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Ethnoscience in Physics Learning: A Systematic Literature Review

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Received: October 1st, 2024. Revised: October 19th, 2024. Accepted: October 23rd, 2024

Keywords :

Ethnoscience; Physics; Physics Learning

ABSTRACT

This article presents a systematic review of ethnoscience in physics learning. This research was conducted to examine how the utilization of ethnoscience in physics learning. This type of research is a Systematic Literature Review (SLR) with the PRISMA method. Findings on google scholar found 30 articles that match the theme. Ethnoscience obtained from the results of this review include traditional games, traditional foods and drinks, dances, musical instruments, crafts, history of a region, and habits carried out by residents to meet their needs. Utilization of various kinds of ethnoscience in physics learning can produce products in the form of learning media such as modules, learning comics, booklets, and also other learning media developed by utilizing technology. In addition to learning media, ethnoscience-based learning tools were also found. These learning tools include Learning Implementation Plans (RPP), Learner Worksheets (LKS), and assessment instruments. Ethnoscience in learning can also be integrated with learning models. Learning physics by utilizing ethnoscience can influence learning outcomes, critical thinking skills, concept understanding, learning motivation, interest, science literacy, and student character.

INTRODUCTION

Indonesia as a country that has been recognized by various countries in the world, has different characteristics when compared to other countries [1]. Indonesia is an archipelago, a country rich in natural beauty and environment. This wealth creates a diversity of habits, cultures, customs, food, arts, folklore, games, ways of making, building and responding to natural conditions, all of which create a uniqueness between one region and another. The variety of cultures that are the wealth and pride of the Indonesian nation should be preserved [2].

However, the increasing use of technology and globalization has resulted in the fading of culture in Indonesia. This is in line with research that has been done before stating that in the era of technological development revolution and globalization has resulted in cultural contact between tribes

and between outside cultures [3]. One of the most pronounced impacts of rapid globalization is the erosion of local cultural values in Indonesia. Local wisdom, which is full of cultural values, should be preserved and maintained its existence to the younger generation [4]. Preservation efforts that can be done is by integrating Indonesian culture in learning.

Students as one of the successors of culture have a diverse level of knowledge. Student experience is in the form of mindset (cognitive), attitude pattern (affective) and behavior pattern (psychomotor). All three are needed as an educational breakthrough that combines culture with science called ethnosience [5]. Local wisdom is also a reflection of ethnosience owned by a particular cultural community [6]. Ethnosience comes from the word *ethnos* (Greek) which means nation, and *scientia* (Latin) which means knowledge [7]. Ethnosience can be utilized by integrating it with classroom learning.

Learning will feel more meaningful if it is associated with everyday life or local wisdom of the local community [8]. One of the subjects that can be associated with ethnosience is physics. However, physics learning associated with ethnosience is still rarely done. Various problems in the application of ethnosience were found. The findings of interviews with several teachers stated that ethnosience was already known but during learning had not tried to apply it [2]. So that some studies related to ethnosians in physics learning are needed. There are many potentials of ethnosience that can be associated with physics concepts. It is important for a teacher to link physics concepts with ethnosience in an effort to improve the quality of physics learning. Ethnosience-based learning aims to introduce students to facts that have developed in a society which are then associated with learning materials [9]. Ethnosience integrated learning is able to realize contextual learning [10]. The application of contextual learning has an impact on increasing students' understanding of the material being studied. Therefore, it is important for a teacher to link physics concepts with ethnosience [11]. Empowerment of local wisdom by teachers can create a learning environment that is relevant, meaningful, and inspires students' pride in their local culture [12]. The importance of ethnosience in learning allows ethnosience to be applied to every lesson so that it benefits the understanding of the material and the preservation of local culture. Ethnosience in learning also makes it easier for students to learn to understand the material by connecting it to everyday life or habits.

In general, science learning in schools is still centered on book materials using conventional learning methods. It is still rare for science learning to really reveal the cultural reality around students [13]. Ethnosience applied in physics learning is still rare. It is necessary to conduct further systematic studies on ethnosience in physics learning. The results of this study are expected to provide an overview in the world of education related to ethnosience-based physics learning. The description includes a variety of local wisdom that can be used in ethnosience-based physics learning, the benefits of ethnosience in physics learning, physics materials that can be associated with local culture, and the influence of ethnosience in physics learning.

METHOD

This research was conducted using the PRISMA method with the type of research used is Study Literature Review (SLR). The steps in conducting research with the SLR method are the first stage that is done is to search for articles on Google Scholar using the main keywords, then from the findings using the main keywords the filtering process is carried out based on the year, besides that, filtering is also carried out based on the type of subject and the right keywords until finding as many as 30 desired articles.

The steps in conducting research with the SLR method are as follows: The first step is to search for articles on Google Scholar using the main keywords about the ethnosience relationship in learning. There were 2560 articles related to the search using the main keywords. Furthermore, the second stage of the findings using the main keywords is the filtering process based on the year. Articles were filtered starting from 2018-2024 so that 2410 articles were found. Then in the third stage the articles

were filtered again using the keyword ethnoscience in physics learning found as many as 1360 articles. Furthermore, the fourth stage of 1360 articles was filtered again based on local wisdom used in physics learning, how the implementation of ethnoscience in physics learning, and the effect of ethnoscience utilization in physics learning so that 30 articles were found. The diagram of the systematic review stages is shown in Figure 1.

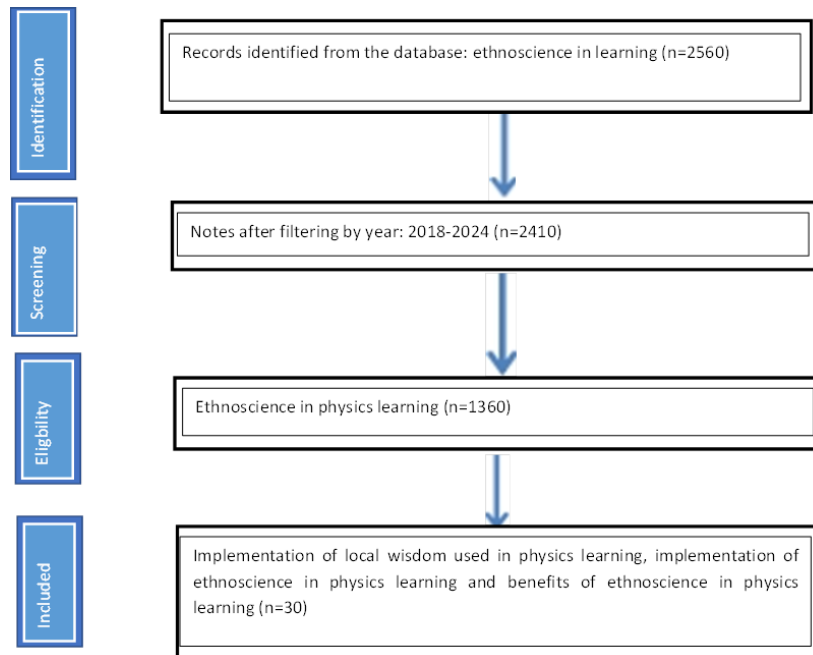


Fig 1. Sistematic Review

RESULTS AND DISCUSSIONS

Review of several articles found from google scholar, among others, related to local wisdom in Indonesia used in physics learning, the benefits of local wisdom-based physics learning that presents learning products such as learning media, learning models and learning tools, physics materials that are connected to ethnoscience-based learning and also the effect of ethnoscience-based physics learning.

Local Wisdom Used in Ethnoscience-Based Physics Learning

Based on the findings of the search on google scholar found some local wisdom that can be applied in learning ethnoscience-based physics. The local wisdom can be shown in Figure 2.

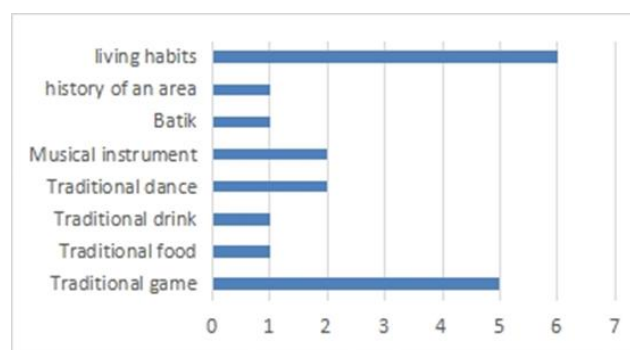


Fig 2. Local Wisdom Applied in Ethnoscience-Based Physics Learning Ethnoscience-based Physics Learning

Based on the results of the review, the most commonly found local wisdom is related to the habits of life carried out by the local community. These life habits include the process of cultivating cattle, the process of making coal, how to deal with environmental problems called *Sar Sukun Kanum*, the use of measurement terms such as cubit, *dapo* and *term*, as well as procedures for planting and storing rice (*Ngguda Labo Ampa Fare*), plowing rice fields (*Rawi Dana*), *Tenun Tembe Nggoli*, wearing a hena on the bride (*Peta Kapanca*), moving house (*Hanta Uma*).

Karapan sapi or *kerabhan sapa* is a Madurese term used to name a cattle race [14]. In this case, *kerapan sapi* can be interpreted as the race of a pair of cows linked by using pangonong and kaleles. Bull racing is one of the superior genetic potentials that can continue to be developed on Madura Island because the males used in this race are pure breeds of Madura cattle [15]. In addition to cattle racing, another local wisdom is red bricks.

Red bricks are one of the materials used in building construction. Red bricks are made from clay that is molded and then burned. Next is the culture of *Sar Sukun Kanum*. Tomer Village is one of the villages that is home to the Kanum tribe, one of the indigenous tribes in Merauke. In their daily lives, the Kanum tribe still depends on their nature. Farming and hunting are ways for them to fulfill their daily needs. The dependence of their lives on nature has been realized by their own ancestors, so there is a culture passed down by their ancestors related to the preservation of their environment and nature. This aims to maintain their environment and nature so that their lives will continue well. One such culture is *sar*. *Sar* is a culture that basically prohibits humans from taking or processing natural products from a place and within a certain period of time. The implementation of this culture is carried out when one of the Kanum tribe members dies with the aim of honoring that person [16].

Hasta, dapo and jangka are units of length used by the Minangkabau people [17]. Planting and Storing Rice (*Ngguda Labo Ampa Fare*), Plowing Rice Fields (*Rawi Dana*), *Tenun Tembe Nggoli*, Wearing Hena on the Bride (*Peta Kapanca*), Moving House (*Hanta Uma*). In the process of planting rice there are community habits where in this process many people plant themselves without the help of tools or others. Bima people always *do Nguda Fare* or planting rice as well as praying for the rice planted. This process is expected to have an abundant harvest and as a form of gratitude from the local community for the rainy season that has come. In Bima, the process of plowing rice fields is done with the help of buffaloes (*Sahe*) or plow machines. There are two plowing processes carried out by the people of Bima, namely, rice field plowing and mountain plowing. Plowing rice fields itself is done with the help of buffaloes or machines where the harvested land will be plowed again for the replanting process. Then the mountain plow itself is carried out by a group of residents to open new land in the mountains or valleys. This process is carried out by a group of people by clearing or burning part of the land in the mountain or valley with the aim of making new land or a road to the garden (*Oma*). *Tenun Tembe Nggoli (Muna)* is the process of making a typical Bima woven fabric which is also called *Tembe Nggoli*. The making of this woven fabric itself uses special tools, usually those who do this weaving are women, namely mothers and are taught to their children. The woven fabrics made are usually with certain patterns and bright colors that signify harmony and happiness. The use of hena or *Peta Kapanca* is one of the traditions of the Bima community carried out by the bride's family before the wedding. *Peta Kapanca* itself is carried out with several stages where the bride-to-be is paraded around the village on the laps of 4 brothers or the closest family. The bride-to-be will sit like a queen in a horn accompanied by Bima tambourines and flutes. After going around the village, the next process is to place a natural hena or what the Bima people call *kapanca* on the palm of the bride's hand. Moving House or what the Bima people call *Hanta Uma* is one of the cultures of the Bima people to move the house. Usually the wooden house that has been built by the builder will be lifted and placed on the land of the house owner or this process is also carried out if there are residents who exchange houses, where one community with another exchanges houses with certain agreements [18].

Benefits of Ethnoscience in Physics Learning

Ethnoscience in physics learning can provide benefits such as products such as interesting learning

media, ethnoscience-based learning tools and learning models integrated with ethnoscience. The benefits of ethnoscience in physics learning can be shown in Figure 3.

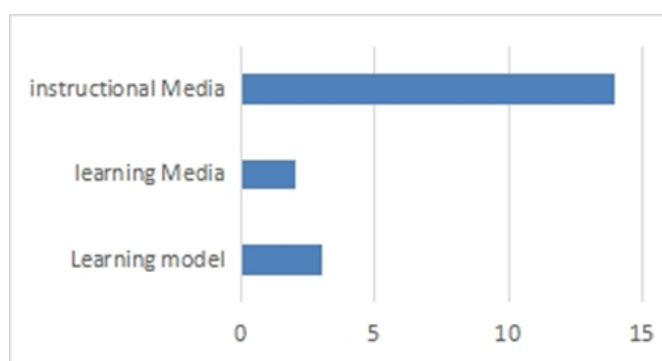


Fig 3. Products produced in ethnoscience-based physics learning

Ethnoscience connected with physics learning provides benefits in terms of product development such as learning media in the form of electronic modules. E-module is a form of module digitally and packaged more interestingly. Similar to modules, e-modules are believed to be able to help students learn actively and independently [17]. Furthermore, research produced ethnoscience-based physical comics [19]. Comics are images designed in cartoon form that reveal characters and act out a story in a tight sequence to provide entertainment to readers. Learning media in the form of comics can be an alternative in learning physics. In addition to packaging contemporary learning, physics comics can also help students understand learning through the language used, the language used usually tends to be easy to understand and not rigid. In addition, the stories and pictures presented can increase the excitement and reasoning of students. In addition to comics, other media developed are booklets. Ethnoscience-based booklets can be teaching materials that support school textbooks that are dominated by images. Booklet is a collection of several leaflets that are put together so that they are formed into a book that discusses a certain topic [20]. LKPD (Participant Worksheet) is also one of the ethnoscience-based physics learning media developed. In addition to ethnoscience-based learning media, the development of ethnoscience-based learning tools was also carried out by Dani et al [10]. This learning tool is also associated with learning using Flipped Classroom combined with a guided inquiry model [10].

Physics Materials Associated with Ethnoscience-based Learning

Physics materials that are linked to ethnoscience-based learning include angular velocity and elasticity. This material is connected to the local wisdom of the traditional game *Lastik (Katapel)* [2]. In addition, other traditional games that are connected to physics material are *Patok lele* and *gobak sodor* [8]. *Egrang* is also a traditional game that can be associated with the physics material of Effort and Energy. *Egrang* is a game that uses bamboo or wood shaped like a stick and there is a footstool. The long bamboo used is 2 meters long, the diameter of the bamboo is 4 cm, and the height of the footing is different (30 cm, 40 cm, and 50 cm). This game requires the strength of the leg and hand muscles used for walking [21]. The *dol* music game can also be related to physics material Interference and sound intensity levels [13]. *Baingkaan* or *balala-saman*, is also a traditional game that can be associated with the physics of parabolic motion [22].

Typical foods can also be a reference used to develop ethnoscience-based physics learning media. *Usaku* (corn flour) is one of the traditional foods from South Timor Tengah Regency that contains carbohydrates. *Usaku* consumed by the people of South Central Timor Regency, especially in Noesiu Village, is a mixture of corn that is pounded and mashed with grated coconut and then fried (roasted). The process of making *Usaku* can be related to the physics material of force, pressure, density, temperature, heat, substance change and momentum [5]. In addition, plate dance can be related to motion material in physics [23]. The *Dhadak Merak Reog Ponorogo* dance can be related to physics material, namely Equilibrium and moments of force [24].

Batik making is one of the cultural preservation activities that can be associated with temperature and heat physics material [25]. Musical instrument *bundengan* which is associated with the physics of vibration, waves and sound [26]. Furthermore, related to local community habits such as cow racing (*kerabhan sape*) which is a habit of the people of Madura can be associated with physics material Regularly Changing Straight Motion (GLBB) [15]. *Sar sukun kanum* which is associated with the physics of environmental pollution [16]. Making red stones that are associated with physical material of physical and chemical properties and changes in the form of objects [20]. In addition, ethnosience-based learning in physics can also be associated with the history of a region with effort and energy material [19].

Influence of Ethnosience in Physics Learning

Ethnosience in physics learning can influence science literacy skills, learning outcomes, interest, motivation, concept understanding, character and critical thinking skills. The influence of ethnosience in physics learning can be shown in Figure 4.

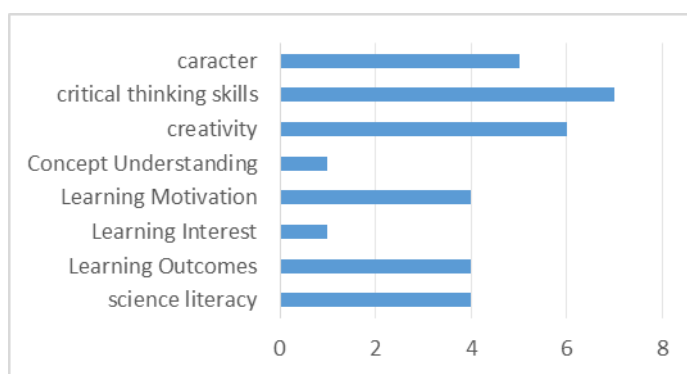


Fig 4. Influence of Ethnosience in Physics Learning

Ethnosience in physics learning has a major influence on students' critical thinking skills. This is in accordance with the results of research about ethnosience-based physics E-modules can improve students' critical thinking skills [27]. Research entitled analysis of ethnosience-based learning tools obtained results can improve students' critical thinking skills [2]. The next effect is on the creativity of students. Research about physics E-modules can also increase the creativity of students [27]. Other research that supports is research about the practicality and effectiveness of high school physics e-modules based on guided inquiry integrated ethnosience can increase student creativity [17]. Another effect of the application of ethnosience in physics learning is the character of students. This is in accordance with research about the design of the ethnosience integrated physics teaching curriculum to influence the character of love for the country [28]. Ethnosience-based physics learning also has an influence on student learning motivation. This is in line with the research on physics learning integrating ethnosience Traditional games have an influence on student learning motivation [6]. Another supporting research on a review of the analysis of ethnosience-based physics education, culture, and local wisdom in Indonesia which has an influence on learning motivation [28]. Science literacy can also be developed from local wisdom-based science learning. According to Fatimah in her research on analyzing the feasibility of android-based physics learning media through an ethnosience approach can improve students' science literacy skills, other findings the feasibility of ethnosience-based Student Activity Sheets (LKS) on the theme of herbal medicine can have an influence on students' literacy skills [29]. Learning outcomes can also be influenced when implementing ethnosience-based physics learning. Research about application of ethnosience-based discovery learning has an influence on student learning outcomes [30]. As well as ethnosience-based physics learning can improve concept understanding in accordance with the research about the development of physics enrichment books with ethnosience contexts in *Patok lele* and *gobak sodor* games [8].

CONCLUSION AND SUGGESTION

Ethnoscience in physics learning can be applied by linking local cultural wisdom to physics material. Local wisdom that can be used include traditional games, traditional foods and drinks, dances, crafts, history, musical instruments and even the living habits of local communities. Ethnoscience-based physics learning can provide benefits including creating creative learning media, interesting learning tools and learning models that can be linked to ethnoscience itself. So that it can have a good influence on learning including influencing critical thinking skills, creativity, character, concept understanding, motivation, interest, learning outcomes, and science literacy of students.

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