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Science E-Module Based on Ethnoscience

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ABSTRAK

Covid-19 menjadi kendala proses pembelajaran di sekolah sehingga berdampak pada ketersediaan bahan ajar yang digunakan. Guru ditantang untuk menghasilkan bahan ajar elektronik yang menarik dan mudah dipahami serta dapat mengintegrasikan etnosains. Penelitian ini bertujuan untuk mengembangkan dan menguji kelayakan e-modul sains berbasis etnosains. Metode penelitian yang digunakan adalah Research & Development (R&D) dengan model Borg & Gall revisi Sugiono yang dimodifikasi menjadi 10 tahap. Subyek dalam penelitian ini adalah ahli konten (2 orang), ahli media (1 orang), dan uji coba modul pada siswa kelas III Sekolah Dasar (5 orang). Metode pengumpulan data yang digunakan dalam penelitian ini adalah wawancara dan observasi. Metode analisis data yang digunakan dalam penelitian ini adalah statistik deskriptif dan analisis kualitatif. Hasil penelitian dan pengembangan menunjukkan bahwa e-modul sains berbasis etnosains yang dikembangkan sangat berkualitas dengan rata-rata hasil produk mencapai 98,07% sehingga layak digunakan. Implikasi dari adanya e-modul sains berbasis etnosains adalah guru dapat lebih mudah menyampaikan pembelajaran dan memahami budaya sekitar yang dipelajari secara ilmiah.

ABSTRACT

Covid-19 has become an obstacle to the learning process in schools, impacting the availability of teaching materials used. Teachers are challenged to produce engaging and easily understandable electronic teaching materials that can integrate ethnoscience. This research aims to develop and test the feasibility of ethnoscience-based science e-modules. The research method used is Research & Development (R&D) with the Borg & Gall revised Sugiono model, which has been modified into 10 stages. The subjects in this study are content experts (2 people), media experts (1 person), and module testing on third-grade students at elementary school (5 people). Data collection methods used in this research are interviews and observations. Data analysis methods used in this research are descriptive statistics and qualitative analysis. The results of the research and development show that the developed ethnoscience-based science e-module is highly qualified, with an average product result reaching 98.07%, making it suitable for use. The implication of having ethnoscience-based science e-modules is that teachers can deliver learning more easily and understand the culture around them that is studied scientifically.

1. INTRODUCTION

The Covid-19 pandemic has had significant impacts on various sectors of human life, including the education sector. All activities that involve large gatherings, such as workshops, seminars, and study tours, have been suspended, and the previous face-to-face learning methods have been replaced with online learning (Chang Et Al., 2020; Remuzzi & Remuzzi, 2020; Wong Et Al., 2020). Online learning is a transformation of learning methods from direct face-to-face interaction to technology-based forms, which provide flexibility for students to learn independently without being constrained by time and place (Hussein et al., 2020; Hwang et al., 2021; Kkese, 2020). In online learning, the ability of learners, educators, and even parents to use technology is crucial for conducting the learning process effectively (Andel et al., 2020; Lage-Cala et al., 2020). Moreover, the success of online learning depends on the use of good learning media. One of the learning media that can be used is teaching materials.

Teaching materials are materials designed by educators so that they can be used in the teaching and learning process. Teaching materials can be defined as materials that are created comprehensively, regularly, and tailored to the principles of student-centered learning and the learning process (R. Puspasari & Suryaningsih, 2019; Rizki & Linuhung, 2017). The selection of teaching materials to be used must be done wisely in accordance with the needs and characteristics of students (Darmayasa et al., 2018; Pratiwi et al., 2017). Teaching materials should be designed to be more interesting to motivate students to learn. The selection of good teaching materials should align with curricula that integrate science and

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culture in daily life, making it easy for students to understand (Martha & Andini, 2019; Saputra et al., 2022; Weriyanti et al., 2020). Good teaching materials not only enhance conceptual understanding but also improve skills in analyzing, interpreting, summarizing, and solving problems with creative solutions. Based on these explanations, it can be said that the presence of teaching materials has a positive impact on the teaching and learning process. This statement is supported by several studies that have been conducted previously. Research has shown that teaching materials are effective in improving students' character and responsibility (Estuwardani & Mustadi, 2016; Lestariningsih & Suardiman, 2017). The results of previous research indicate that there is a difference in the improvement of science literacy skills between students using balanced teaching materials (Paramita et al., 2017). Other research results show that the use of thematic teaching materials significantly influences student learning outcomes (Puspita & Purwo, 2019). Other studies also demonstrate that the effective use of writing teaching materials can enhance the writing skills of students (Owon, 2017). Therefore, appealing teaching materials can balance students' abilities, including attitudes, skills, and knowledge. As educators, we must always strive to select teaching materials that align with the characteristics and curriculum requirements.

However, based on field conditions during the interview and observation process with third-grade students at SD Negeri Inpres 02 Sanoba, Nabire Regency, it was noted that there were still no electronic teaching materials used in the learning process. Furthermore, the existing teaching materials used demonstrate several weaknesses. The content in textbooks is still incomplete, some instructional activities lack systematic and contextual approaches, and the teaching materials used still do not integrate ethnoscience. This is evident from the feedback given by students, with a significant number expressing disinterest in the provided materials. The current teaching materials are not attractive enough for students, resulting in a lack of motivation and enthusiasm for learning. The materials owned by students are limited, not systematic, and lack detailed explanations along with insufficient exercise questions. Students' learning materials also lack innovation, resulting in a monotonous learning experience (Firdaus & Mukhaiyar, 2021; Hidayah & Priscylio, 2019). This is emphasized by the initial analysis, indicating that there are still no electronic teaching materials used during the learning process. Furthermore, the existing teaching materials still demonstrate several shortcomings. The content in textbooks is still incomplete, some instructional activities lack systematic and contextual approaches, and the teaching materials used still do not integrate ethnoscience. This is evident from the feedback given by students, with a significant number expressing disinterest in the provided materials. The disparity between the ideal conditions and reality necessitates an improvement in learning quality. One solution is to provide balanced teaching materials, including the use of electronic modules.

Module is one of the various types of teaching materials. Electronic module or e-module is a digital medium that is effective, efficient, and prioritizes students' independence in conducting learning activities containing a unified set of teaching materials to help students solve problems on their own (Fausih & Danang, 2015; Lestari & Parmiti, 2020; Widya Dwiyanti, 2018). E-modules and appropriate learning processes can boost motivation and stimulate learning, also providing positive psychological effects for learners (Febriana & Sakti, 2021; Karuwisi et al., 2020). The presence of e-modules in the learning process will have a positive impact. Some effects of the presence of e-modules in the learning process include the successful improvement of numeracy literacy and character education through ethnomathematics content, making learning more contextual and meaningful. The presence of e-modules can enhance students' learning outcomes (Alipah et al., 2018; Lestari & Parmiti, 2020), develop science process skills (Dari & Nasih, 2020), and improve subject mastery (Tjiptiany et al., 2016; Widiantari et al., 2022). Therefore, the impact of e-modules can be significant on the learning process.

Currently, the demanded e-modules are those that present examples of science and culture in daily life. A good module not only contains a collection of materials but also integrates the Ethnoscience approach. Ethnoscience is an approach that connects the application of science and culture in daily life, forming lasting character traits in students. The Ethnoscience approach is easier to identify through the educational process in daily life. The importance of learning with an Ethnoscience approach is being able to utilize culture and community environments and instilling not only knowledge but also attitudes and a love for the culture being studied (Aza Nuralita, 2020; A. Puspasari et al., 2019; Syah et al., 2020). Furthermore, the learning process using the Ethnoscience approach can cultivate a love for the environment and serve as an effort to preserve local culture. Several studies have been conducted regarding Ethnoscience -based e-modules, including a study stating that the phenomenology of using e-modules in online learning for the subject of Science at SD Muhammadiyah 5 Jakarta (Dwiyanti et al., 2021). Another study indicating the successful development of a Problem-Based Learning e-module for science subjects for grade VII students in odd semesters. A commonality in these studies is the use of e-modules as independent learning materials for grade V students at elementary school (Putra et al., 2017; Shufa, 2018). Another study showing that the development of Ethnoscience -based science learning

modules on the theme of Ecosystem Subtheme 1 is very valid, highly effective, and very practical when applied in fifth-grade classes (Melawati & Istianah, 2022). Another study showing that the implementation of an Ethnoscience -Based Science Module in the Bengkulu Community through Discovery Learning can improve critical thinking skills (Sakti et al., 2020). A study states that an Ethnoscience -based chemistry module is categorized as feasible and practical to use (Utari et al., 2020). In this research, there are some differences compared to existing studies, namely using ethno-scientific-based e-modules, which are studies of local culture and phenomena related to nature and society, and using Ethnoscience-based e-modules, where learning integrates local culture with scientific learning that helps students understand the studied material. Based on the information described above, the researcher is interested in conducting research related to the development of Ethnoscience-based e-modules for Science in Papua, with the aim of enhancing student learning outcomes. The objective of this research is to develop and test the feasibility of ethno-scientific-based Science e-modules in Papua.

2. METHOD

This research adopts the Research and Development (R&D) approach with modifications based on Suigiyono's R&D steps and Borg & Gall's R&D model (Sugiyono, 2018). The focus of the research is to create an innovative electronic module (e-module) for teaching Natural Sciences to third-grade students in Elementary School (SD) based on ethnoscience. The research stages include: 1) Identifying the potential and problems related to module development, 2) Collecting data related to student needs and the curriculum, 3) Designing the product involving content, structure, and learning features planning, 4) Preliminary testing of the product design, 5) Correcting the design if necessary, 6) Field testing the product in the context of third-grade SD learning, 7) Adjusting the product based on the test results, 8) Extensive testing of module implementation, 9) Correcting the product (if necessary) after implementation testing, and 10) Large-scale production if the module proves successful and effective. By following these steps, it is expected that the resulting electronic module can become an innovative learning tool, meeting the needs of students, and can be widely adopted in the educational environment.

This research was conducted on a subject group consisting of five third-grade students from Inpres 02 Sanoba Elementary School in the Nabire District, Nabire Regency, Papua Province, during the first semester of the academic year 2022/2023. The selection of this location was based on considerations to represent the variation in the backgrounds and characteristics of students in that region. Inpres 02 Sanoba Elementary School was chosen because it reflects the diversity of learning conditions in the area. The trial subjects in this research consisted of six reading proficiency test participants, randomly selected to ensure a balanced representation of reading abilities. Meanwhile, ten students participated in the limited trial (small group) to evaluate the effectiveness of the tested learning methods in a more focused classroom setting. The selection of the number of students in both groups aims to obtain more representative results and better generalization regarding the implementation of the tested learning methods. Through this approach, the research aims to provide deeper insights into the impact of learning methods on the reading proficiency of third-grade students, with a focus on the specific context of Inpres 02 Sanoba Elementary School.

The questionnaire method in this research was developed as a structured instrument using the Likert scale. Respondents include expert validators, including researchers with expertise in the subject matter and media, as well as students participating in the small group trial. This method is designed to summarize a comprehensive perspective from various involved parties, ensuring that the research results reflect a deeper understanding of the impact of learning methods on the reading proficiency of third-grade students at Inpres 02 Sanoba Elementary School. In the questionnaire method, indicators are maintained to ensure the validity and reliability of the data. The development of the questionnaire pays attention to well-designed, clear, and relevant questions aligned with the research objectives. Here, an assessment is made of the product that has been designed by an expert team. This assessment involves a rating scale that includes 5 points for "excellent," 4 for "good," 3 for "fair," 2 for "poor," and 1 for "very poor." The use of the Likert scale is expected to reflect the level of agreement or disagreement of respondents regarding statements related to the learning methods. Additionally, respondent selection is done carefully to ensure representative variation, involving expert validators such as researchers, teachers, and education specialists. Through this approach, the questionnaire method is expected to provide accurate and representative data regarding the perceptions of experts and stakeholders on the effectiveness of the researched learning methods. By combining this method with interviews, reading proficiency tests, and small group participation, this research aims to provide a holistic and in-depth understanding of the impact of learning methods on the reading abilities of third-grade students at Inpres 02 Sanoba Elementary School.

The data analysis process involves assessing the validity and effectiveness of the developed product, adopting a quantitative descriptive method based on validation results, responses, and feedback from validators through the e-module. Initially, the product's validity is evaluated to ensure its alignment and accuracy with the research objectives. This evaluation includes assessing the consistency between the product's content and established standards. Additionally, validators' responses to the product are examined to identify areas requiring improvement or enhancement. A quantitative descriptive approach is employed to measure the extent to which the e-module meets specific criteria and how effectively it achieves learning objectives. Validation results and validators' responses are statistically analysed to obtain a clearer understanding of the product's quality and effectiveness. Furthermore, the feedback provided by validators is integrated into the data analysis process to offer detailed suggestions for improvement and development. This process entails a thorough interpretation of validators' comments and recommendations, ensuring that proposed enhancements can be implemented effectively. In summary, the data analysis process aims to present a comprehensive overview of the validity and effectiveness of the developed e-module, with the objective of formulating specific improvement steps based on the evaluation conducted by validators as show in Table 1.

Table 1. Achievement Level Conversion with Scale 5

Achievement Level	Qualification	Information
90% - 100%	Very Good/Very Valid	No need to revise
75% - 89%	Good/Valid	Revised as necessary
65% - 74%	Fairly Good/Fairly Valid	Quite a lot of revisions
55% - 64%	Not Good/Invalid	Much revised
0% - 54%	Very Poor/Very Invalid	Total revision

3. RESULT AND DISCUSSION

Result

One of the purposes of developing e-modules is to present learning materials that are in line with the curriculum, taking into account the needs of learners. This includes providing teaching materials that match the learning content and characteristics of individual learners, especially in the context of organizing learning during the COVID-19 pandemic. The generated e-modules specifically focus on the field of Natural Sciences (IPA) and use an ethnoscience approach. The development of ethnoscience-based IPA e-modules follows a development guide that adapts the Borg & Gall model, which has been updated by Suigiyono. This approach involves several main steps, including the identification of potential and initial problems, data collection, product design, design validation, design improvement based on validation, product testing, further revision, product use testing, ongoing improvement, and mass production. The initial stage involves identifying existing potentials and obstacles, where information related to potentials and obstacles in the school environment is collected. The focus is on revealing potentials that can add value if utilized. Researchers conducted a series of interviews with subject teachers to gather data. The results of interviews and observations depict the challenges faced during the COVID-19 pandemic in online learning. One of the problems is the suboptimal use of teaching materials due to a lack of physical interaction caused by online learning. As a result, teachers face difficulties in delivering science material, and learning objectives are constrained. Learning materials are not scientifically linked to local culture, making the learning experience less engaging. However, in the Papua region, there is significant potential in the form of local culture that can be integrated into scientific learning.

The second stage is information collection, where in this step, an ethnoscience-based e-module is used as a medium. The collected material focuses on topics related to theme 2, namely "Caring for Plants and Animals," with the first sub-theme discussing "The Benefits of Plants for Human Life." Then, the third stage is product design, where the author will design the e-module according to the desired specifications. This design process involves the use of the Canva program to create a design for an ethnoscience-based IPA e-module. This stage begins with the creation of the module framework and the arrangement of materials according to the desired concept, as well as the application of the ethnoscience approach, especially those relevant to the Papua region. Moving further, the fourth stage is design validation. The results of this validation stage include qualitative and quantitative data, providing information about the level of suitability and quality of the designed product. Further data processing will be carried out to determine the product's validity developing ethnoscience-based science e-modules in Papua.

The overall research results are the answer to the purpose of this research, which is: 1). The research results show the success of the development of science e-modules based on ethno-science in Papua; proven by the results of validation by material experts and media experts who get very good

results. 2). The research results show the success of the feasibility test of science e-modules based on ethno-science in Papua; proven by the results of the trial which get very good results. The results of feasibility testing by experts are presented in Tables 2 and Table 3.

Table 2. Validation Results of Material Expert Ei-Modul Science Based on Ethnoscience

No	Aspect	Indicator	Validator	
			1	2
1.	Content Eligibility	Compatibility of material with KI & KD	90	90
		Material accuracy	92	88
		Sophistication of material	95	90
2.	Feasibility of Presentation	Presentation technique	85	87
		Supporting Presentations	90	90
3.	Assessment	Contextual assessment	90	86
Percentage of each validator			**90.33%**	**88.5%**
Percentage overall			**89.41%**	
Criteria			**Very good**	

Base on Table 2 show evaluation results of the IPA e-module content, focusing on ethnoscience, indicates that each aspect has received an average score of 89.41%. This assessment reflects an excellent level of achievement, ensuring that no revisions are required. The next step is to proceed to the next phase with some suggestions from the validators. These suggestions include improving the quality of the instructional material design and enhancing the images to be integrated into the material to inspire students' enthusiasm and interest in learning further. Validation results of media e-modul ipa experts based on etonians is show in Table 3.

Table 3. Validation Results of Media E-Modul IPA Experts Based on Etonians

No	Aspect	Indicator	Validator
1.	Graphics	Module size	90
		Module cover design	85
		Module content design	80
Percentage			**91%**
Very good			**Very good**

Base on Table 3 the average assessment from media design experts in the validation process indicates an excellent level of qualification, reaching 91%, and does not require additional revisions. In the validation balancing stage, revisions were made to the media design module by experts in response to some product deficiencies. Feedback, suggestions, and criticisms from the balancing validation process, as well as aspects of design and module readability, have been taken into account and integrated into the mentioned revisions. The fifth stage involves design improvements, carried out by considering feedback from validators on the modules currently in balancing. Therefore, improvements are needed for the ethnoscience-based IPA e-modules according to the suggestions from validators. This is aimed at improving the quality of the current balancing e-modules and allowing for further testing. Meanwhile, revisions proposed by media design experts include improving the clarity of images, adjusting column widths in tables, adding details to tables, using a bibliography list derived from Google Images, and adjusting spaces to fill in answers in accordance with the expected answer format. The sixth stage involves product testing, where students become the subjects of the trial. Ethnoscience-based IPA e-modules, along with assessment sheets, are also provided to students. This step aims to gain an understanding of the responses given by students to the attractiveness of these ethnoscience-based IPA e-modules. The results of the feasibility test from students are presented in Table 4.

Table 4. Ethnoscience Based Science E-module Trial Results

No	Indicator	Student Response				
		1	2	3	4	5
1.	Material	16	16	15	15	16
2.	Language	16	15	15	16	15
3.	Module content design	20	20	20	20	15
Total score		**255**				
Maximum score		**260**				

No	Indicator	Student Response				
		1	2	3	4	5
Validation of errors		98.07%				
Criteria		Very good				

Base on Table 4 show the overall achievement average from the product test reaches 98.07%, indicating an excellent level of quality and not requiring any further improvements. Nevertheless, there are some suggestions and feedback, such as sentences that need to be reevaluated for easier understanding by students. The product that has undergone the trial is then improved based on the feedback from students. The seventh stage is to re-examine the product, where the IPA e-module that integrates an ethnoscience perspective has been successfully reviewed comprehensively, producing interesting conclusions. Therefore, it can be concluded that the balancing of this e-module has been successfully completed, and the final product has been created without the need for further revisions. Subsequently, the completed product will be disseminated in a digital file format. An illustration of the created e-module can be seen in Figure 1.

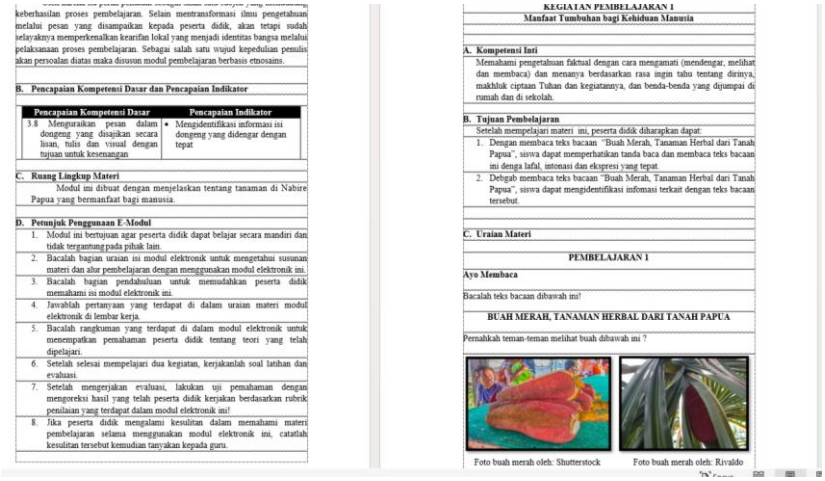

Figure 1. Ethnoscience-Based Science Module

Discussion

Based on the experts' assessments, the achievement obtained is considered exceptional. In this situation, the e-module serves as a tool for understanding Natural Sciences (IPA) content while providing an enjoyable learning experience for the students (Lestari & Parmiti, 2020b; R. Puspasari & Suryaningsih, 2019). The learning content becomes more engaging and inspiring for students if it is integrated with the local culture in the region. The content has been adapted to be more relevant to Papuan culture, especially in the Nabire region. In scientific education, this area can be used as a concrete example accompanied by illustrations, aiding students in better understanding. When designing the content, attention is given to the depth of the material and the inclusion of content in a systematic manner. Depth refers to how thoroughly the concepts are studied by the students, while clarity of content is related to the amount of material included in the learning. Accurate identification of the learning content is required to ensure the achievement of students' competencies precisely. Moreover, in selecting the teaching model, understanding the types of content that will be taught will lead to accuracy in choosing the appropriate teaching model. The content or learning materials are related to instructional material delivery strategies. According to the design experts' evaluations, the results obtained are excellent. This aligns with the view that vivid and engaging images are crucial because, in addition to clarifying the material explanations, visuals also enhance visual appeal and reduce students' sense of boredom during the learning process of the module.

Based on the evaluation of the product trial, it can be concluded that the product has successfully achieved a highly positive qualification. This finding aligns with the viewpoint expressed by Setiawan in 2021, stating that effective learning materials involve engaging images to prevent student boredom. In the current era, a mature approach to content balancing is crucial to enhance students' enthusiasm and motivation in the learning process. Characteristics considered appropriate for modules include presenting clear learning objectives, packaging the material in an engaging manner to encourage active student participation, using an assessment system based on understanding, accommodating various learning

styles and assigned tasks, providing space for individual differences among students, and aligning with comprehensive learning objectives. The study also indicates that the use of ethnoscience-based e-modules not only reflects students' characteristics directly but also fosters active participation in the learning process (Aza Nuralita, 2020; Darmayasa et al., 2018). The value of these e-modules has significant benefits, both in obtaining student feedback and enhancing students' understanding of the explained content, especially when discussing topics related to nutritious food (Fatmawati & Andromeda, 2021; Núñez-Peña et al., 2015). Therefore, it can be concluded that ethnoscience-based IPA e-modules on healthy food content are suitable for implementation in the classroom learning process.

Leveraging electronic modules in the educational process can enhance students' understanding and foster their active participation in the learning material. In doing so, such a situation can stimulate improvements in learning outcomes. The success of learning can be enhanced through the careful design of content and well-structured teaching steps, where the material is presented in interconnected segments with varying levels of depth and complexity. For this purpose, the synthesis of learning steps becomes crucial. Synthesis focuses on integrating concepts within a scientific discipline with a nuanced understanding of the field of study, ultimately making the taught material more meaningful. The result is that students develop strong recall abilities and maintain a solid understanding of the topics learned. An ideal learning content in the learning environment should be relevant to the learning objectives, appropriately challenging to match the students' capacity, capable of motivating learners, stimulating critical thinking and engagement in the learning process, and aligning with established teaching procedures while using existing teaching resources. When discussing the balancing of electronic modules (e-modules), learning material should adhere to a structured curriculum and analyse specific learning objectives.

4. CONCLUSION

The development of science e-modules based on ethno-science in Papua has been proven to be successful with very good validation results. Furthermore, the success of the feasibility test of science e-modules based on ethno-science in Papua has been proven to be successful with very good trial results. The electronic module (e-module) in the Natural Sciences subject (IPA) with a focus on an ethnoscience approach, covering the topic of a healthy food system for third-grade elementary students, has the potential to be applied effectively in teaching activities. It is hoped that this ethnoscience-based e-module can serve as a suitable alternative for learning resources during the adaptation period to the COVID-19 pandemic. With this, the module is expected to provide support for teachers and students in continuing the learning process more effectively. Moreover, this approach can stimulate students' interest in learning and help them understand scientific concepts about the surrounding culture, analysed through a scientific perspective.

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