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Preminilary Study of E-modul Based on Ethnoscience Lake Ranau to Improve Literacy skills of Students on Renewable Energy Topic

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Abstract: This study aims to identify the needs in the physics learning process from the perspectives of students and teachers. A survey method was used by distributing questionnaires to 184 students and 40 physics teachers in South Sumatra, selected through purposive sampling. The results show that students better understand physics when it is related to natural phenomena and everyday life, such as renewable energy. However, they face challenges with formulas, scientific terms, and connecting concepts to real-life contexts. Both students and teachers agree that integrating ethnoscience into physics learning can effectively enhance scientific literacy. All participants stated the need for learning resources that incorporate ethnoscience from Lake Ranau in Ogan Komering Ulu, South Sumatra. Based on these findings, an e-module was developed featuring concise explanations, visual elements, videos, interactive quizzes, and practical experiment activities. The results indicate the importance of developing an ethnoscience-based e-module to improve students' literacy in the topic of renewable energy.

Keywords: E-modul; Enthoscience; Lake Ranau; Literacy skills; Renewable Energy Topic

Introduction

Science education in the 21st century demands a learning approach that not only focuses on mastering theoretical concepts but also on developing critical thinking, problem-solving, collaboration skills, and awareness of global issues such as climate change and the energy crisis (Lestari, Novika; Fitriani, 2016). In the context of physics education, students often face difficulties in understanding abstract and complex material due to the lack of connection between the lessons and real-life situations (Yunita & Hamdi, 2023). This disconnection contributes to low learning motivation and scientific literacy, especially in topics related to renewable energy, which plays a vital role in achieving the Sustainable Development Goals (SDGs) (Akhsan et al., 2021; Nurvita et al., 2022). The limited integration of local contexts in physics education further widens the gap between students and their surroundings, even though the environment is rich with potential as a source of learning (Lohr, 2014; Yunita & Hamdi, 2023). Therefore, a more contextualized approach, grounded in students' experiences, is urgently needed to create meaningful physics learning.

Ethnoscience-based learning offers a promising alternative to address these challenges. Ethnoscience integrates scientific concepts with local wisdom, thus bridging the gap between modern science and indigenous culture (Acciaoli, 2001; Ardilafiza et al., 2021). This approach not only enhances students' understanding of science but also fosters a sense of ownership of their culture and environment (Blanchet-Cohen & Reilly, 2013; Cosquer et al., 2012; Zsóka dkk., 2013). Given Indonesia's rich cultural heritage and biodiversity, this approach is highly relevant and valuable. In physics education, ethnoscience enables

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students to observe the application of scientific concepts in everyday community practices, such as traditional uses of renewable energy, local irrigation systems, and sustainable resource management by indigenous peoples (Kriewaldt & Lee, 2023). Integrating local culture into science curricula has also been shown to increase student engagement and motivation, as learning becomes more relatable and meaningful.

Exploring the potential of local wisdom in physics education involves utilizing the surrounding environment as an authentic and contextual learning resource. One area rich in natural and cultural resources is Lake Ranau, located in Ogan Komering Ulu Regency, South Sumatra Province. The lake offers not only ecological potential but also valuable cultural knowledge held by the local community that can be integrated into physics learning—particularly in renewable energy topics. Highlighting this potential in the classroom can deepen students' understanding of science while also fostering environmental awareness. Unfortunately, this local potential has not been widely utilized as a learning resource in physics education.

Previous research emphasized the importance of ethnoscience-based education in improving critical thinking and high-level skills in students. For example, Fadilah et al., (2019) linked science concepts with Jambi Malay customary processions, while Sunarsih et al., (2020) developed an effective local potential-based biodiversity module used at SMAN 1 Kertek. Irfandi et al., (2023) found that combining ethnoscience with learning management systems (LMS) improved student learning outcomes. Martawijaya et al., (2023) reported that the Ethno-STEM-PjBL learning model improved understanding of physics concepts and higher-level thinking skills. Meanwhile, students Wahyudi et al., (2023) reported significant improvement in critical thinking skills when they were given a hybrid approach (Ethnoscience-PjBL). However, the development of more innovative and relevant learning approaches to the local context is still very limited (Jufrida et al., (2019). Whereas more contextual learning can improve high-level thinking skills (Akhsan et al., 2020b, 2020a) and reduce misconceptions of physics learning (Akhsan et al., 2023). As a solution, ethnoscience-based models can be an innovative and relevant source of learning.

Several studies have also shown that the use of technology, including e-modules, can increase student engagement and motivation to learn. Apriansyah et al., (2024) reported ethnoscience-basede-modules on the biodiversity of Bugis medicinal plants are valid and practical with a practicality percentage of 85% to 94%. Furthermore, the ethnoscience-based electrical module in primary schools led to a significant increase in the level of student patriotism with an increase in point scores of 30 points reported by Ardianti et al (2023). However, there has been no research that specifically examines the effect of ethnoscience-based e-modules in the context of physics and environmental education, especially on ranau lakes.

Based on the results of the distribution of questionnaires conducted by researchers, of the 166 students from South Sumatra Province, 98.2% had heard of Lake Ranau, and 71.1% of them had visited Lake Ranau. However, only 77.7% of students aim to travel, while 12% only take pictures, and 10.2% for educational purposes. Ethnoscience learning in students in South Sumatra has great potential in improving their understanding of physics concepts and concern for the environment. Therefore, a combination of local wisdom and physics concepts is needed in the development of ethnoscience-based e-books, which have great potential to improve students' understanding of physics concepts while strengthening their environmental awareness (Hadi et al., 2019; Net et al., 2024; Rachman et al., 2022). By incorporating the local wisdom of Lake Ranau into renewable energy topics, it is intended that students will gain a more comprehensive understanding of physics concepts alongside an increased sensitivity toward environmental conservation

This study aims to develop an ethnoscience-based module as a physics learning tool that can improve the understanding of physics concepts and environmental awareness of high school students, especially in the context of Lake Ranau. However, before that, it is necessary to analyze the needs both from the point of view of teachers and students related to the development of ethnoscience-based e-modules on increasing students' literacy on renewable energy topics.

Method

The research was conducted in March 2024 involving 184 high school students and 40 physics teachers. The sample was selected using purposive sampling, which is a sample determination technique with certain considerations such as the quality of respondents (Creswell & Poth, 2018). The research that has been conducted is a survey study. This type of research is a data collection technique carried out by compiling a list of questions or statements in the form of questionnaires submitted to respondents as research samples. The data collected from the survey were then statistically analyzed to draw research conclusions.

Data collection was carried out using a closed questionnaire made by modifying answers with 4 available answer choices. The questionnaire used in this study was given through a Google form sent to respondents. The questionnaire was made by compiling several statements related to the analysis of physical learning characteristics, the use of technology in learning, learning resources and media, project-based learning, renewable energy topic, e-module content needs, learning independence, evaluation, and assessment, and the integration of ethnoscience in the learning process. These things will provide an overview to researchers related to the products that will be developed to suit the needs of students and teachers. Data analysis was carried out quantitatively using the calculation of the number of respondents' answers in one item divided by the number of respondents then presented. The results of the questions from the survey are presented in the form of tables and diagrams to illustrate the pattern of respondents' responses, then draw relevant conclusions.

Result and Discussion

Research related to the needs analysis of the development of an E-Module Based on Lake Ranau Ethnoscience to Improve Learner Literacy on Renewable Energy Topic has been carried out. In this study, information related to the analysis of student characteristics, curriculum analysis, and the implementation of the learning process was obtained. The results of the analysis related to the data that has been obtained in detail are described as follows.

Aspects of Physics Learning Characteristics

The initial information obtained is related to students, especially about their perspectives on physics learning. The information includes three aspects, including other interests in learning physics, preferred learning methods, and difficulties faced. The results are shown in Figure 1.

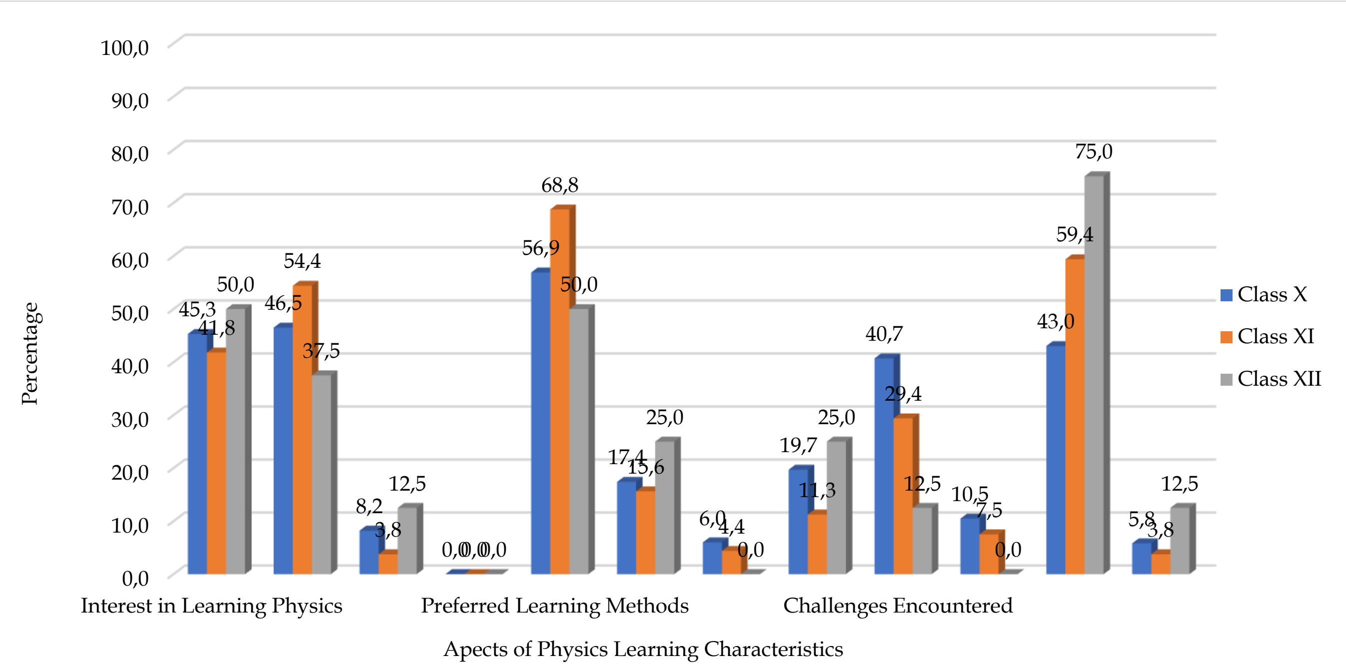

Figure 1. Physics Learning Characteristics

Based on Figure 1, the results vary greatly among students at each level. In the aspect of interest in learning physics, students in class XII showed better interest in learning physics because they enjoyed understanding natural phenomena compared to the other two classes. The class X in the second position is quite interested in physics learning, especially on certain topics. Finally, class XI is less interested because the material is difficult to understand. This is by the density of the material at each level. In the curriculum, the distribution of material at each level has a significant difference compared to the previous curriculum. Class X includes only 3 main topic, namely measurement, renewable energy, and global warming. The class XI has fairly dense material ranging from kinematics, dynamics, fluids, temperature, and heat and thermodynamics. Whereas in class XII the material is more specific to the concepts of electricity, magnetic fields, and modern physics.

Then the most preferred way of learning by students is through hands-on practicum/ experiment activities. This is because through practicum activities students can be directly involved in the learning process, besides that collaboration activities between students are also built (Pamungkas et al., 2017). In addition, learning activities through practicum can develop students' process skills (Kurnianto et al., 2010).

However, if during the learning process, there is only one activity, namely practicum, it will have an impact on good affective learning outcomes. Meanwhile, students' high or low abstract thinking skills did not show a significant increase (Pamungkas et al., 2017). So that the learning process must be carried out by combining various ways of learning so that the learning dynamics feel fun for each student.

The results showed that watching videos directly and listening to the teacher's explanation became the preferred way of learning for students. This shows that although many ways of learning are available, the teacher's explanation given directly is still one of the preferred ways by students. Direct explanation allows students to get information directly and accurately on the material presented (Sevtia et al., 2022). Then reading books or learning modules becomes the choice of the way of learning that is least preferred by students. This is because usually teachers in class only provide conventional learning modules or topic in printed form (Wati et al., 2017). The module only contains writing, pictures, formulas, and practice questions so it becomes very boring and does not attract students to read the given module. The presence of modules as learning resources should be a good variation in the learning process and will help students understand the material delivered by the teacher (Korkmaz, 2018; Zulherman et al., 2021).

These results are supported by the information obtained further related to the difficulties faced by students in the physics learning process. The majority of students find it difficult to understand physics learning because of formulas and calculations, it is difficult to understand scientific terms, and it is difficult to associate concepts with everyday life. Even though physics is one of the disciplines that does not contain scientific formulas, calculations, and terms. However, many things can be explored and associated with students' daily lives so that learning becomes more meaningful. Like applying the local culture that exists around students (Nazhifah et al., 2022; Wiyono et al., 2024).

Ethnoscience aspects in learning

The next aspect of the needs analysis questionnaire is the need aspect of ethnoscience-based modules in physics learning. This aspect is viewed from the perspective of the field of teachers and students. The results of the analysis can be seen in Figure 2 below.

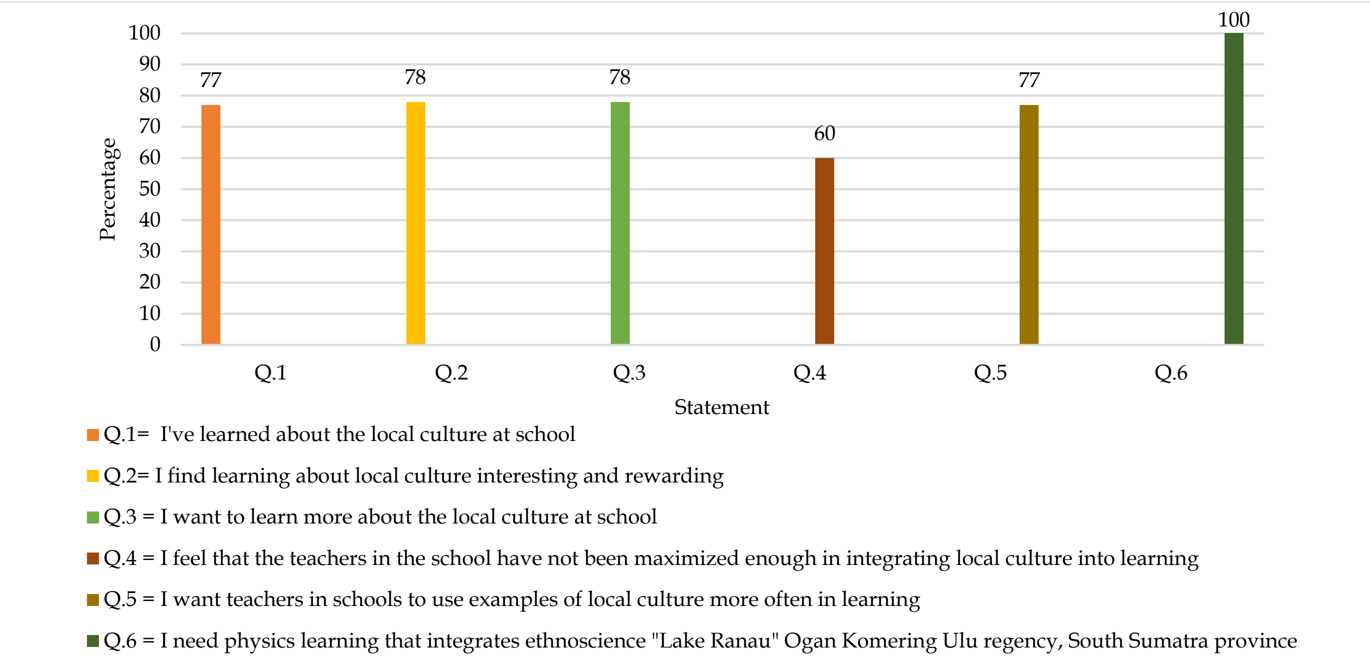

Figure 2. The results of the student perspective questionnaire related to ethnoscience in learning

Based on Figure 2, it was found that as many as 77% of students stated that they strongly agreed that they had learned about local culture at school. A total of 78% strongly agree that learning about local culture is interesting and useful. Then 78% of students want to learn more about local culture at school. The application of ethnoscience in the learning process can present fun learning because it provides examples of material relevant to the daily lives of students (Wiyono et al., 2024). It also supports students to make it easier to understand the material and think more critically about various things around them (Mulatsih et al., 2023). However, this has not been supported by the resources of teachers in schools. Based on the results of the analysis, as many as 60% of students believe that teachers in schools have not maximized enough in integrating local culture into learning. Students want teachers in schools to use examples of local culture more often in learning. These results are inversely proportional to the teacher's point of view which can be seen in Figure 3.

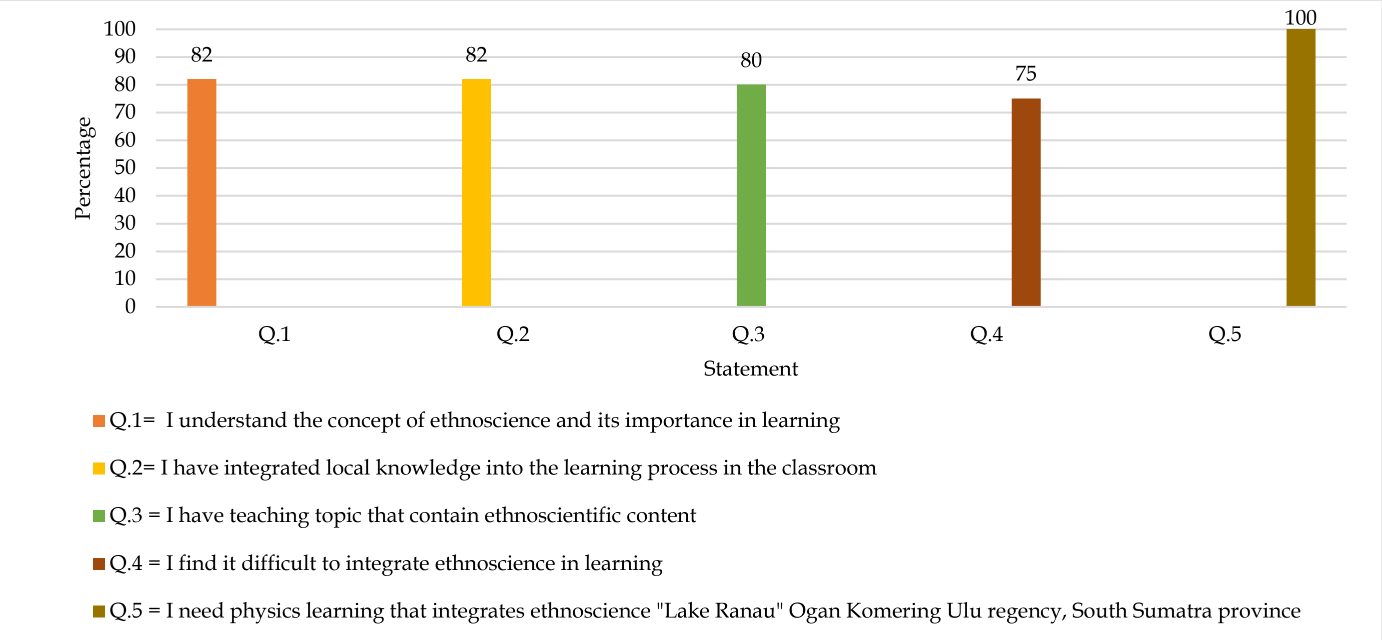

Figure 3. The results of the teacher perspective questionnaire related to ethnoscience in physics learning

Based on these data, it can be seen that according to their teachers, they have integrated local knowledge into the learning process in the classroom. These results are certainly different from the perspectives of students that have been conveyed previously. This can happen due to several reasons, one of which is that the concept of local knowledge conveyed by the teacher has not been properly conveyed to students. Then the local understanding conveyed is less relevant to the lives of students. For example, the majority of students come from South Sumatra, but the local knowledge integrated into the learning process is local wisdom on the island of Java. This certainly will not be meaningful for students, because the knowledge provided is less relevant to students' daily lives. So it is important for a teacher in developing learning resources to pay attention to the characteristics of students so that the learning carried out is meaningful.

The results of the needs analysis on the aspects of the needs of ethnoscience-based modules in physics learning stated that both teachers and students need the application of ethnoscience "Lake Ranau" Ogan Komering Ulu regency of South Sumatra province by 100% which is included in the criteria of "Strongly agree". This finding is also supported by the background of the majority of students who are respondents from the Ogan Komering Ulu area, South Sumatra so that they know the initial information related to Ranau Lake. This ethnoscience integrator is expected to support success in physics learning (Maryam et al., 2022). In addition, students can preserve local wisdom in everyday life (Mulatsih et al., 2023). Then the values of local wisdom that are instilled help students get used to doing good (Amanah et al., 2023). This is in line with previous research conducted by (Khusniati et al., 2023) which showed that ethnoscience-based learning was able to improve students' conservationist character. In addition, integrating the ethnoscience of local wisdom can make the learning process much more complex, so that students are accustomed to representing science with everyday life, as well as applying science concepts in solving problems (Nazhifah et al., 2022).

Material Aspects of Renewable Energy

Schools in Indonesia starting from the 2022/2023 school year have implemented an independent curriculum in teaching and learning activities (Nazhifah et al., 2024). The independent curriculum is different from the previous curriculum. In its application, the learning process in the Merdeka curriculum at the school level is divided into several phases. At the high school level, it is divided into two phases, namely grade 10 phase E and grade 11 and 12 phase F. In phase E class 10 there are only three physical topic, namely measurement, renewable energy, and global warming. Table 3 below shows the results of students' perspectives on physics topics. Based on these data, according to students, renewable energy topics are one of the topic that can be understood by students at each level.

However, students feel that it is still sufficient to understand the application of the concept of data on the topic. This is because the material taught to students tends not to be too contextual and related to the daily life of students. So when equations or physics concepts are presented in the learning process, students feel difficulties in their implementation.

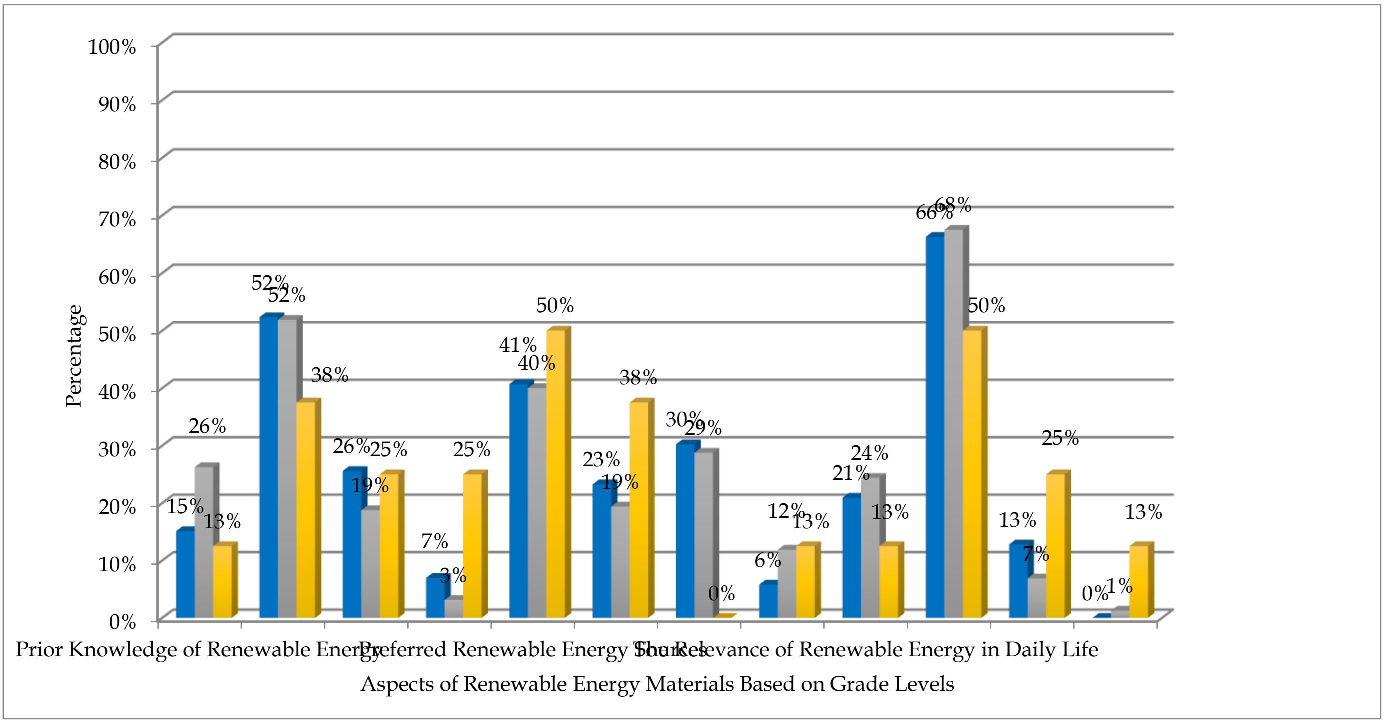

Figure 4. The results of a questionnaire of students' perspectives on renewable energy physics topic

Aspects of E-Module Content Needs

The next aspect is the need for fore-module content. These aspects include the desired e-module format, the preferred form of evaluation in the e-module, and the interactive features expected in the e-module from the learner's point of view. The results of the e-module content needs analysis can be seen in Figure 5.

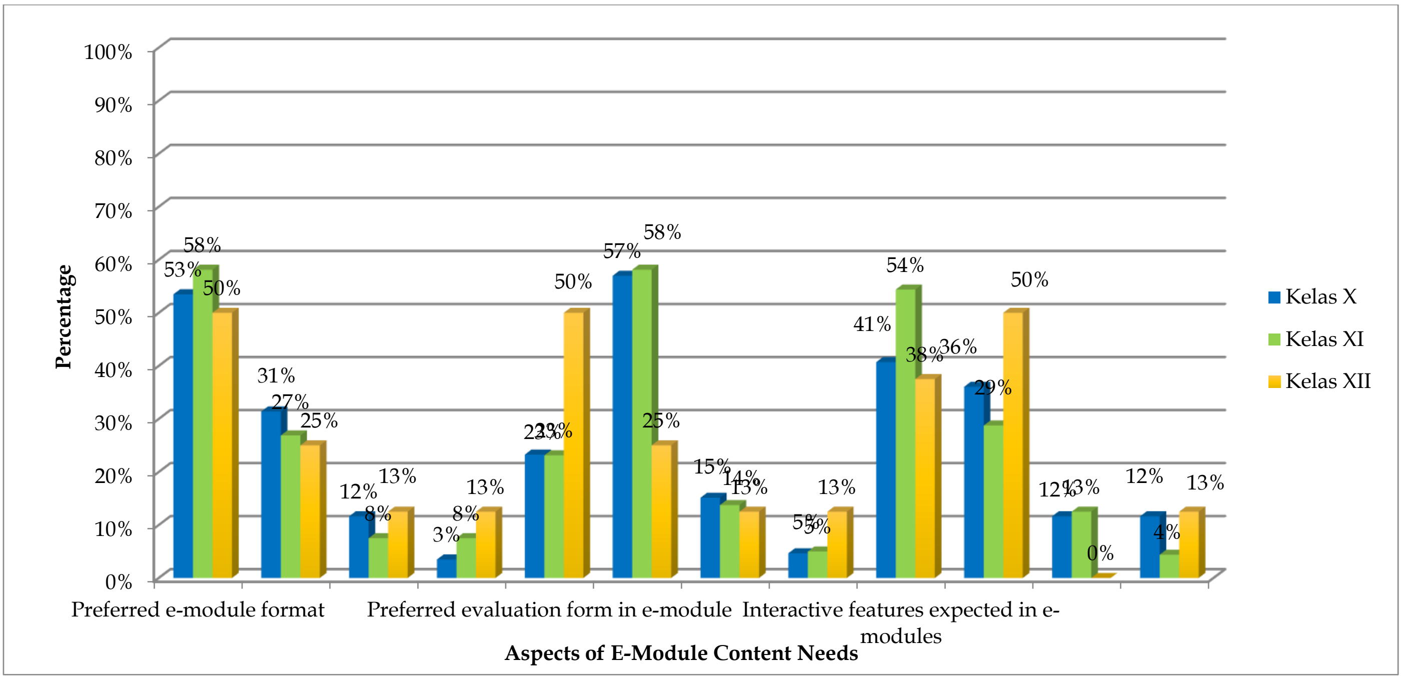

Figure 5. The results of the e-module content need a questionnaire

Based on the results obtained, show that in the aspects of the e-module format, the majority of students at all levels want a combination that contains concise text, images, videos, and interactive quizzes. These results are in line with research conducted Nabilla et al., (2021) which states that e-modules are learning resources that contain text, images, animation, and learning videos. In addition, students expect that in the developed e-module there is an interactive quiz with direct feedback, then multiple-choice questions with discussion and project assignments with complete guidance. Then students want there to be simulations such as virtual experiments that can be tried directly. And students want on the e-module there are navigation buttons and menus that are easy to use. E-modules are learning resources that can be used easily and interestingly (Saprudin et al., 2021). These results are in line with the results of research conducted by Putri et al., (2020) which states that the development of e-modules needs to be carried out as a form of innovation in the development of learning resources, especially those that can be used by students independently. Through learning using e-modules, students become more enthusiastic during the learning process. Moreover, the use of this e-module can make it easier for them because it can be accessed without being limited in space and time (Nabilla et al., 2021).

So the discussion about the importance of using electronic learning resources such as e-modules in physics learning becomes our focus in choosing the right approach to improve the quality of physics learning, especially in renewable energy topic. Based on the questionnaire that has been distributed, both teachers and students agreed to apply the Ranau Lake ethnoscience approach in physics learning e-modules to improve students' literacy on renewable energy topic. These learning resources can be used by teachers as one of the guidelines in the learning process. In addition, it can also be used by students as a learning resource that supports the process of understanding the material and improving the quality of learning outcomes and the skills needed. Therefore, the development of modules in the learning process is very important.

Analysis of science literacy needs

Science literacy is defined as the ability to engage with science-related issues and science ideas, as a reflective citizen (OECD, 2018). People who have good scientific literacy skills are willing to engage in discourse about science and technology, which requires competence to explain phenomena scientifically, evaluate and design scientific investigations, and interpret data and evidence scientifically (OECD, 2018). Simply put, science literacy is the ability of students to understand information, science, knowledge, and facts about the environment, health, economy, and phenomena in the community (Mardhiyyah, et al., 2016; Salamah, et al., 2017).

Evidenced by the results of a study in 2018 conducted by the Programmed for International Student Assessment (PISA) on 15-year-old students which showed that out of 79 participating countries, Indonesia was ranked 75 with a score of 396, far below the average highest score of 489 (OECD, 2018). In line with this, the results of the study Suroso et al. (2021) showed that the science literacy ability of students in East Java was 58.80% with a low category. The same issue was also found by Adnan et al. (2021) that the science literacy ability of students in southern Sulawesi is still relatively low. Ridho, Aminah, and Supriyanto (2018) Doing the same thing and obtaining the results of the science literacy ability of students is meant in the medium category. As well as the research conducted, the Andriani, Saparini, and Akhsan (2018) results of science literacy ability of students in South Sumatra are still very low. So it can be concluded that in general, Indonesian students have low science literacy skills.

This can occur because of several things, including Teachers do not maximize their role in supporting and facilitating students to develop science literacy skills in the learning process (Ridho, Aminah & Supriyanto 2018). Teachers still have difficulty in carrying out meaningful, research-based, and fact-based teaching so the potential of students has not been able to develop optimally (Kurniaman & Noviana, 2017). Students are poorly trained in solving problems related to problem-solving that prioritize science literacy and demand intellectual activity, argumentation and creativity (Akhsan et al., 2020; Novili et al., 2016), then the assessment carried out by the teacher only focuses on science content that is not related to daily life (Nasution et al., 2019), and the availability of instruments that do not accommodate the full criteria for assessing science literacy and the low ability of teachers to develop the problem (Afriana et al., 2016; Kusuma et al., 2017; Zahro et al., 2021).

Various alternatives are proposed to try to provide solutions to these problems such as policy making, increasing efforts to implement learning and curriculum changes that are more oriented to students' science literacy competencies by PISA (Andriani, Saparini & Akhsan 2018). Another alternative that can be done is to develop learning resources in the form of modules that are integrated with local wisdom (ethnoscience). The development of this e-module is important and urgently needed by both teachers and students to improve students' science literacy skills during the learning process. And by integrating ethnoscience in the form of local wisdom, Lake Ranau can produce much more complex science literacy-based learning resources, so that students are better trained in representing and bringing science closer to everyday life, as well as applying science concepts in solving problems (Ikhwanudin, 2018; Maulida & Sunarti, 2022).

By designing ethnoscience-based learning, students not only develop scientific literacy skills but also gain the ability to discover knowledge related to competence aspects and apply their knowledge to solve problems in their surroundings (Sudarmin et al., 2020). Integrating ethnoscience into learning creates meaningful learning experiences, allowing knowledge to be embedded as long-term memory, which in turn enhances knowledge production. This is supported by research conducted by Hastuti et al., (2020), which demonstrated that integrating local wisdom content into the learning process significantly improves scientific literacy in all aspects, including knowledge production. This further reinforces the need to develop ethnoscience-based teaching materials to enhance students' scientific literacy skills.

Conclusion

This study highlights the importance of integrating local wisdom into physics learning through the development of an ethnoscience-based e-module on renewable energy using the context of Lake Ranau. The findings reveal that contextual and culturally relevant materials can enhance students' understanding of physics concepts and foster their environmental awareness. The e-module developed in this study combines interactive features and local knowledge, offering an innovative and engaging learning resource. Its implementation is expected to improve students' science literacy and support more meaningful, locally grounded science education.

Author Contributions

Conceptualization, K.K, H.A, K.W.; methodology, K.K, H.A, K.W.; validation, H.A and K.W.; formal analysis, K.K.; investigation, K.K.; resources, K.K.; data curation, K.K.; writing—original draft preparation, K.K.; writing—review and editing, K.K, H.A and K.W.; visualization, K.K. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The author declares that there is no conflict of interest regarding the writing and publication of this paper.

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