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ETHNOSCIENCE-BASED INTERACTIVE E-MODULE: E-MODULE DEVELOPMENT ON NONRENEWABLE RESOURCES TOPIC

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ABSTRACT

This study aims to develop an ethnoscience-based interactive e-module with the topic of non-renewable resources. Research and Development in this study adopted the ADDIE theory by Dick and Carry which consists of five stages: 1) Analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. This research only reached the third stage because at that stage the research objectives had been achieved. The instrument of this research is a Likert scale questionnaire which is analyzed by percentage. The results showed that the interactive e-module was declared feasible to be applied in learning with content and media expert validators giving an average score of above 75%. Student responses to this e-module also reached more than 75%, so this interactive e-module was stated to be very interesting. The conclusion of this study is that this interactive e-module is valid so that it can be applied in physics learning. For further research, it is hoped to develop e-modules on different topics.

E-MODUL INTERAKTIF BERBASIS ETNOSAINS: PENGEMBANGAN E-MODUL PADA TOPIK KETERBATASAN SUMBER ENERGI

Kata Kunci:

Etnosains
E-modul interaktif
Keterbatasan sumber energi

ABSTRAK

Penelitian ini bertujuan untuk mengembangkan e-modul interaktif berbasis etnosains dengan topik sumber energi tak terbarukan. Penelitian dan Pengembangan ini mengadopsi teori ADDIE oleh Dick and Carry yang terdiri dari lima tahap: 1) Analisis, 2) perancangan, 3) pengembangan, 4) implementasi, dan 5) evaluasi. Penelitian ini baru mencapai tahap ketiga karena pada tahap tersebut tujuan penelitian telah tercapai. Instrumen penelitian ini adalah angket skala likert yang dianalisis dengan persentase. Hasil penelitian menunjukkan bahwa e-modul interaktif dinyatakan layak untuk diterapkan dalam pembelajaran dengan validator ahli isi dan media memberikan skor rata-rata di atas 75%. Respon siswa terhadap e-modul ini juga mencapai lebih dari 75%, sehingga e-modul interaktif ini dinyatakan sangat menarik. Kesimpulan dari penelitian ini adalah e-modul interaktif ini valid sehingga dapat diterapkan dalam pembelajaran fisika. Untuk penelitian selanjutnya, diharapkan untuk mengembangkan e-modul pada materi yang berbeda.

1. INTRODUCTION

Education is one of the frontline aspects of a country [1]. Through education, the state seeks various ways to educate the nation's generation. In Indonesia, various educational policies have been initiated by the Indonesian government, including: improving the curriculum and advocating the use of various learning media [2]. There are various learning media that can be applied, including books, modules, worksheets, etcetera [3]. The module is one of the learning media that can be presented in print or electronic form [4]–[6]. Modules that are presented electronically are called e-modules. E-modules are very efficient to use, especially in prototype curricula that use blended learning methods [7]. Blended learning is learning that is done offline and online [8]. Online learning can be supported with electronic-based learning tools. Electronic learning enables interactive learning and is more interesting to learn. E-module is one of the learning media that can be created interactively [9].

Interactive e-module is a dynamic technology that can be used to convey information in the form of text, graphics, animated images and videos [10]. The use of interactive media provides a learning experience that is not boring for students [11]. The application of Interactive E-Modules is one way that teachers can use in delivering material in distance learning [12]. Designs that are accessible anywhere with the help of smartphone/laptop devices make this media very helpful for teachers in delivering distance learning [13], [14]. Interactive e-modules are more effective and efficient than print modules.

Based on previous research, interactive e-modules have been proven to help students more easily understand the concept [9], [15]. In addition, other research shows that the integration of ethnoscience in learning helps students to understand concepts more easily while at the same time introducing local wisdom [16]–[18]. However, most of the interactive e-modules currently available are not suitable for learning needs. One of the needs that must be met at this time is the development of character, especially the nationalist character. Based on the findings in the field, in 2002 there were 93.5% of respondents proud to be Indonesian, in 2005 there were 70.5% while in 2007 there were only 65.9%. And this number continues to decrease every year. This needs to be overcome by integrating learning with regional characteristics (ethnoscience). So that students can understand the ethnoscience of their own area and can recognize the potential that exists. So there is a need for learning media that is integrated with ethnoscience [19].

Several studies on ethnoscience have been carried out, such as the development of guided inquiry-based ethnoscience e-modules [20], development of Ethnophysics-based temperature and heat material modules [11], and the practicality and effectiveness of the ethnoscience integrated guided inquiry e-module [21]. However, there is no research that discusses ethnoscience-based e-module from eastern Ogan Komering Ulu (OKU) Regency, Palembang City, South Sumatra Province. Moreover, previously there was no research that discusses ethnoscience on nonrenewable resources. So the purpose of this study is to develop an ethnoscience-based interactive e-module on the topic of nonrenewable resources for class 12 science.

Ethnoscience is knowledge possessed by a nation, especially a certain ethnic group or social group [16]. Ethnoscience from each region is different. Perjaya Dam is one of the famous icons in South Sumatra. This dam can irrigate the areas of komering, macak, belitang, bahuga, mucak kabau, lem debris and onion bones (Lampung). The benefits of the Perjaya dam can be felt by the whole community because it is able to irrigate agriculture, plantations and fisheries. So that the South Sumatra region is able to get the title of the 5th national food barn in Indonesia [19]. Another benefit is that the Perjaya dam is used to overcome nonrenewable resources by using it as a Micro-hydro Power Plant in

East OKU. So it will be very good if this topic is integrated into learning. It is hoped that this interactive e-module will assist teachers in conveying information more effectively and the nationalist character of students can be increased.

2. METHOD

This type of research is research and development, which aims to develop and validate learning media to ensure that the media is suitable for use in learning. The result of this research is an ethnoscience-based interactive E-Module on the topic of nonrenewable resources. The research population was all 12th grade high school students in East OKU, while the sampling technique was done by cluster random sampling. The research instrument used observation, and a closed questionnaire. The research data were analyzed by: 1) qualitative and 2) quantitative. The stages of this research adapted the ADDIE theory by Dick and Carry which consists of 5 stages: 1) analysis, 2) design, 3) development, 4) implementation, dan 5) evaluation. This research was carried out until the third stage because the purpose of this study was the development of interactive e-modules. The stages of research and development are described in Figure 1 below.

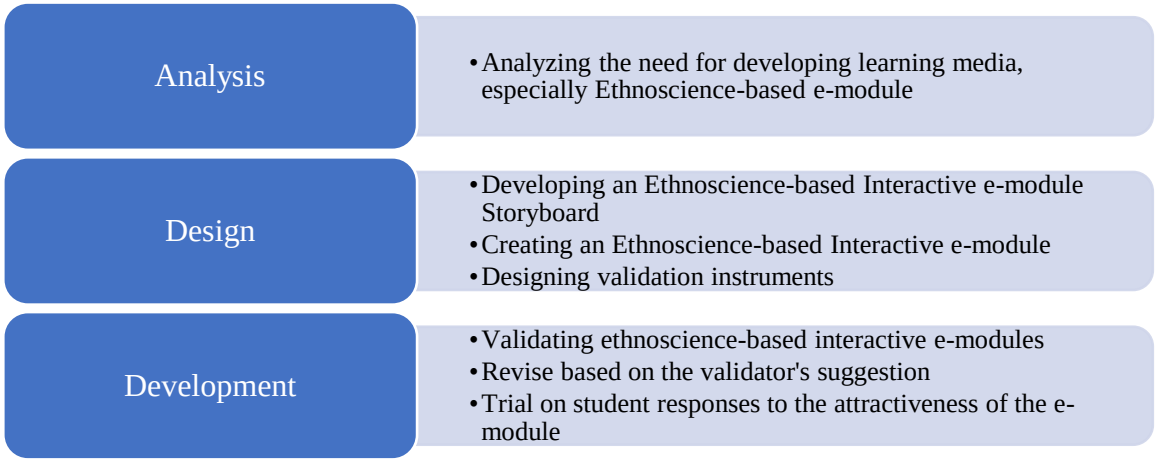

Figure 1. Research Stages

The instrument (validation and response) used in this study is a Likert scale with the provisions shown in Table 1 [22].

Table 1. Likert Scale Criteria

Score	Criteria
1	Strongly Disagree
2	Disagree
3	Agree
4	Strongly Agree

In this research and development, several stages of qualitative and quantitative data analysis were carried out. Qualitative data were analyzed through reading and writing, describing, and classifying the data. While the data analyzed quantitatively is the score of the questionnaire (validation and trial). The data analysis techniques for research and product development are 1) expert validation, to analyze the feasibility and assessment of interactive E-Modules through expert views (media expert validators and content expert validators); and 2) Student analysis is the result of students' responses to the attractiveness of interactive E-Modules. The formula for determining the value of expert judgments and student responses is [23].

$$P = \frac{Total\ Score}{Maximum\ Score} \times 100\% \quad (1)$$

The interpretation of the validation results is shown in Table 2 and the interpretation of the attractiveness response is shown in Table 3.

Table 2. Likert Scale Interpretation (Expert Validation) [24]

Percentage	Description
0 < P ≤ 25	Totally unacceptable
25 < P ≤ 50	Unacceptable
50 < P ≤ 75	Acceptable
75 < P ≤ 100	Totally Acceptable

Tabel 3. Likert Scale Interpretation (Attraction Response) [23]

Percentage	Description
0 < P ≤ 25	Very Unattractive
25 < P ≤ 50	Unattractive
50 < P ≤ 75	Attractive
75 < P ≤ 100	Very Attractive

3. RESULTS AND DISCUSSION

In this study, various stages were carried out until the interactive e-module was declared feasible and acceptable. The results of each stage are described in detail as follows.

3.1 Analysis

At the analysis stage, several stages were carried out including analysis of literature studies, analysis of learning media needs, analysis of interactive e-modules, and analysis of materials for making interactive e-module. Based on the results of the literature analysis, it is known that there are still very few ethnoscience-based interactive e-module journals, especially for high school students. Based on the results of the needs analysis, high school students need more interesting learning media, so far they tend to still use print modules or informative e-modules. So we need interactive e-modules as student teaching materials [10].

3.2 Design

At the design stage, the researcher carried out several stages including: compiling content storyboards, making ethnoscience-based interactive e-modules, and making validation instruments. In the preparation of the storyboard, the researcher carried out several stages as described in Table 4.

Table 4. Storyboard Creation Process

Content	Ethnoscience	Description
Nonrenewable resources	**Ethnoscience:** energy sources in South Sumatra Province.	Instructions for using e-books, study instructions, concept maps and descriptions of several references are provided 

1. Definition of Energy Resources. Various energy resources (renewable and non-renewable energy)	**Ethnoscience**: Energy sources in South Sumatra: 1. Renewable resources: a. Sun Figure 1: drying salted fish Video 1: scheme of applying solar cell b. Water (Musi River, Ogan River, Komering River) Figure 2: Musi River as transportation infrastructur Video 2: Schematic of making a waterwheel c. Biogas Figure 3: The use of a biogas stove 2. Nonrenewable resources: a. Petroleum Figure 4: Petroleum Refinery in Plaju Palembang Gas Alam Figure 5: the use of natural gas as LPG substitute b. Coal Figure 6: Coal Mine in Kertapati, Palembang Video 3: Coal management scheme	Complete materials are provided according to the instructions for use  Sumber energi adalah segala sesuatu di sekitar kita yang mampu menghasilkan energi. Di sekitar kita banyak sekali macam-macam sumber energi yang bisa menghasilkan berbagai macam energi. Sumber energi dapat dibedakan menjadi dua yaitu sumber energi terbarukan dan sumber energi tak terbarukan. Gambar 1. Menjemur ikan asin https://kumparan.com/urbanid/potret-kampung-siabang-sentra-pembuatan-ikan-asin-di-palembang-1yAUmlIVHca/full **Pernahkan kalian melihat ini????** Selain itu, dikembangkan pula teknologi energi surya termal. Selama ini, pemanfaatan energi surya termal di Indonesia masih dilakukan secara tradisional, misalnya untuk mengeringkan hasil pertanian dan perikanan secara langsung. Teknologi energi surya termal memiliki prospek yang cukup besar dalam mendukung peningkatan kualitas pascapanen, sebagai pengeringan atau pendingin sayuran ikan. Berikut video 1 tentang beberapa penerapan panel surya. Selain video 1, energi matahari dapat digunakan apa saja disekitar tempat tinggalmu? Jawab: https://rb.gy/o58cts
2. Power plants (Work process of power plants, equipment at the power plant and types of power plants).	**Ethnoscience**: existing power plants in South Sumatra: 1. Hydro Power Plant (HPP)/ Micro Hydro Power Plant (MHPP) Figure 1: Komering Jaya MHPP Video 1: Hydro Power Plant 2. Rantau Dedap Geothermal Power Plant (GPP) Figure 2: GPP Rantau Dedap Video 2: Geothermal Power Plant 3. Mulut Tambang Steam Power Plant (SPP) Figure 3: Mulut Tambang SPP Video 3: Steam Power Plant 4. Musi Green Hybrid Solar Power Plant (SPP) Gambar 4: Musi Green Hybrid Solar Power Plant Video 4: Solar Power Plant 5. Gas Power Plant (GPP) in Borang, Banyuasin. Gambar 5: Gas Power Plant (GPP) in Borang, Banyuasin Video 5: Gas Power Plant	 Sungai Musi adalah sungai terpanjang yang ada di Indonesia, sungai ini merupakan sungai lintas provinsi yang mengaliri wilayah provinsi Bengkulu dan Sumatera Selatan. Dengan panjang 720 km, sungai ini membelah kota Palembang menjadi dua bagian, yakni bagian ilir dan ulu. Kedua bagian tersebut dihubungkan oleh Jembatan a Palembang dan tiga jembatan lainnya. Sejak zaman kerajaan Sriwijaya hingga sekarang, sungai ini terkenal sebagai sarana transportasi utama bagi masyarakat. Hulu Sungai Musi berada di Bukit Kelam, sekitar 15 kilometer dari Curup, ibu kota Kabupaten Rejang Lebong, Provinsi Bengkulu. Air sungai Musi di titik paling awalnya memancar dari dasar tebing di Bukit Kelam, dengan lebar 5 meter dan kedalaman semata kaki, dengan dasar berupa batu-batu kerikil. Air dari tebing tersebut turun ke arah tenggara dan semakin membesar setelah menyatu dengan air dari sumber-sumber lain, termasuk puluhan anak sungai, dan mengalir hingga 720 km panjangnya sebelum bermuara ke Selat Bangka. Bagian hulu sungai ini dalam kebudayaan Rejang dikenal sebagai Luak Ulu Musi. *Sumber :* https://id.wikipedia.org/wiki/Sungai_Musi Pemanfaatan energi air menerapkan konsep energi potensial gravitasi. Energi mekanik aliran air digunakan untuk menggerakkan turbin atau kincir air sehingga mampu membangkitkan energi listrik. Video 2 merupakan penerapan energi air.  Gambar 2. Sungai Musi sebagai sarana transportasi https://tinyurl.com/uw8e4rns 

	Video 6: wind power plant	
3. The impact of limited energy and the use of alternative energy.	**Ethnoscience:** the use of alternative energy in South Sumatra: The use of biogas as stove fuel Video 1: biogas management process Video 2: biodiesel management process Video 3: bioethanol management process	
Projects about making products related to alternative resources as solutions for non-renewable resources in Indonesia, such as: 1. Hydropower Plant 2. Wind Power Plant 3. Solar Power Plant	Various power plants in South Sumatra 1. Hydropower Plant 2. Solar Power Plant 3. Wind Power Plant	Students are directed to make projects related to the manufacture of Hydro Power Plants (HPP), Wind Power Plants (WPP), and Solar Power Plants (SPP). A project planning schedule form is provided. A process monitoring form for the project is provided. Directions and product assessment forms are provided 
Nonrenewable resources		Cognitive test assessments are provided, questions about project activities that have been carried out are provided, and a suggestion column for the next project activity is also provided.

3.3 Development

There are several activities at this stage, including: Expert test of product validity which is assessed by 2 content expert lecturers and 2 Media Expert Lecturers. All comments and suggestions from content expert lecturers and media experts have been revised by the researcher. The following are the results before and after the revision of the ethnoscience-based interactive e-module product.

Table 5. Product Revision Results

No	Before Revision	After Revision
1	Micro Hydro Power Plant 	MHPP in Belitang 
2	There is no source for every quoted image  Gambar 5. Penggunaan Gas Alam sebagai bahan bakar kompor gas di Palembang	Source has been added to each image quoted  Gambar 5. Penggunaan Gas Alam sebagai bahan bakar kompor gas di Palembang *Sumber:* https://sumatra.bisnis.com/read/20191129/534/1175821/berkah-gas-bumi-bagi-umkm-di-lumbung-energi

Validation results from content and media experts.

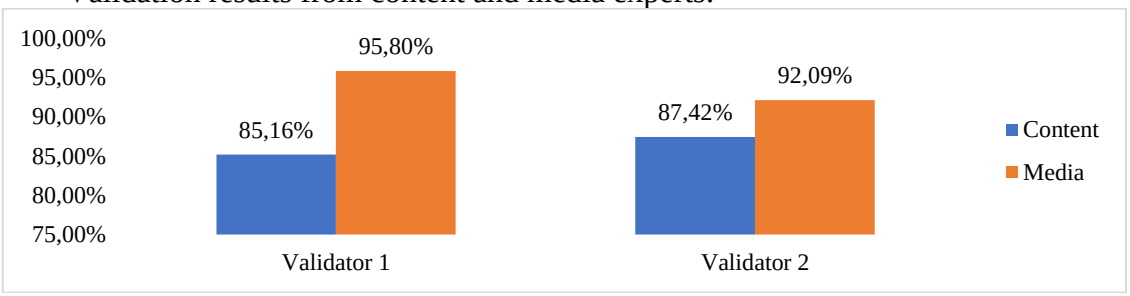

Figure 2. Instrument Validation Results

The results of the students' responses to the interactive e-module.

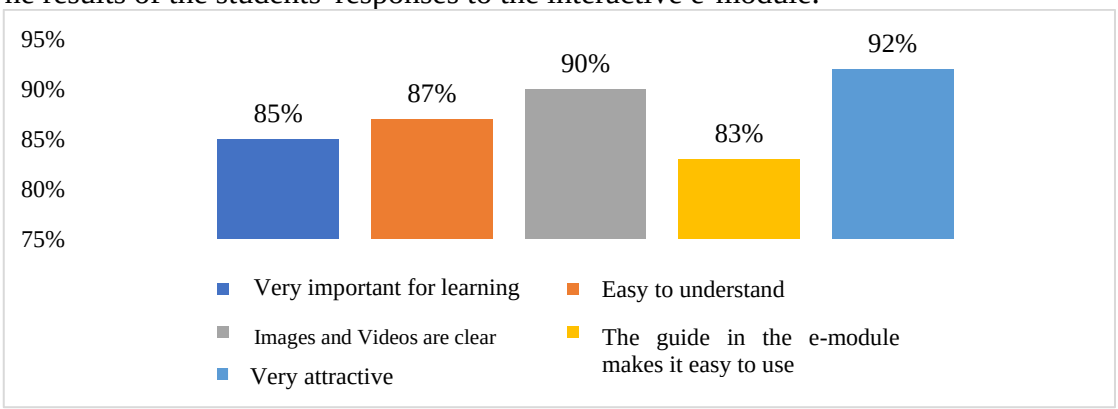

Figure 3. Students' Response

The results of this study state that e-module is feasible to be applied in learning because core competencies, basic competencies, and ethnoscience are clear in each part. The results of student responses are also very high (very good) on each indicator. This shows that interactive e-module is needed by students. Moreover, some studies also stated that interactive e-module makes students more enthusiastic in learning it makes it easier for them to understand concepts [25], [26]. Moreover, the development of interactive e-module supports learning theory which includes four components including Behavioristic, Cognitive, Constructivism, & Humanistic [27]–[30]. This interactive e-module presents material based on the realities of life experienced by students on a daily basis, so that students will understand the non-renewable resources that we have, it is hoped that students will be wiser in using the next energy source. This process is in accordance with the behavioristic learning theory. In cognitive theory, this e-module is equipped with information that can increase the cognitive level, besides, cognitive measurements are also presented in the form of multiple choice questions. Furthermore, the theory of constructivism is related to the discovery of students' talents. In this e-module, not only pictures and videos are provided, but also projects are provided to stimulate students to discover talents. Finally, the humanistic theory is also instilled in students through this e-module, with ethnoscience descriptions, it is hoped that students will be able to think positively about the potential that exists in their area so that they can be developed later.
The findings of this study confirm the findings of several previous studies, that modules that are integrated with ethonscience can provide students with insight into their regional sciences [11], [20], [21]. However, like other man-made products, this product still has its drawbacks. Because this product is distributed online, students need internet access, and when used offline, its functionality is not optimal. But of course, schools and governments can facilitate this.

4. CONCLUSION

From this research, an ethnoscience-based interactive e-module on the topic of non-renewable energy was successfully developed. The results showed that the interactive e-module was declared feasible to be applied in learning by experts with a percentage above 75%. Student responses to this product are also above average, with a percentage above 75%. So interactive e-module is stated to be very interesting and suitable for use in learning. The conclusion in this study is that the interactive e-module developed is valid and can be applied in learning. For further research, it is hoped to develop e-modules on different topics.

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