Development of an Ethnoscience-Based E-Module with the PBL Model to Improve Problem-Solving and Critical Thinking Skills: A Literature Review

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Abstract: Problem-solving and critical thinking skills are important skills that students must have in learning physics. Problem-solving and critical thinking skills can be facilitated through the use of ethnoscience- based e-modules with the PBL model. This study aims to identify and analyze research trends using ethnoscience -based e-modules with the PBL model to improve problem-solving and critical thinking skills in physics learning. This research method is descriptive and analytical. The data used in this study were obtained from documents indexed by Google Scholar from 2015-2024 using Publish or Perish and Dimension.ai. The research procedure used the PRISMA guidelines. The data identified and analyzed were the types of publications, sources of publications, and research titles on the PBL model to improve problem-solving and critical thinking skills in physics learning that were widely cited. The data analysis method used bibliometric analysis assisted by VOS viewer software. The results showed that research trends on this topic had increased significantly from 2015 to 2024. This indicates a high interest in innovative approaches that combine local cultural aspects (ethnoscience) with problem-based learning strategies.

Keywords: Critical thinking; E-module; Ethnoscience; PBL; Problem solving skills

Introduction

Digital technology has dominated all elements of society in all areas of life, including in the field of education (Helaluddin, 2019). The paradigm of learning innovation that leads to technology adaptation means that education must make a new breakthrough. One of the innovations made is the transfer of printed modules to electronic modules or what is called e-modules.

E-module is an electronic-based learning media, which consists of text, images, animations, graphics and videos (Rahmadhani et al., 2021). The use of e - modules to deliver learning materials so that students have flexible time and place in accessing information delivered by the teacher (Nurhayati et al., 2021). In addition, teachers also need to relate learning to everyday life, by integrating science into the local

cultural context (Munandar et al., 2022). This approach, known as ethnoscience learning, aims to create a more contextual and meaningful learning environment, so that students can understand scientific concepts more easily and effectively (Wahyu, 2017).

Ethnoscience is an approach that links scientific knowledge with local culture, so that learning becomes more contextual and meaningful for students . (Widyaningrum, 2018)Ethnoscience knowledge functions to introduce the surrounding environment to students through direct learning and experience (Syazali et al., 2022). The use of ethnoscience -based e- modules is expected to be able to link the original knowledge of the community with scientific science concepts so that the learning process is more relevant and interesting for students. This can help students in solving problems,

one of which is the use of e - modules ethnoscience based.

E-modules based on ethnoscience are closely related to daily life where they can integrate indigenous knowledge of the community into scientific knowledge (Utari et al., 2020). The use of e - modules Ethnoscience - based learning can enable students to learn independently and explore local cultural diversity that is connected to the concept of science (D. Wulandari et al., 2023). Thus, students will be more enthusiastic, interested, and happy in a conducive learning situation (Alfiana et al., 2022). Therefore, schools need to implement ethnoscience- based learning by promoting local culture.

Local culture has great potential to be developed into interesting and relevant learning materials for students while still strengthening cultural identity. Learning that is associated with ethnoscience can create a more comprehensive and holistic understanding, especially in physics lessons (Pertiwi et al., 2019). Because physics lessons involve a lot of logic and reason in understanding a concept that is still abstract (S. I. Wulandari et al., 2023).

Physics learning based on ethnoscience can encourage students to improve their understanding of indigenous cultural knowledge and be able to be preserved (Dani et al., 2022). Physics learning when associated with ethnoscience makes students more involved, because the material is relevant and meaningful to them personally (Dani et al., 2022). However, research on the ethnoscience of the Sasak tribe which is identified as having ethnoscience potential on Lombok Island is still rarely carried out, especially those related to physics learning (Hikmawati et al., 2021).

The research conducted by Widayanti produced output in the form of an e-module integrated with Jambi regional ethnoscience on the material of measurement, temperature and heat (Widayanti et al., 2022). Based on the results of observations that have been carried out at SMAN 3 Mataram, it shows that students have never read and found an ethnoscience -based e-module in physics learning. So students need a guide in the form of an ethnoscience- based e-module to increase their knowledge independently and be able to find their own knowledge. The part that is no less important than that is the selection of the right learning model so that it can facilitate the e-module to improve students' abilities. In the development of this ethnoscience- based e-module, the Problem Based learning model is used. Learning (PBL).

Problem Based Model Learning (PBL) is one of the learning models that can train students in analyzing problems, describing them to finding ideas in solving a problem (Aripin et al., 2021). This learning model can indirectly develop problem-solving skills, critical thinking and scientific argumentation because in this PBL activity students are required to think critically in solving problems based on students' scientific arguments (Saputra et al., 2024).

Problem-solving skills are skills used to solve problems in real life, because every student has a need to investigate the environment and build their knowledge personally (Susino et al., 2023). Problem-solving skills are one of the foundations in deepening knowledge through critical thinking (Billa et al., 2025). Critical thinking skills are a way of processing all information, observations and problems obtained, by making decisions (Shafa et al., 2023).

However, research related to the application of ethnoscience in science learning, especially physics, is still limited. Previous studies have shown that the integration of ethnoscience in physics learning can improve students' conceptual understanding through relevant cultural contexts (Subiantoro et al., 2019; Sudiarta et al., 2020). However, few studies have specifically explored the potential of ethnoscience of the Sasak tribe on Lombok Island in physics learning, especially those based on traditional means of transportation such as cidomo (Hikmawati et al., 2021).

In line with this, several studies have shown the effectiveness of e-modules in improving students' problem-solving and critical thinking skills (Prasetyo et al., 2021; Susanti et al., 2019). However, most of these studies still focus on the use of e-modules that are general in nature or based on modern science concepts, without any deep integration of local culture.

Therefore, this study wants to know the research trend using ethnoscience- based e-modules with PBL models to improve problem-solving and critical thinking skills in students. It is hoped that this study can be a reference in developing further research related to problem solving and critical thinking in physics learning.

Method

This research method is descriptive analytical, which aims to understand and describe research trends on ethnoscience- based e-modules with PBL models to improve problem-solving and critical thinking skills. The data used in this study were obtained from information sources indexed by Google Scholar using the analysis tool such as Publish or Perish and Dimension.ai. To conduct a search on Google Scholar, keywords related to research trends on e-modules with PBL models to improve problem-solving and critical thinking skills in physics learning.

In this study, the analysis was conducted on 169 documents that have been indexed by Google Scholar from 2015 to 2024. The Google Scholar database was chosen as a place to search for documents because Google Scholar applies consistent standards in selecting documents to be included in its index , and Google Scholar displays more documents than other top

databases, especially research in the field of education (Yang et al., 2023; Zawacki-Richter et al., 2019). To filter the data that has been collected through Publish or Perish, the researcher used the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Guidelines.

Result and Discussion

This study aims to describe the research trends in the development of ethnoscience- based e-modules with the PBL model to improve problem-solving and critical thinking skills conducted from 2015 to 2024. Figure 1 is presented below regarding the research trends on e-modules with the PBL model to improve problem-solving and critical thinking skills.
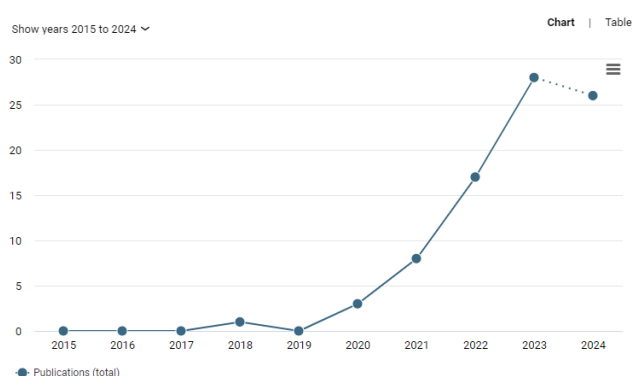

Figure 1. Research trends of e-modules based on ethnoscience with PBL model for problem solving and critical thinking skills

Based on the research trend graph above, it can be seen that there is a significant increase in the number of research publications from 2019 to 2023, with a peak of publications around 2023. This trend indicates an increase in interest in certain topics, possibly including research related to ethnoscience -based e-modules and Problem Based Learning (PBL) models.

When connected with research on ethnoscience-based e-modules using the PBL model, this may be one of the topics that has received increasing attention in recent years, along with the increasing need for innovation in effective learning methods ('Adiilah et al., 2023). This research can be seen as an effort to integrate local cultural approaches (ethnoscience) with learning strategies that encourage students to actively solve problems, think critically, and improve scientific understanding (Wibawa et al., 2021).

In the context of using ethnoscience- based e-modules , this study may focus on developing more relevant and contextual learning materials for students with local cultural backgrounds. These e-modules are then applied in PBL scenarios, where students are faced with real problems related to their culture, thus

encouraging them to apply scientific knowledge in critical problem solving (Putri et al., 2023; Sari et al., 2022).

This increasing publication trend reflects the urgency in improving the quality of physics learning, especially in utilizing digital technology (e-modules) and problem-based approaches that can train critical thinking and problem-solving skills in students.

Table 1. Trends in Ethnoscience Based E-Modules to Improve Problem-Solving and Critical Thinking Skills Based on Type of Research Publication

Publication Type	Amount
Article	70
Book	13

Based on Table 1, it can be seen that the research trend on Ethnoscience- Based E-Modules to improve problem-solving and critical thinking skills has increased in recent years. This research is published in two types of media, namely articles and books. Most of the publications related to this topic are in the form of scientific articles, with a total of 70 documents showing academic attention to the development of this innovative learning material through leading journals. These articles are usually published in scientific journals, both print and online (Bahtiar et al., 2023; Suseno et al., 2020).

In addition, there are 13 documents in book form that expand the scope of the study and provide more in-depth information on the application of Ethnoscience-Based E-Modules in the context of science education. The number of publications indicates that both through articles and books, this topic has received significant attention among researchers and education practitioners. This reflects the increasing need for culturally relevant teaching materials, as well as the development of problem-solving and critical thinking skills among students. The following table 2 presents the top ten (10) source title trends in research on Ethnoscience- Based E-Modules to improve problem-solving and critical thinking skills in science learning.

Based on Table 2, Advances in Social Science, Education Humanities Research is the top journal in terms of publications related to this topic, with a total of 13 publications and 12 citations, indicating a mean citation ratio of 0.92. This shows that articles in this journal have a fairly good influence in the fields of education and social sciences.

Jurnal Edukatif Jurnal Ilmu Pendidikan, although it only has 6 publications, has received 29 citations, making it a journal with a high number of citations with a mean citation ratio of 4.83, which shows that its articles are widely referenced and considered important by other researchers.

Table 2. Top 10 Source Titles of Ethnoscience Based E-Module Trends to Improve Problem-Solving and Critical Thinking Skills in 2015-2024
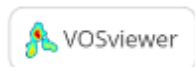
Name	Publication	Quote	Meaningful Quotes
Advances in Social Science, Education Humanities Research	13	12	0.92
Educational Journal of Educational Sciences	6	29	4.83
Journal of Science Education Research	5	4	0.80
Basicedu Journal	5	1	0.20
Journal of Chemical Education Innovation	2	3	1.50
Journal of Education and Teaching	2	0	-
Tadris Journal of Teaching and Education Science	2	0	-
Journal Of Educational Action Research	2	15	7.50
Indonesian Journal of Science and Mathematics	2	3	1.50
Journal For Lesson and Learning Studies	2	2	1.00

Several other journals such as Jurnal Penelitian Pendidikan IPA and Jurnal Basicedu also show contributions with 5 publications each, but have lower meaningful citation ratios. Meanwhile, the Journal Of Education Action Research journal has a high meaningful citation ratio (7.50) with only two publications, indicating that publications published in this journal have a significant influence. Other journals such as Jurnal Inovasi Pendidikan Kimia and Indonesian Journal Of Science and Mathematics also contribute to this trend, with varying numbers of citations but indicating the quality of the published articles.

Overall, this table provides an overview of the contribution of leading journals in the dissemination of research on ethnoscience- based e-modules in the context of improving critical thinking and problem-solving skills, with variations in the number of publications and citations reflecting the academic impact of each journal.

Below is a visualization achieved by creating a landscape map, which offers a visual representation of the subject matter of a scientific study. The results of the bibliometric mapping for the shared word network in articles related to the topic of Ethnoscience- Based E-Module Trends to Enhance Problem-Solving and Critical Thinking Skills are illustrated in Figure 2.

Figure 2. Visualization of the concept network for developing ethnoscience -based e-modules with the problem based learning (PBL) model

VOSviewer software to visualize the relationship between keywords related to the Ethnoscience- Based E-Module research in the context of the Problem Based Learning (PBL) model to improve problem-solving and critical thinking skills. In the figure, several important keywords, such as "problem," "problem-based," "PBL," and "problem model," are displayed with connections between them, indicating a close relationship between these topics in the literature. Different colors indicate topic clusters that have certain relationships based on their frequency of occurrence in scientific articles. The size of the dots (nodes) on each keyword illustrates the importance or frequency of occurrence of the keyword in the studied literature network. Meanwhile, the distance between words indicates the degree of interconnection or collaboration between the concepts, where keywords that are close to each other have a closer relationship.

In this study, it is seen that the terms "problem based," "PBL," and "problem-based" have a strong connection, indicating that they often appear together in the literature, indicating the importance of using the problem-based PBL model in developing learning modules (Lestari et al., 2024). This study as a whole helps provide an overview of how themes related to "problem solving" and "critical thinking" are integrated in research related to ethnoscience- based e-modules for science learning.

Figure 3 shows the trend of keywords related to ethnoscience- based e-module research with the PBL model to improve problem-solving and critical thinking skills in Google Scholar indexed journals from 2015 to 2024. The trend of article writing themes from the oldest to the newest years is marked by the color themes of purple, blue, turquoise, dark green, light green and yellow. The image below shows that critical thinking skills, PjBL, case studies. This shows that these keywords are widely used by researchers in 2022. In 2023, the keywords that often appear are the PBL model, SD MI, problem-based to improve critical thinking skills.

Figure 3. Overlay visualization on the use of ethnoscience- based e-modules with the PBL model to improve problem-solving and critical thinking skills

In the visualization, it can be seen that more and more studies are using keywords such as "PBL model" and "problem-based" in recent years (2022-2023). This shows a causal relationship between the increasing need to develop students' critical thinking and problem-solving skills with the implementation of the Problem Based Learning (PBL) model. PBL, which is specifically designed to engage students in the process of solving real problems, is considered effective in developing students' critical thinking skills, as stated by (Hoidn et al. (2021). In addition, the integration of ethnoscience in learning modules allows students to connect scientific concepts with local culture, which further motivates them to think critically and solve problems (Ilwandri et al., 2023). Therefore, the increasing trend of using keywords such as PBL and ethnoscience in research shows an academic response to the challenge of improving students' critical thinking skills through innovation in learning methods.

Research on ethnoscience -based e-modules with PBL models to improve problem-solving and critical thinking skills in physics learning is one of the rapidly growing research fields in recent years. The following also presents research trend keywords based on density visualization in Figure 4. The density of research themes is indicated by bright yellow. The brighter the theme color, the more research is done. The dimmer the color means the theme is rarely researched (Kaur et al., 2022; Liao et al., 2018).

The figure illustrates that the brightest dots (Bright Yellow) on the words "problem" and "problem-based" are the most prominent, indicating that the concept of problem-based learning (PBL) is very often used and is the main focus in the development of this e-module. The yellow dots on other words such as "PBL" and "problem model" also appear with high intensity, but are slightly less prominent than the term "problem." While the darker dots (Green) on words such as "sd mi," "study," and "to improve ability" also appear, but with lower frequency or relevance. This indicates that these topics are related but not central to the analyzed concept network. And the dark background (dark blue) indicates areas where there are no related terms or very low relevance to the main concept.
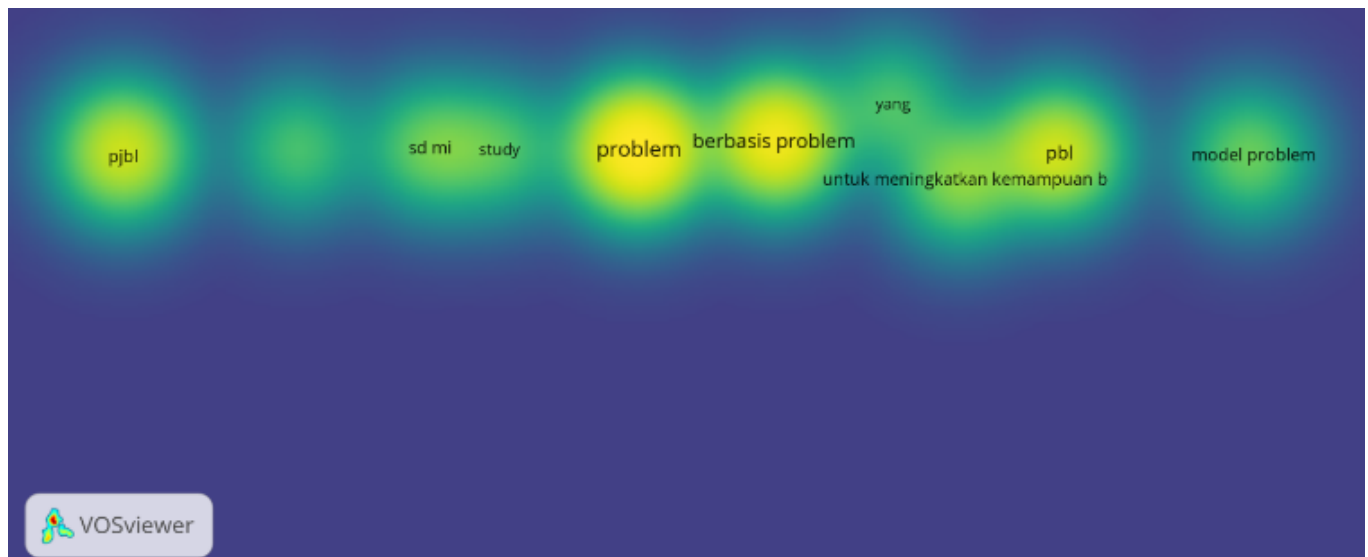
Figure 5. Visualization of relationships between keywords using VOSviewer

Overall, this visualization confirms that the Problem Based Learning (PBL) approach is very important in the context of developing ethnoscience-based e-modules . PBL is identified as the main method used to improve critical thinking and problem-solving skills in educational contexts (Riska et al., 2024).

Conclusion

This research successfully identified and analyzes research trends that use ethnoscience based e-modules with the Problem Based Learning (PBL) model to improve problem-solving and critical thinking skills in physics learning. From the results of the analysis, it can be seen that research trends on this topic have increased significantly from 2015 to 2024. This shows a high interest in innovative approaches that combine local cultural aspects (ethnoscience) with problem-based learning strategies. Ethno science based e-modules with PBL has proven effective in improving students' critical thinking and problem-solving skills, especially because this approach makes learning more relevant, contextual, and meaningful for students. This study also provides an overview that the application of technology in science learning, especially through e-modules, plays a very important role in supporting the development of 21st century skills. Thus, this study serves as a strong basis for further research in developing more effective learning modules, particularly in physics education that links local cultural aspects with scientific problem solving.

Author Contributions
All authors contributed to writing this article.

Conflicts of Interest
No conflict interest.

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