



## **Analysis of the Need for Development of Physics Electronic Modules using the Kaili Ethnic Culture Approach**

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**Abstract:** *The main challenge in physics education is the assumption by students that the material is difficult and abstract, and this is exacerbated by the threat of globalization to the preservation of local wisdom. The purpose of this study is to describe the needs analysis for the development of an electronic module on temperature and heat based on ethnoscience (Batik bomba) of the Kaili tribe culture for 11th grade MIPA students. The research used the 4D Research and Development (R&D) model. This research was in the define stage and used descriptive data analysis techniques. The research was conducted as a survey, with data collected through a needs analysis questionnaire for physics teachers and 38 grade XI high school students in Central Sulawesi. The results show that 100% of teachers need more interesting and contextual teaching materials, while 50% experience difficulties in developing independent modules. From the students' perspective, 88% want to learn the application of physics in real life, and 85% are motivated by examples of applications in local culture. The identified needs include: (1) the development of ethnoscience modules that integrate the local culture of Kaili (Bomba Batik Weaving), (2) the strengthening of practical learning, and (3) the availability of digital learning resources (e-modules). Based on these findings, the development of Kaili Ethnic Science electronic modules is urgently needed as a solution to overcome teaching obstacles while fostering positive attitudes and appreciation for local culture.*

**Keywords:** *electronic modules, ethnoscience, needs analysis, research and development, temperature and heat*

## **Analisis Kebutuhan Pengembangan Modul Elektronik Fisika dengan Pendekatan Kebudayaan Suku Kaili**

**Abstrak:** Tantangan utama dalam pendidikan fisika adalah anggapan peserta didik bahwa materi di dalamnya sulit dan abstrak, dan semakin parah dengan ancaman globalisasi terhadap pelestarian kearifan lokal. Tujuan penelitian ini yaitu mendeskripsikan analisis kebutuhan untuk pengembangan modul elektronik materi suhu dan kalor berbasis etnosains (Batik bomba) kebudayaan suku Kaili untuk peserta didik kelas XI MIPA. Penelitian menggunakan *Research and Development* (R&D) model 4D. Penelitian ini merupakan tahap define dan menggunakan teknik analisis data deskriptif. Penelitian yang dilakukan merupakan penelitian survey, dengan data dikumpulkan melalui angket analisis kebutuhan terhadap guru fisika dan 38 peserta didik SMA kelas XI di Sulawesi Tengah. Hasil menunjukkan bahwa 100% guru membutuhkan bahan ajar yang lebih menarik dan kontekstual, sementara 50% mengalami kesulitan dalam pengembangan modul mandiri. Dari sisi peserta didik, 88% ingin belajar aplikasi fisika dalam kehidupan nyata, dan 85% termotivasi oleh contoh aplikasi dalam kebudayaan lokal. Kebutuhan yang teridentifikasi meliputi: (1) pengembangan modul etnosains yang mengintegrasikan budaya lokal Kaili (Tenun Batik Bomba), (2) penguatan pembelajaran praktikum, dan (3) ketersediaan sumber belajar digital (e-modul). Berdasarkan temuan ini, pengembangan modul elektronik Etnosains sangat diperlukan sebagai solusi untuk mengatasi hambatan pengajaran sekaligus menumbuhkan sikap positif dan apresiasi terhadap budaya lokal.

**Kata kunci:** analisis kebutuhan, etnosains, modul elektronik, *research and development*, suhu dan kalor

## INTRODUCTION

Globalization poses a serious challenge for Indonesia, a country with many cultures and customs. In this era of globalization, information and foreign cultures are rapidly entering the country and influencing various aspects of life. Globalization can gradually distance and erode the cultures that surround individuals. In addition, the impact of globalization can affect various aspects of life, including education, which is required to develop 21st-century skills (Riskayanti, 2021).

Culture and education influence each other because education and culture are closely intertwined. Education cannot be separated from culture; without the process of education, it would be impossible for culture to exist and develop. The process of education is nothing more than a process of cultural transmission (Andriansyah, 2024). We must be able to take advantage of globalization in order to compete and not be left behind in this era of digitalization, especially in the field of education, by utilizing it as a method that is considered effective in today's world. Improving students' ability to think and create caring and reliable characters in society will indirectly enable education to create a society that is ready to face the changes brought about by globalization (Munandar et al., 2022).

Education is essentially a conscious effort to nurture and develop human resources, especially students, by guiding and facilitating their learning activities (Astalini et al., 2018). Education is the spearhead of a nation's civilization development, consciously nurturing human resources through the learning process (Muna, 2017). Education is one of the tools that plays an important role in human awareness, especially in a country (Debrah et al., 2021). In the context of good education, effective learning processes are essential for developing students' skills and knowledge. This learning aims to generate interest among students, enabling them to engage with concepts that stimulate the development of their thoughts, ideas, principles, and skills in thinking and design, ultimately helping them become productive individuals (Mawaddah & Maryanti, 2016).

Learning is a process within a structured system that is planned, designed, implemented, and evaluated to facilitate learners in achieving learning objectives effectively and efficiently. It is also an activity that produces changes in information, transforming learners from ignorance to knowledge through interaction between teachers and learners (Saleh et al., 2023). The nature of learning and education needs to be studied in depth. Learning is defined as a conscious activity undertaken by an individual through experience or practice, which results in behavioral changes, including knowledge, attitudes, and skills (Faizah, 2020). Learning is a process that involves many interrelated aspects. Therefore, to create good learning, it is necessary to pay attention to the following skills: learning skills and teaching skills (Andriyani, 2022). One of the main subjects in the education curriculum is physics. Physics is often considered an abstract and complex subject, leading students to assume that the material is difficult to understand, which results in a lack of interest in learning physics.

Physics is a branch of natural science that emphasizes mastery of concepts. In physics learning, students mastery of concepts can be demonstrated through a good understanding of the material. Physics is a science whose fundamental learning objective is to guide students in developing the experience to formulate problems (Kulsum & Nugroho, 2014). Physics consists of abstract and complex concepts and principles, which often results in students' knowledge being incomplete. In physics learning, conceptual understanding is a very important part. Conceptual understanding is something that needs to be developed and must receive serious attention in the learning process (Sari et al., 2018).

A good learning process will enable students to understand physics concepts (Widayanti et al., 2021). Students' existing conceptual understanding will greatly help them solve problems encountered in life (Molamahu et al., 2025). In studying physics, the main thing needed is conceptual understanding. The concepts taught will form the basis for the development of further concepts. If the basic concepts received by students are not well understood, it will have an impact on their understanding of subsequent concepts. This will result in students having a poor understanding of the concepts (Sartika et al., 2025).

Physics is one of the essential sciences that forms the basis for the development of science and technology. Given the importance of physics, it is only natural that students should have a strong understanding of it. However, students often encounter obstacles in their efforts to learn physics, as it is generally considered a difficult subject to understand (Ma'rifa et al., 2018). In physics learning, understanding concepts and answering questions is not enough to master the material (Nurroniah et al., 2025). Therefore, physics is synonymous with difficult lessons and abstract concepts. These characteristics of physics are expected to be utilized to familiarize students with and develop their basic thinking skills, leading to higher-level thinking skills (Husein et al., 2015). Innovation is needed in delivering material so that concepts that are considered abstract can be linked to students' real experiences, thereby increasing their interest in learning.

The Kaili tribe's culture is one that educators can incorporate into their teachings. The Kaili are an ethnic group or indigenous tribe of Palu City. The Kaili are considered one of the largest ethnic groups in Central Sulawesi Province, spread across almost the entire region, because in addition to inhabiting Palu City, there are several other areas where the Kaili ethnic group is spread out, including Sigi Regency, Donggala, Parigi Moutong, parts of Poso, and North Mamuju in West Sulawesi Province (Firmansyah & Rusady, 2023). It contains the culture of bomba batik weaving, which can be incorporated into the learning process. Bomba batik is a traditional woven fabric that still uses traditional techniques and natural dyes (Nuraedah & Bakri, 2017). The integration of the bomba batik weaving process into physics lessons enables students to understand the application of science in their own cultural heritage.

Based on the background description presented above, it is clear that the first step that needs to be taken is to analyze the need for an approach that is not only effective but also capable of creating meaningful learning for students. In addition, integrating local cultural values into teaching materials is another important consideration as a form of contribution to efforts to preserve the heritage around the school. By conducting a needs analysis, researchers can analyze the obstacles and desires from the perspective of both educators as facilitators and students as learners. They can then determine strategies for how specific learning can bridge the gap between physical concepts and the realities encountered.

## **METHOD**

The research conducted is a type of research and development (R&D), with models 4D. This research was conducted on February 11-20, 2025. The subjects of the research were physics teachers and grade XI MIPA students at two high schools in Central Sulawesi. A needs analysis questionnaire was distributed to two physics teachers (one teacher at SMA Negeri 2 Palu and one teacher at SMA Negeri 3 Poso) and 38 grade XI students as respondents. This research is the needs analysis stage of the overall R&D process (Sugiyono, 2018). This study uses 4-D, which includes the stages of defining, designing, developing, and disseminating. This technique and model were chosen

because they aim to produce a product. The 4D development model was chosen because it is programmed in a series of scientific activities to solve learning problems in accordance with the desires and characteristics of the students. The data collection technique used was a questionnaire, which was given to teachers and students to identify field needs and existing problems, using the Guttman scale, as shown in Table 1.

**Table 1.** Rating Scale

| Scale | Rating |
|-------|--------|
| 0     | No     |
| 1     | Yes    |

Next, using the data obtained, the percentage of requirements for each question item from the needs analysis instrument used in the study can be calculated. The calculation is done using the following Equation (1).

$$P = f/N \times 100\% \quad (1)$$

Where, for formula (1),  $P$  is the assessment percentage,  $f$  is the score obtained, and  $N$  is the overall score (Sahara et al., 2022). This yields a percentage for the needs analysis data, which can be seen from each question item.

## RESULTS AND DISCUSSION

Research data was collected through questionnaires distributed to a number of respondents. The research subjects were two high school teachers at two schools and a total of 38 students in grade XI. Data collection from two different perspectives (educators and students) aimed to obtain a more comprehensive and complete picture of what was being studied. Based on the processing of data from the responses provided by all participants, the following research findings were obtained.

### Results of Teacher Needs Analysis

The needs analysis conducted on physics teachers, consisting of two physics teachers at SMA 2 Palu and SMA 3 Poso, showed the results obtained from the questionnaire distributed with five aspects of needs analysis, namely the availability of learning resources, teaching methods, supporting facilities, challenges in teaching, and the need for teaching material development. Several questions were asked for each aspect of the needs analysis, as shown in Table 2.

**Table 2.** Summary of Teacher Needs Analysis Results

| Aspect                             | Results   |
|------------------------------------|---|
| Availability of Learning Resources | 100% of teachers teach heat in physics lessons<br>100% of teachers have textbooks/handbooks other than student textbooks<br>Do not yet have ethnosience-based textbooks<br>100% of teachers use other teaching materials (modules, videos, teaching aids)<br>100% of teachers use modules to teach about heat<br>50% of teachers create their own modules<br>100% of teacher modules need improvement |
| Teaching methods                   | 50% of teachers use special methods.<br>100% of teachers encourage students to conduct experiments.<br>100% present phenomena in learning.<br>100% of teachers encourage students to ask questions.<br>100% of teachers implement PBL.<br>50% of teachers experience difficulties implementing PBL.   |
| Supporting Facilities              | 100% Has laboratories and libraries to assist   |

| Aspect                              | Results  |
|-------------------------------------|--|
|                                     | 100% Has heat experiment equipment in the lab<br>100% The library provides adequate references   |
| Challenges in Teaching              | 50% of teachers have difficulty teaching heat.<br>100% of students' motivation and abilities influence learning success.<br>100% of students are enthusiastic about learning about temperature and heat. |
| Teaching Material Development Needs | 100% of teachers need more interesting teaching materials<br>100% of teachers agree with the development of ethnoscience modules   |

Based on Table 2, it can be emphasized that there is a need for module development: although teachers recognize the importance of PBL (Problem Based Learning) and local context (ethnoscience), the lack of structured resources hinders effective implementation and further distances students from the surrounding culture Table 2 also shows that teachers need improvement in learning resource indicators because there are questions that teachers have not addressed at all.

### Results of Student Needs Analysis

The results of the questionnaire distributed to 38 grade XI students produced data similar to the teachers' need for more contextual and technology-based learning. Which uses five specifications of needs analysis covering aspects of learning material suitability, learning methods, learning resources, support from teachers, and learning motivation. This is represented by several questions in each aspect. The results are shown in Table 3.

**Table 3.** Summary of the Student Needs Analysis Results

| Aspect                                | Results  |
|---------------------------------------|--|
| Appropriateness of Learning Materials | 92.11% feel that the material currently being taught is appropriate for the needs of students.<br>57.89% need additional material to better understand physics concepts.<br>89.47% want to learn more about the application of physics in everyday life, such as in the surrounding culture.   |
| Learning Methods                      | 97.37% feel that the current learning methods are effective for understanding the material.<br>97.37% prefer learning that involves experiments and hands-on practice.<br>84.21% feel that there needs to be variety in learning methods (e.g., group discussions, presentations, etc.).   |
| Learning Resources                    | 97.37% feel that the available learning resources (books, modules, videos, etc.) are sufficient to support physics learning<br>73.68% want access to additional learning resources (e.g., e-modules, instructional videos, etc.)   |
| Support from Teachers                 | 92.11% feel that additional support from teachers is needed to understand physics material.  |
| Motivation to Learn                   | 92.11% feel more motivated to learn physics if there are real-world applications, such as from culture, for the concepts being taught.<br>94.74% feel more interested in learning physics when the material being taught is related to phenomena that occur in the surrounding cultural environment.<br>92.11% want to see more examples of physics applications related to local culture in learning. |

Based on the analysis of teacher data in Table 2, teachers do not yet have ethnoscience-based textbooks. 100% of teachers need more interesting teaching materials. Technology can engage students by providing interesting teaching materials. Books with colorful and attractive illustrations can make students interested in reading enrichment books and illustrations (pictures) in accordance with the pictures presented

(Wahyuningsih et al., 2024). 100% of teachers agreed with the development of ethnosience modules, because 50% of teachers had difficulty creating their own. The development of structured, visually appealing, and contextual modules became crucial. 50% of teachers had difficulty implementing PBL, problem-based learning, which is student-centered learning, but still had difficulty implementing it in the classroom. PBL is a student-centered learning model.

The PBL model is a student-centered learning model. Students need to adapt to situations where they become the main subjects in the learning process (Ardianti et al., 2021). The application of student-centered learning models is expected to increase active engagement in the classroom and transform the role of teachers into facilitators. By integrating ethnosience into PBL syntax, contextual issues from local culture can become an effective stimulus in triggering students' curiosity. One aspect that can be developed in learning is modules. Modules integrated with ethnosience in problem-based learning are very suitable for implementation. Ethnosience provides contextual problems from local cultures that can be presented by educators and serve as the basis for implementing PBL syntax, thereby increasing student activity and attracting students. In a study conducted (Manggul & Pratiwi, 2025) the lack of learning resources that encourage analytical thinking is one of the factors causing low critical thinking skills among students. Resources that are not interactive and do not encourage them to investigate problems make students more passive.

Table 3 shows that, in general, students feel that they have adequate access to learning resources to support their physics learning process. However, there are some interesting findings that can be highlighted, namely, 97.37% prefer learning that involves experiments and hands-on practice, indicates that despite the availability of learning resources, there is a need for interactive learning resources that are able to connect physics theory to the surrounding cultural environment, and 94.74% feel more interested in learning physics when the material taught is related to phenomena that occur in the surrounding cultural environment. 92.11% feel more motivated to learn physics if there are real-world applications, such as from culture for the concepts being taught. And 92.11% want to see more examples of physics applications related to local culture in learning. This indicates that students are more motivated when their learning involves and relates to the surrounding culture or local culture that is closer to them. In line with the research conducted by (Sahara et al., 2022). The same applies to the research conducted (Djarwo et al., 2025) this approach makes students more critical in utilizing digital resources, better able to connect theory with real-world practice, and more motivated to explore learning in greater depth. Incorporating ethnosience learning or approaches into learning materials can have an impact on student engagement, making students more enthusiastic about exploring concepts independently, thereby increasing their motivation to learn.

The implementation of the problem-based learning model is considered to be a relevant and effective solution when integrated with the ethnosience approach. The integration of the two can create learning that is not only oriented towards solving technical problems, but also rooted in contextual local wisdom values for students. This is because the syntax in PBL is centered on students, encouraging them to explore learning with phenomena around them. Through this integration, it is hoped that students' attitudes towards physics will change, and their activity and enthusiasm in learning will increase. The ethnosience approach, which is also integrated into PBL, plays a role in changing students' mindset towards the negative stigma of learning, as physics has often been viewed as a rigid, boring, and abstract discipline. By establishing the connection

between the principles of physics and cultural practices in the surrounding culture, students will realize that physics is very relevant and applicable, so that the gap between academic theory and real life can be bridged effectively.

## CONCLUSION

Based on the results of the needs analysis that has been conducted, this study successfully identified various fundamental problems in physics learning in the era of 21st century education. The main challenge found is rooted in the strong negative stigma among students who consider physics to be a very abstract and difficult subject to understand. This condition is exacerbated by the limited learning resources available to bridge the gap between theoretical scientific concepts and the reality of students' daily lives. Therefore, these findings explicitly point to the need for more structured and applicable teaching materials that are able to integrate students' knowledge and local wisdom (culture) into the formal science framework.

Furthermore, the findings of this study confirm that the current transformation of education requires a learning model that is not only contextual and digitally based, but also capable of stimulating students' independent activity. As a strategic step, the development of ethnoscience-based electronic physics modules (E-modules) presents an innovative solution to overcome these instructional barriers. Through this approach, learning no longer feels foreign to students because it is based on cultural values that they recognize. The implementation of these ethnoscience-based E-modules is projected to be effective not only in improving cognitive understanding and learning effectiveness, but also in playing an important role in fostering a positive attitude among students towards physics while preserving local cultural identity amid the tide of modernization.

## ACKNOWLEDGEMENTS

The author would like to express his gratitude to the Master of Physics Education program, Faculty of Teacher Training and Education, Sebelas Maret University, for the academic support provided so that this research could be carried out successfully. The author would also like to thank the editor and reviewers of the Kasuari Physics Education Journal (KPEJ) for their suggestions and input, as well as for the opportunity to publish this article. And at the schools where the research was conducted, namely Palu High School 2 and Poso High School 3.

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