (Purnawan & Sardiana, 2017; Juwita et al., 2019). Edu-tourism provides a learning experience with direct involvement, linking academic studies, vacations, skills improvement, career development courses, and agricultural businesses (Wardana et al., 2022). The concept of edu-tourism can be used as an alternative to out-of-school learning activities so that students can observe flora diversity directly in the location.

The concept of learning to identify flora in Villa Tani Indonesia edu-tourism is done with the help of a QR-code scanner. Translating QR-code information quickly facilitates the identification process (Akhbar, 2018). This QR code is an educational facility in every Villa Tani, Indonesia plant. A QR-Code contains plant information such as morphological recognition of each plant part, IUCN status, taxonomy, benefits, distribution, and cultivation methods. Visitors or students only need to scan one QR code once to get complete information about the plant they are looking for. The QR code information is scattered throughout each plant. A teaching tool is needed to collect this information so students can learn about all the plants at Villa Tani in class, at school, or at home.

Learning with direct involvement or examples from the surrounding nature requires independent teaching materials that can enrich students' learning experiences. Teaching materials that have the advantage of being able to be studied independently are modules (Puspitasari, 2019). Independent teaching materials are characterized by self-instructional, self-contained, stand-alone, adaptive, and user-friendly (DEPDIKNAS, 2008). Students can use modules to improve their understanding of the material taught by the teacher. This is because each module presents a context for understanding and applying a particular concept with specialized material (Zulhaini, 2016). The concept of specialized material in the module causes the module content to look complex, so the module is integrated with a QR code to utilize its function as a store of more specific or detailed information about the material in the module.

Methods

The research was conducted in May 2023-May 2024 at Villa Tani Indonesia, Untirta Biology Lab, and SMAN 5 Kota Serang. The research method used is the research and development (R&D) method, with the research design referring to the development of the 4D model (Define, Design, Development, and Disseminate) (Trianto, 2010). However, the research only reaches the 3D stages, namely define, design, and development, because the research will focus on the product development process and limited testing on students. In the define stage, the steps taken are needs analysis on students and teachers, curriculum analysis, and material analysis. At the design stage, the initial design is made by designing the concept of the material that will be included in the module. Finally, the development stage contains material expert validation from 2 (two) UNTIRTA lecturers and 1 (one) biology teacher, then media validation from 2 (two) UNTIRTA lecturers and 1 (one) manager of Villa Tani Indonesia. After expert validation is carried out, followed by revision, the last stage will be limited testing on students. The limited test was conducted to determine the students' response to the module quality that

experts had validated by conducting an assessment using a student response questionnaire sheet and given to 20 students from SMAN 5 Kota Serang and visitors to Villa Tani Indonesia who were grade X students. This is based on the statement of Restiyowati & Sanjaya (2012) that the minimum user response test is 10 to 20 students. If less than 10, then the data obtained does not adequately describe the expected population, and if more than 20, then the data obtained is less useful for analyzing in small groups.

Results and Discussion

This study created a QR-Code-based edu-tourism module on flora diversity to facilitate students' conducting edu-tourism on flora diversity at Villa Tani, Indonesia. The development of QR-Code-based edu-tourism modules requires several stages: define, design, and develop.

Define

The "define" stage aims to identify and determine the requirements for developing learning materials (Widiyasari et al., 2020). The requirements in question are needs analysis of students and teachers at SMAN 5 Serang City, curriculum analysis, and material analysis. Based on the results of the needs questionnaire, the following underlie the development of this edu-tour module (Table 1).

Table 1. Results of needs analysis on students and teachers at SMAN 5 Serang City

Results of needs analysis	Based on the literature study	Solution
The learning preferences of class X students of SMAN 5 Kota Serang are that they feel happier with the learning process outside the classroom and find it easier to understand the material by seeing direct examples.	According to Albecht & Karabenick (2018), learning outside the classroom facilitates students' direct contact with learning objects, thus helping them better understand learning concepts and materials. In addition, learning outside the classroom can also improve student learning outcomes.	Learning outside the classroom is not just moving lessons outside the classroom but inviting students to interact with nature and make observations of objects in the surrounding environment (Ariesandy, 2021). Regarding understanding biodiversity material, one of the places that can be used as a learning location outside the classroom, especially in the Banten region, is the Villa Tani Indonesia edu-tourism located in Cilegon. Villa Tani Indonesia edu-tourism has various types of flora diversity and educational tourism activities that can be used as learning content on biodiversity material, especially the subtopic of flora diversity.
Most students have difficulty understanding diverse material because of many terms, classifications, and scientific writing.	According to Asril et al. (2022), biodiversity is a complex material because it contains various kinds of material about living things and the ecosystems they form. Biodiversity contains various types of species. These species are classified based on taxonomy, and each taxonomy has its term or mention (Sunarmi, 2014). The	Developing edu-tourism modules on flora diversity is packaged attractively with realistic images of flora diversity in Villa Tani Indonesia so students can easily understand it. The module is also equipped with a glossary that explains some of the scientific terms used in the discussion of flora diversity.

Results of needs analysis	Based on the literature study	Solution
	differences and the number of terms make it difficult for students to read them, which further causes students not to understand the terms (Amri & Jafar, 2016).	
As the main teaching material in the classroom, the book is not independent for students to learn.	In learning diverse material, including plants, animals, and microorganisms, the learning process should emphasize direct observation activities, such as looking at real examples or learning experiences in the field (Bebbington, 2005).	Learning with this concept requires independent teaching materials (Rafi'y et al., 2022). Independent teaching materials are self-instructional, self-contained, stand-alone, adaptive, and user-friendly (DEPDIKNAS, 2008).
Students feel more comfortable and happier with technology-based teaching materials	The grade X students who were used as respondents to the needs analysis in this study belong to the Generation Z category. Generation Z, also known as Zoomers, is a demographic group aged 11 to 25 (Arum et al., 2023). Generation Z grows with the development of technology, the internet, and social media, often called the digital generation (Adityara & Rakhman, 2019).	The module developed in this research is technology-based, namely QR-Code, which stores information on flora material and identifies flora contained in the Villa Tani Indonesia edu-tourism to facilitate students' interest in technology.

Making edu-tourism modules in this study is inseparable from curriculum analysis. The edu-tour module refers to the Merdeka Curriculum because it adapts to the curriculum currently in effect by the regulations of Kepmendikbudristek No.56/M/2022, namely, the development of the curriculum for the education unit can be about the 2013 Curriculum or the Merdeka Curriculum. In addition, based on the analysis results, teachers at SMAN 5 Kota Serang have also implemented a Merdeka Curriculum. In the Merdeka Curriculum, 2 (two) components must be applied, namely the components of biological understanding and process skills. The material on the diversity of living things is included in phase E-learning outcomes. Each curriculum component is a reference for making Learning Objectives (TP) and Flow of Learning Objectives (ATP) (Hermawan et al., 2020). Learning objectives are divided into 2 (two) groups based on the components in the curriculum, namely the biological understanding component and the process skills component. The learning objectives and flow of objectives developed in this study are listed in Table 2.

Table 2. Learning objectives and learning objective flow

Component	Learning Objectives	Learning Objective Flow	Pancasila Student Profile
Biology Comprehension	1. Explain the role of flora for life 2. Analyze the factors that threaten the preservation of flora diversity 3. Analyze the characteristics of flora diversity	1. Explain the role of flora in daily life 2. Give an example of how to preserve flora diversity based on personal opinion. 3. Analyze the problems of current environmental issues related to threats to the preservation of flora diversity.	1. Have faith, fear of God, and have noble character. 2. Independent 3. Critical reasoning

Component	Learning Objectives	Learning Objective Flow	Pancasila Student Profile
		4. Analyze the characteristics of flora based on the table of differences and similarities contained in the module. 5. Analyze the preservation of flora diversity in the surrounding environment.	
Process Skills	Explore the diversity of flora in Villa Tani Indonesia and categorize based on the same family.	1. Identify flora based on their morphology and then group them based on the same family. 2. Present the results of the exploration of flora diversity in Villa Tani Indonesia.	1. Engage in global competition 2. Mutual cooperation 3. Critical reasoning

The results of the curriculum analysis were used as the basis for analyzing the material (Magdalena et al., 2020). The analyzed material focuses on the diversity of flora in the Villa Tani Indonesia edu-tourism site. The module was prepared to support students' flora identification skills so that each sheet of flora diversity contained a discussion of identifying the flora in the form of identifying leaves, flowers, or fruits. The subject matter in the module is the diversity of flora in Indonesia, the eco-tourism program at Villa Tani Indonesia, the diversity of flora at Villa Tani Indonesia, and flora identification information based on its morphology.

Design

The design stage aims to make the initial design of the module. The first design stage is to create a storyboard, which contains a detailed explanation of each flow in the module (Ariyana et al., 2022). The storyboard contains module components, component descriptions, module displays, and information in tables so that the components appear clearly and are organized. Next is the collection of references to design this edu-tourism module, in the form of source material for flora diversity from the LIPI publication "Status of biodiversity in Indonesia," a trusted website from Digital Flora of Indonesia which always updates data every certain period, Earth.org, taxonomic information from GBIF Backbone Taxonomy, and material on flora characteristics and identification from the book Plant Morphology by Gembong (2020) and Wahyuni et al. (2022), as well as various photos of flora in Villa Tani Indonesia which come from the author's documentation, furthermore, for the preparation of software to compile QR-Code-based edu-tourism modules, namely Canva, Heyzine Flipbook, and QR-Code with logo.

The next stage in designing the product is divided into 3 three parts: the beginning, content, and closing. The initial part consists of a cover, preface, table of contents, analysis of learning outcomes, and instructions for use. In this developed module, the cover background is white with a supporting image of the founder of Villa Tani, who is providing direction in cultivation activities at Villa Tani Indonesia; on the cover, there is brief information for confirmation of the content of the material to be studied (Figure 1a). Widiastika et al. (2021) state that selecting the cover image should present the module's contents. In the QR-Code-based edu-tourism module of flora diversity at Villa Tani Indonesia, get image sources from the Villa Tani Indonesia website. The background color of the page of each content of this developed edu-tourism module is white. The use of white as a background color so that the level of color brightness in other parts is not disturbed (Putri et al., 2021). Each new subchapter in the module in this study is made with a consistent placement of layout elements, such as

the location of the title, the shape of the font, and the shape of the title background. This opinion is based on the research of Marsela et al. (2022), which states that the composition of the size and layout elements of the module must have harmony and balance.
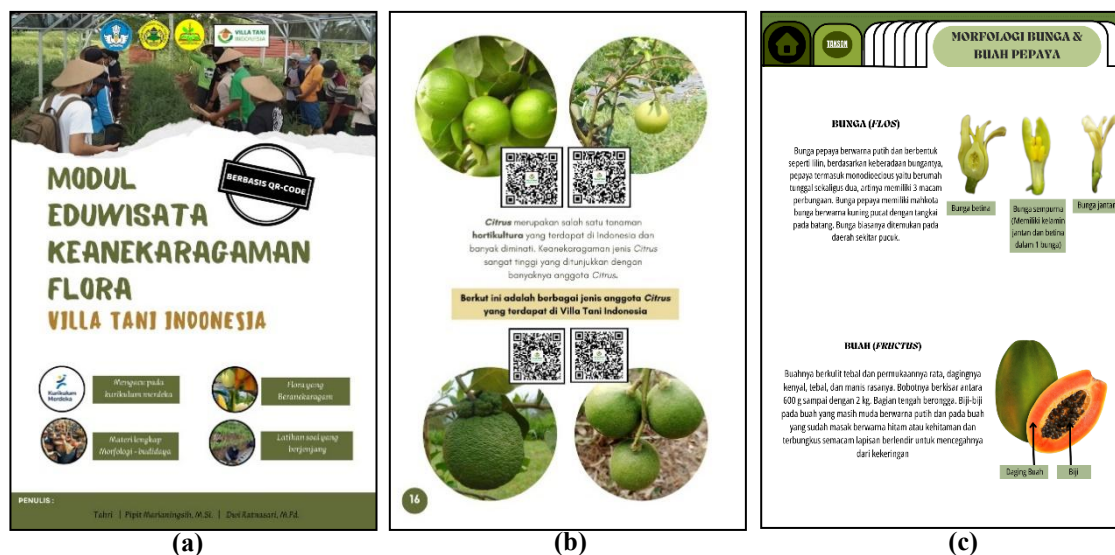

Figure 1. Appearance of the module, (a) the front cover; (b) placement of QR-Code on module content; (c) plant morphology material in QR-Code content

The next part is the content of the module. The flora diversity educational module is made by integrating QR-Codes that translate links from various websites for further material information and Heyzine flipbook links containing the main material for each flora in Villa Tani Indonesia (Figure 1b). The main material aimed at each flora is the morphology of roots, stems, leaves, to flowers/fruits, to support students' identification skills by recognizing each part of the flora. The QR code in the educational module is duplicated to be placed on each plant at Villa Tani Indonesia. QR-Code technology was chosen because it has various advantages in streamlining material to be learned by students. The most prominent advantage of QR-Code is the speed in translating its contents easily (Jakson, 2011). Thus, only needing one scan makes it easier for students to access information. In the type of printed module, these advantages make it easier for students to access material that is digital or via the website. The educational module developed in this study was made so that it could be accessed in 2 (two) forms, namely print and digital. This is done to be able to adjust the learning preferences of students who prefer digital or book-based learning. Therefore, each QR-Code is equipped with a hyperlink to facilitate access to information in the digital module type, while in the printed module, the information in the QR-Code can be accessed by scanning the QR-Code.

To meet the main objective of supporting students' flora identification skills, the module is equipped with a discussion on how to identify flora on each flora introduction sheet, such as what morphological parts can be observed and how to observe them, as well as special characteristics that can be observed from flora (Figure 1c). Thus, students are expected to be able to analyze what things can be used as a reference when making direct identification and can further analyze the similarities and differences in characteristics in determining the family of a flora (Safitri et al., 2014). Another activity that students can do to practice identification skills while reading this edu-tourism module is to open the information in each QR code of the flora introduction. In 1 (one) QR-Code, there is information on 1 (one) flora that is fully loaded, starting from morphology to the distribution of this flora in Indonesia or in the world. When studying flora morphology, on the first page, there are images of all parts of the flora; these parts have been inserted with hyperlinks, which, when pressed, will load information about the part. The experience provided while studying flora morphology by observing and studying the parts one by one is expected to train students' flora identification skills. The

module is also equipped with information related to dichotomous keys and dendrograms. The information can be used for students in conducting further identification activities after field exploration activities to recognize the placement of flora in taxonomy, as well as classify flora by genus to family based on similarities and differences.

The closing section includes an evaluation, scoring guidelines, a bibliography, a glossary, and an author's bio. Evaluation activities aim to measure the level of student learning success and learning objectives in curriculum outcomes (Suarga, 2019). In addition, according to Widiastika et al. (2021), learning accompanied by exercises makes capturing material easier and training critical thinking easier. The evaluation contained in this edu-tour module is in the form of identification, which is divided into 3 three types: identification of vegetative morphology, identification of generative morphology, and field exploration at Villa Tani Indonesia. The types of evaluation are arranged according to the stages of student recognition in conducting identification activities or plant recognition, which starts with recognizing and studying vegetative, generative parts, and then recognizing other things, such as characteristics in shape, color, or smell. Each evaluation has an assessment guide attached to inspire students to complete the evaluation as much as possible. The assessment guide also provides openness or transparency to the value that students will get. According to Andayani & Madani (2023), assessments carried out with transparency provide opportunities for students to know their learning outcomes and abilities; by seeing learning outcomes and feedback, students can monitor their learning progress, identify areas for improvement, and know the advantages they have.

The last stage is the preparation of assessment instruments for the feasibility of teaching materials, consisting of 3 (three) instruments, namely for media experts, materials, and student responses. Product assessment instruments are made based on modifications from the Education Standards, Curriculum, and Assessment Agency (2023) and Istiamah (2020). Furthermore, the instrument was validated and improved based on the validator's assessment, and product validation was carried out using the revised instrument.

Development
Expert Validation
Expert validation uses the following assessment score criteria (Table 3) and validity criteria (Table 4).

Table 3. Assessment score criteria (Arikuno, 2010)

Value	Description	Score
Yes	If according to the assessment criteria	1
No	If not according to the assessment criteria	0

The resulting score is then calculated as a percentage using the formula:

$$NP = \frac{R}{SM} \times 100\% \quad (\text{Purwanto, 2010})$$

Description: R : score value obtained
NP: Percentage value   SM: Maximum score value

Table 4. Validity criteria (Arikuno, 2010)

Achievement level (%)	Category
75,01-100,00	Very good
55,01-75,00	Good
40,01-55,00	Bad
< 40,00	Very bad

Validation of product feasibility by material experts and media experts resulted in an overall average score of 87.18% for material experts and 97.22% for media experts, both categorized as very good (Figure 2).
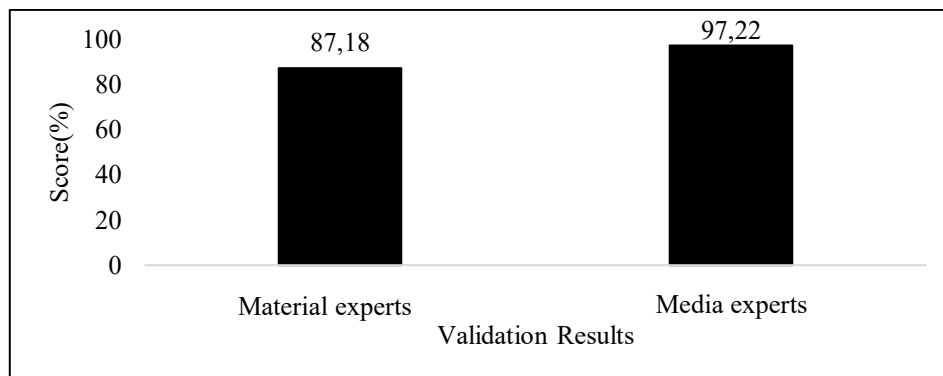

Figure 2. Expert validation results

The validation results by material experts on each aspect can be seen in Figure 3. Based on the expert's assessment, the aspect that obtained the lowest score was the aspect of the currency of the material, with a value of 56%. In this aspect, there is 1 (one) indicator, namely the suitability of the material with scientific developments. The development of science is based on the applicable curriculum, namely the Merdeka Curriculum. One of the characteristics of the Merdeka Curriculum is that it focuses on improving 21st-century skills, such as critical thinking skills, creativity, collaboration, communication, problem-solving, and digital literacy (Jufriadi et al., 2022). According to the expert, in the developed QR-Code-based edu-tourism module on flora diversity, the content of critical thinking and problem-solving skills has not been conveyed much. Improvements were made by adding social problems from the latest news and then giving a *G-Form* link for students to access the news further to listen to the problem properly. Furthermore, there is also a *G-Form* link that contains questions that students can answer according to their personal opinions related to the problem of biodiversity damage conveyed in the news; students can provide solutions to these problems, as well as questions about the importance of biodiversity and the role that will be obtained from the existence of biodiversity and flora.

Description:
a. Suitability of the material with the curriculum
b. Accuracy of the material
c. Learning material support
d. currency of the material
e. learning characteristics to support student identification skills
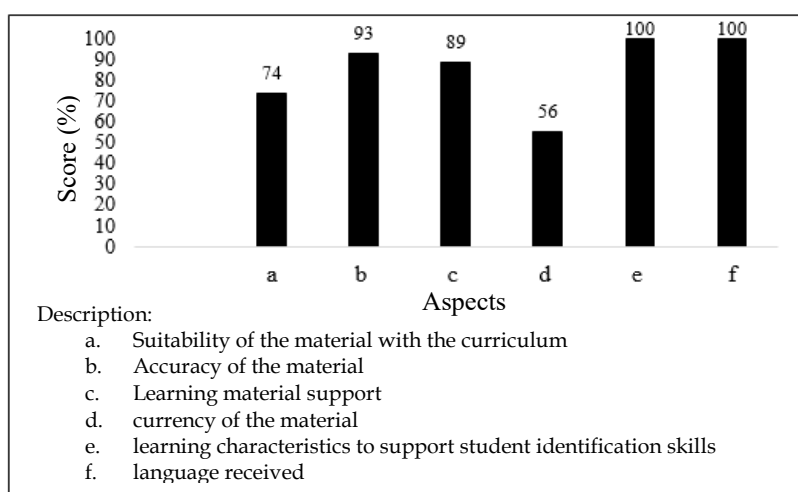f. language received

Figure 3. Results of material expert assessment

The results of the next assessment on the suitability of the material with the curriculum obtained a score of 74%. This aspect has several criteria, namely the completeness of the

material, the breadth of the material, and evaluation. In the material completeness criteria, some indicators need to be improved, namely, the suitability of the material with learning outcomes. The learning outcomes contained in the module are not written in full on process skills; Learning Objectives (TP) and Flow of Learning Objectives (ATP) are not conveyed, so there are no restrictions on the material in the module. According to Palupi (2018), learning objectives are to see a picture of student achievement of the expected competencies. The improvement is to write the learning outcomes in full and then provide information on learning objectives and the flow of learning objectives.

The next aspect, namely learning material support, received a score of 89%, the material's accuracy was 93%, and aspects of learning characteristics to support student identification skills and language received a score of 100%. Each component of these aspects falls into the excellent category. There are no important notes for improvement, but paying attention to the consistency of writing and the range of material contained in the module is necessary.

Figure 4 shows the validation results by media experts on each aspect. The content aspect of the module obtained a score of 94%. This value has a very good category, but the expert suggested improvements, namely regarding the consistency of the image layout and QR-Code, so as not to cover each other. The improvement is to re-layout the QR-Code and other images so that they are proportional and can be easily accessed by students.
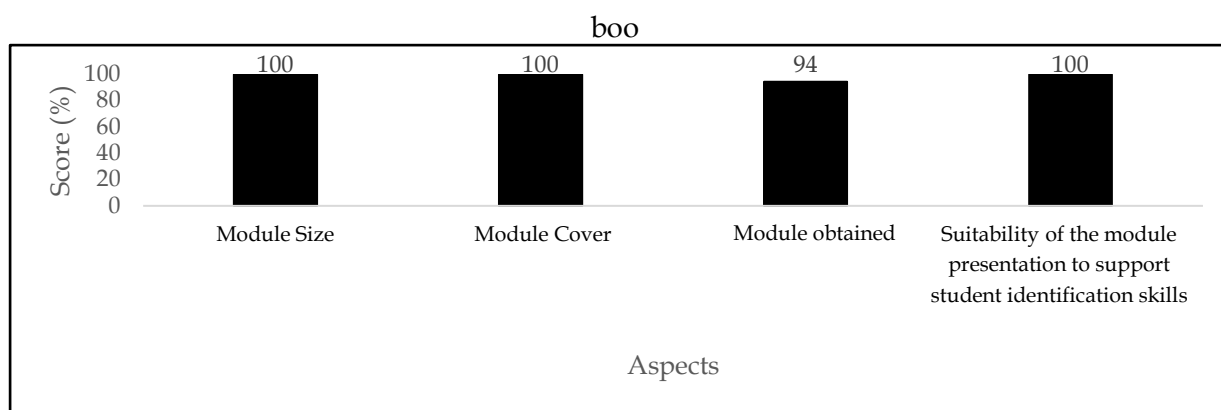

boo

Figure 4. Media expert assessment results

Furthermore, the results of the assessment of the module size aspect, the module cover, and the suitability of the module presentation to support student identification skills received a score of 100%, with a very good category. Each component in this respect received a perfect score because it was made by the applicable module manufacturing standards, according to DEPDIKNAS (2008). Each photo and image is of good quality, and the QR code also appears clear and easy to read. In QR codes, various features are easily understood and can be accessed quickly. Karima et al. (2021) state that a module is said to be good if there is ease of use; this is in accordance with the characteristics of the module, namely that it can be used independently (self-instruction), easy to understand (user-friendly), one unit (self-contained), stand-alone (stand-alone), and adjustment (adaptive).

Student Response Test

Criteria for scoring by students using positive and negative statements (Table 5) with the following validity criteria (Table 6).

Table 5. Assessment score criteria (Riduwan, 2007)

Score		Description
Positive statements	Negative statements	
4	1	Strongly agree
3	2	Agree
2	3	Disagree
1	4	Strongly disagree

The resulting score is then calculated as a percentage using the same formula as expert validation.

Table 6. Validity criteria ([Akbar, 2013](#))

Achievement level (%)	Category
85,01-100,00	Very good
70,01-85,00	Good
50,01-70,00	Bad
< 50,00	Very bad

The overall assessment results received a score of 88.08%, which is categorized as very feasible. The presentation aspect scored 90.41%, and the material aspect scored 86.81%, categorized as very feasible. Complex material is presented in a QR code that can be accessed easily. The assessment results for the two aspects did not get a perfect score of 100%; however, no special improvement notes were given. Based on the assessment analysis results, each statement gave the lowest score of 3 from the range of 1 (strongly disagree) - 4 (strongly agree). Based on this, the module has received good value for students; it has not provided a significant learning experience for some students. Related to this, further research needs to be carried out to use large-scale modules in the direct learning process so that the process of delivering material in the module can be maximally felt.
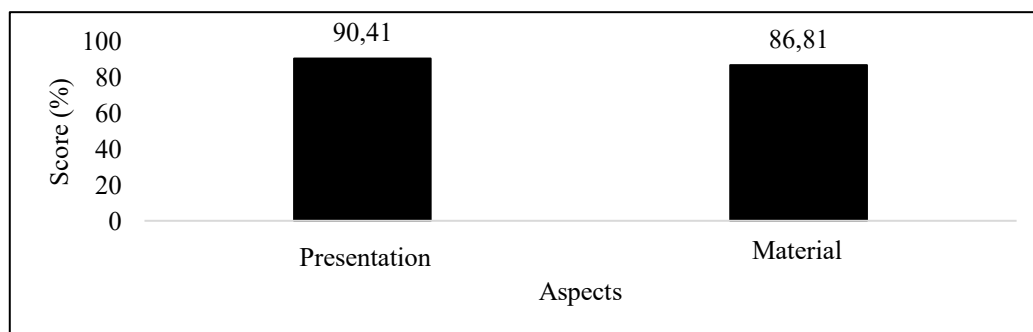

Figure 5. Results of student response test

Conclusion

This research aims to develop teaching materials in the form of edu-tourism modules by utilizing QR-code technology to support students' flora identification skills. The type of research used in this study is the research and development (R&D) method, with the research design referring to the 3D model (Define, Design, & Develop). The research was conducted in May 2023 - May 2024 at Villa Tani Indonesia, SMAN 5 Kota Serang, and Sultan Ageng Tirtayasa University. The feasibility test based on media experts showed a value of 97.22% with a very good category, while based on material experts showed a value of 87.18% with a very good category. The student response test from class X students of SMAN 5 Kota Serang and visitors to Villa Tani Indonesia obtained a score of 88.08% in the very feasible category.

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