



Ethnophysics Studies in Various Indonesian Cultures: A Systematic Literature Review

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Abstract: Research related to ethnoscience from culture, local wisdom, and local potential in Indonesia in the last seven years has developed, but there are still few studies conducted in Physics Education. This study aims to identify and review ethnophysics research from various cultures in Indonesia. A systematic literature review method was used with four stages: identification, selection, eligibility, and inclusion. Of the 695 journal articles screened through Mendeley and Google Scholar applications, 12 were selected as research samples because they met the research criteria. The literature review shows that the cultural aspects studied are still limited to traditional dances, games, and houses. The research is also limited to several regions such as Jayapura, Demak, East Java, West Java, Jambi, West Sumatra, Aceh, South Sulawesi, and South Central Timor in a regional or ethnic context. The physics materials studied include measurement, waves, sound, reflection and refraction of light, lunar and solar eclipses, the concept of energy and its transformation, heat, density, gravity, Newton's law, balance, work, force, motion, magnetic fields, and electric fields. Further research can be done through cultural studies, local wisdom, or local potential from unreached areas in Indonesia. The findings of this study indicate the need for a broader and deeper exploration of ethnoscience in physics education through culture, local wisdom, and other local potential in Indonesia as a learning resource for students in the classroom.

Keywords: ethnophysics, ethnoscience, local wisdom, cultures, physics concept

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INTRODUCTION

Indonesia is a country rich in ethnicity and culture. This makes the Indonesian people pluralistic with their own characteristics. Cultural wealth becomes a separate identity for an ethnic group that shows its identity (Asra et al., 2021). The large number of ethnic groups in Indonesia is the reason for the importance of building scientific knowledge based on culture and local wisdom (Nisa et al., 2015; Arfianawati et al., 2016). Exploration of local wisdom is a strategic effort to build the national character (Rachmawati et al., 2019). Education should produce a generation of professionals and quality citizens who not only have knowledge but also the willingness to continue learning as well as personal abilities and values (Arthur & Wilson, 2010; Rahmawati et al., 2019). Globalization and technological advances demand developments in the knowledge aspect. Community knowledge must also be developed to harmonize with modern knowledge (Harefa, 2017). Individuals with a narrow view will impact the knowledge they gain, meaning that the view and interpretation of community culture only on one side will not improve their mindset (Novitasari et al., 2017). Most of the original knowledge of the community has been forgotten and lost due to a lack of understanding of the importance of the noble values contained therein (Halim et al., 2013; Jumriani et al., 2021). In addition, the exploration of indigenous science that is not accompanied by a logical understanding has the opportunity to give birth to misconceptions in science itself (Novitasari et al., 2017). Another problem is the lack of motivation of young people to recognize and preserve their culture and local wisdom, which is easily eroded by outside culture (Jumriani et al., 2021).

An effort to overcome these problems can be made through education. Culture and education are inseparable in everyday life because culture is knowledge owned by a group related to behaviour (Lubis & Sahyar, 2021). Education is expected to encourage and facilitate students to understand the values contained in local wisdom or culture and be able to juxtapose them with modern science. The original knowledge of the community formed in local wisdom needs to be explored for its truth or usefulness through a scientific method so that it is reconstructed into scientific knowledge (Festiyed et al., 2022). Understanding the value of life can be done through the habits of the people in a particular area (Putra et al., 2022). Exploration of the local wisdom of Indonesia's plural and dynamic culture is a source of local wisdom and has character values that can be inserted into learning (Sumarni et al., 2016). Learning that can integrate local wisdom and local cultural customs

based on the characteristics and background of students is one of the policy directions for implementing the Merdeka Belajar Curriculum (Kemdikbudristek, 2022). This is based on the principles of implementing the Merdeka Belajar Curriculum, which is holistically oriented, competency-based, contextualized, and personalized following the cultural context, school mission, and local environment and the needs of students (Festiyed et al., 2022). Students with knowledge sourced from their character and culture try to examine the original knowledge through certain methods so that new knowledge will be formed, called scientific knowledge (knowledge construct). Students who gain knowledge through direct experience can improve their cognitive aspects (Arfianawati et al., 2016). This can help improve students' ability to understand the material and investigate and explain the scientific knowledge contained in the original knowledge of the community (Syafei, 2016). Students' relationship with the surrounding community can also be improved by linking indigenous knowledge with modern knowledge (Leksono, 2016; Ramdiah et al., 2020). Thus, students can become cultured individuals and agents of change who can transfer culture to the next generation (Fitria, 2020).

Physics is one of the sciences that can be studied through culture, local wisdom, or local potential. It studies the basic properties of matter and energy and the interaction between the two. Physics is one of the essential sciences because its concepts are used to explain existing phenomena (Wulandari et al., 2022; Tanjung et al., 2020). In addition, physics is one of the most studied sciences because it is widely used in developing science (Frankel, 2011; Koonin, 2018). Many problems are found in physics learning. Physics learning is less concerned with the local culture found in the local area (Astuti & Bhakti, 2021). Physics learning only relies on cognitive aspects that reduce the nature of physics as a process, product, and attitude (Nurhidayat et al., 2020). In addition, teachers only give general examples or are rarely known to students, so physics learning is only imaginary (Tanjung & Nasution, 2022; Tanjung & Dwiana, 2019). Therefore, it is necessary to integrate culture, local wisdom, or local potential in physics learning. The study of culture, local wisdom, and local potential associated with physics can be taken from learning resources such as books and research journals. However, ethnoscience research that specifically examines the topic of physics has not been done much. In addition, previous research has limitations in examining Physics concepts in more depth. Another problem is that information or original records of indigenous knowledge often do not exist, so they are easily eroded by time (Puchumni & Magee, 2019). Therefore, this study aims to identify and review physics concepts from ethnoscience research in Indonesia sourced from research journal articles from 2015-2022. The study results are believed to contribute to the development of ethnoscience science and become the first step for researchers who want to research ethnoscience, especially in physics, from local wisdom and local potential in other regions in Indonesia.

METHODS

This study used a qualitative approach to the Systematic Literature Review method with the PRISMA (Preferred Reporting Items for Systematic Reviews-Meta Analysis) technique (Abelha et al., 2020; Moher et al., 2015; Page et al., 2021). A systematic literature review identifies, evaluates, and interprets research sources by formulating the problem or research topic to be reviewed using literature studies (Calderón & Ruiz, 2015). The research process is carried out to identify and analyze relevant research (Liberati et al., 2009; Asra et al., 2021); the results are used to answer research questions (Moher et al., 2016) and provide guidelines for further research (Snyder, 2019). This technique consists of four stages: identification, Screening, Eligibility, and Inclusion. The initial stage is identification, namely searching for articles using the Mendeley application and Google Scholar based on the keywords "Ethnoscience research in Physics" and "Physics education based on local wisdom" with article restrictions from 2015-2022. In the initial search with Mendeley and Google Scholar, 695 articles matched the keywords, and the screening stage was carried out. At this stage, all articles were screened with criteria according to the year limit, namely 2015-2022, and the suitability of the title, abstract, and specific topics. The third stage is checking the eligibility of the article content according to the research question "How is the physics study of ethnoscience research in Indonesia based on the source of journal articles published in 2015-2022?" and summarized in a data mapping table to make it more effective in the analysis stage. In checking the eligibility, 12 articles were obtained that met the research criteria so that they could proceed to the inclusion stage. Activities carried out at the inclusion stage include reviewing, analyzing article content, and summarizing (synthesizing) the review results to describe findings related to physics concepts in ethnoscience research, which is represented by 12 articles.

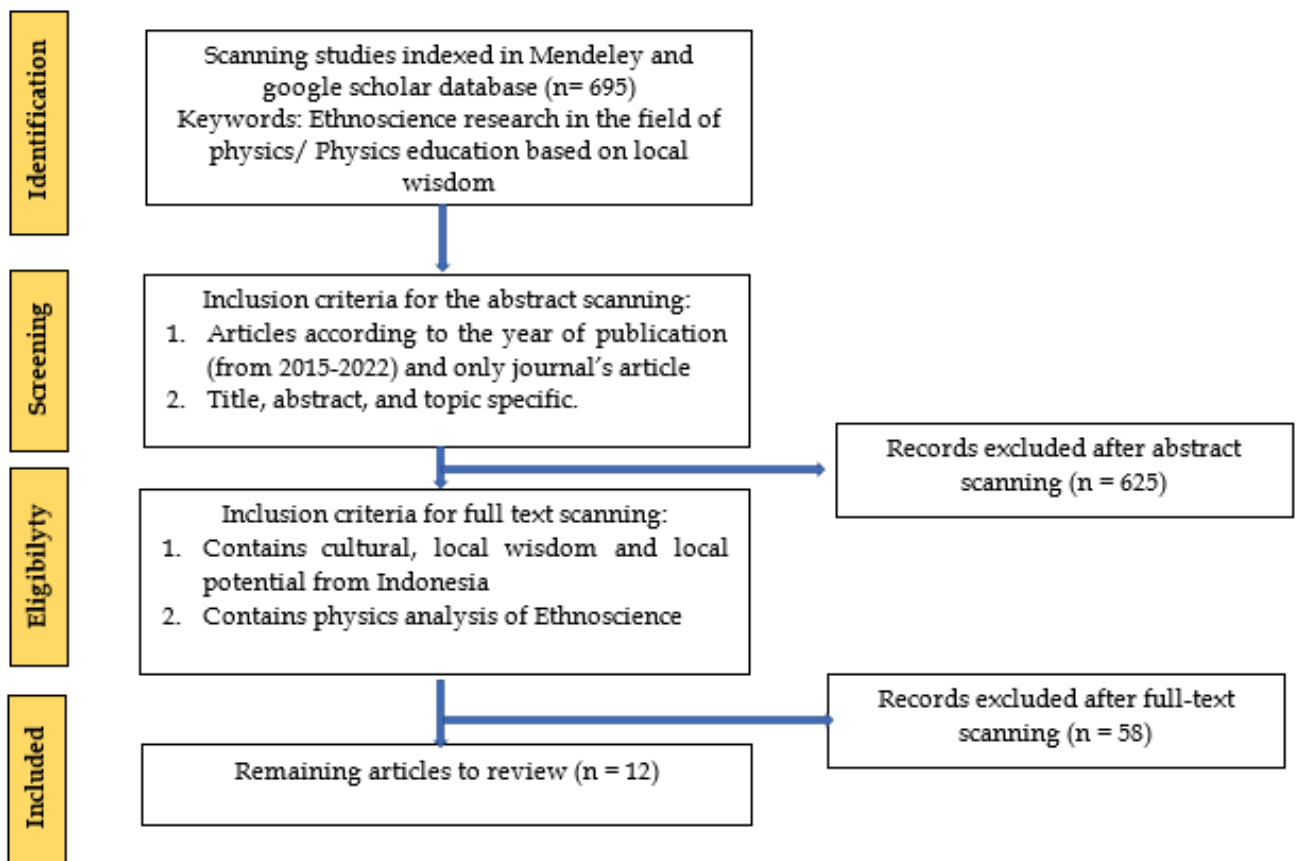


Figure 1. PRISMA Flow Diagram

RESULT AND DISCUSSION

As research data, 12 articles were selected based on the criteria set by the researcher. The mapping of the articles is summarized in Table 1 to identify the identity and strength of the selected articles. The analysis of the articles refers to the research questions that focus on the form of local wisdom or local potential, regional/tribal/cultural origin, and physics concepts presented in Table 1. The physics concepts from the data sources are described and analyzed according to physics theory.

Table 1. Article Identity

Article	Journal & Indexing	Title	Content and Context Related to Physics
Triwiyono et al. (2015)	Journal of Physics and Technology Education/SINTA 4	Identification of Traditional Knowledge of Sentani People and its Opportunities for Physics Learning	Sentani people's knowledge of nature and natural events such as lightning, thunder, and rainbows.
Perwitasari et al. (2016)	Journal of Science Education Research/SINTA 4	Improving Science Literacy through Ethnoscience-Infused Learning of Energy and Its Changes in Fish Smoking	Fish smoking process
Hadi & Ahied (2017)	REKAYASA/SINTA 3	Study of Madurese Ethnoscience in Salt Production Process as Integrated Science Learning Media	Salt production process
Shabrina & Kuswanto (2018)	International Journal of Instruction /Scopus Q1	Android-Assisted Mobile Physics Learning Through Indonesian Batik Culture: Improving Students' Creative Thinking and Problem-Solving	The batik-making process includes boiling, <i>Nyanting</i> , <i>Ngeloret</i> , and drying

Nurhidayat et al. (2020)	ORBITA: Journal of Physics Education Studies, Innovations and Applications/SINTA 4	Ethno Physics in the Form of Implementation of the Concept of Heat in Mojang Priangan Dance	Caloric
Wulansari & Admoko (2021)	PENDIPA Journal of Science Education/SINTA 4	Exploration of Physics Concepts in Dhadak Merak Reog Ponorogo Dance	Dhadak Merak Reog Ponorogo Dance
Tamelan et al. (2021)	VARIABLE/SINTA 4	Exploration of Physics Concepts in the Traditional Matting-Making Process	Making woven mats from Lontar
Fibriana et al. (2021)	EXPERIMENT: Journal of Science Education	Analysis of Grebeg Suro Ritual in Sumber Mujur Village with Ethnoscience Approach as Lumajang Community Tradition	Carrying the mountain of crops at the Grebeg Suro Ritual
Rumiati & Mahardika (2021)	Journal of Physics Education/SINTA 4	Concept Analysis of Mechanical Energy Physics in <i>Egrang</i> Traditional Game as Physics Learning Materials	<i>Egrang</i> Traditional Game
Putri et al. (2022)	PASCAL (Journal of Physics and Science Learning)	Ethnophysical Studies on Candle Dance as Physics Learning Media	Candle Dance
Nurmasyitah et al. (2022)	JPF (Journal of Physics Education)/SINTA 3	Ethnophysical Study of Parabolic Motion Concept in Aceh Traditional Game " <i>Geulengkue Teu Peu Poe</i> "	Traditional Game " <i>Geulengkue Teu Peu Poe</i> "
Lestari et al. (2022)	JPF (Journal of Physics Education)/SINTA 3	Identification of Physics Concepts in Kayangan Api Local Wisdom in Bojonegoro Regency	Kayangan Api
Jefriyanto et al. (2022)	Scientific Journal of Physics Education	Identification of Physical Principles in the Building Poles of Tongkonan Traditional Houses in the Toraja Tribe	House Building Poles

Based on the research results, the study of cultural diversity is still limited to traditional houses, dances, traditional events, and traditional games. Other studies include the process of smoking fish, the process of making salt, the process of making batik, local natural phenomena (*kayangan api*), and natural events associated with indigenous beliefs. These results are summarized in Table 2.

Table 2. Results of Article Analysis

Article	Form of Culture/Local Wisdom/Local Potential	Regional Origin / Tribe	Physics Materials
Triwiyono et al. (2015)	Sentani people's knowledge of nature and its phenomena, colors, sounds, shadows, and measurements	Jayapura District/Papua	Measurement, waves, sound, light reflection and refraction, lunar eclipse and solar eclipse
Perwitasari et al. (2016)	Fish smoking process	Demak Regency/Central Java	The concept of energy and its changes
Hadi & Ahied (2017)	Salt production process	Bunder village and Padelegan village Pamekasan Regency/East Java	Radiation heat transfer.
Shabrina & Kuswanto (2018)	Batik making process	Java	Temperature change and heat transfer

Nurhidayat et al. (2020) Wulansari & Admoko (2021)	Mojang Priangan Dance Dhadak Merak Reog Ponorogo Dance	Sundanese/West Java Ponorogo/East Java	Caloric Equilibrium, Effort, Force, and Newton's Laws
Tamelan et al. (2021)	Making woven mats from Lontar	South Central Timor	Potential energy, mass, force, pressure, effort, equilibrium, Newton's- law, heat
Fibriana et al. (2021) Putri et al. (2022)	Grebeg Suro Ritual Candle Dance	Lumajang/East Java Minang/West Sumatra	Effort and Energy Motion, Equilibrium, Newton's Gravity, and Sound
Nurmasyitah et al. (2022) Lestari et al. (2022) Jefriyanto et al. (2022)	Traditional Game "Geulengkue Teu Peu Poe" The local phenomenon called Kayangan Api Building Support for Tongkonan Traditional House in Toraja Tribe	East Aceh / Aceh Bojonegoro/East Java Tongkonan Ba'tan Ratu/Tana Toraja/South Sulawesi	Parabolic Motion Magnetic and Electric Fields Balance and Pressure

Table 2 shows that the aspects of regions or tribes studied are also still limited to a few regions, such as Jayapura, Demak, East Java, West Java, Jambi, West Sumatra, Aceh, South Sulawesi, and South Central Timor. This regional limitation allows future researchers to conduct research on local wisdom, culture, or potential in other regions that can be associated with physics concepts. In terms of physics, materials studied in these studies are waves, sound, reflection and refraction of light, lunar eclipse and solar eclipse, the concept of energy and its changes, heat, density, gravity, Newton's law, equilibrium, effort, force, motion, magnetic and electric fields. Other physics materials can also be researched through cultural studies, local wisdom, or local potential. However, a deeper understanding of physics concepts is needed to avoid misconceptions (Mufit & Fauzan, 2023; Wulandari et al., 2022). The study of culture and local wisdom is associated with the concept of physics so that the original knowledge of the community can be reconstructed into scientific knowledge. The original knowledge of the community formed in local wisdom needs to be explored for truth or usefulness through a scientific method so that it is reconstructed into scientific knowledge (Festiyyed et al., 2022). Triwiyono et al.'s (2015) research raised the community's indigenous knowledge of events that occur in nature, such as lightning, thunder, and rainbows in the Sentani area of Jayapura district. According to this community, the sun is angry because of human actions, which results in lightning and thunder. According to the concept of physics, lightning occurs due to electron jumps. One of the causes of lightning is the presence of particles floating in the air from industrial waste (Soler et al., 2021). Industrial waste is the work of humans who do not manage waste properly so that it can damage the environment (Chowdhary et al., 2020). If analyzed from the Sentani community's belief that the occurrence of lightning and thunder has something to do with the sun and humans, this can be accepted scientifically because it follows the concept of physics.

Sentani people also believe that the occurrence of rainbows signifies the fruit season. The colors of the rainbow are just like the colors of fruits. According to physical theory, rainbows occur due to the refraction of sunlight by water dots in the air. They are divided into red, orange, yellow, green, blue, indigo, and violet colors (Valenti, 2022). These colors naturally represent the colors of fruits. Another research that examines natural phenomena was conducted in Bojonegoro, East Java, by Lestari et al. (2022), which examines the fire shadow, a place that always emits fire. The concepts of Magnetic Field Physics and electricity can explain this. The fire in the fire shadow is kept alive because of the magnetic field in the earth. There is a change in the value of the earth's magnetic field, which continues to increase if the earth's surface faces the sun. This is what causes the fire in the shadow of fire. Another cause is the electric current flowing through the clay rock. Clay rock is difficult to pass through by fluid, and its permeability is small (Kiftoni & Sungkon, 2014). Research related to culture is in traditional dances (Nurhidayat et al., 2020; Wulansari & Admoko, 2021; Putri et al., 2022). Dancers who move will cause body temperature to increase. After the dancer stops, the body will rest so that there is a decrease in body temperature. In this case, the environment's temperature affects normalized body temperature again. This follows the black principle equation, where the heat released is proportional to the heat received (in an ideal balanced state) (Sofianto & Irawati, 2020). Dance art contains elements of beauty that can be absorbed through the sense of sight (visual) and the sense of hearing (auditive) (Tristiani & Lanjari, 2019). Therefore, a

dancer must have good stamina to perform various movements in the dance to produce a beautiful dance. Dance can be found in a traditional ritual from a particular region. The study of traditional rituals associated with physics has been researched by [Fibriana et al. \(2021\)](#), namely the Grebeg Suro ritual. Grebeg Suro is a cultural tradition of the Sumber Mujur community in Lumajang Regency in the form of a folk party on the night of 1 Suro or 1 Muharram. One of the activities at Grebeg Suro is to bring mountains of crops into natural products. After arriving at the Grebeg event, residents can take and bring home the results of Grebeg Gunung.

The process of carrying the gunung of crops involves effort, which is carried out by someone who utilizes a certain amount of energy. For the gunung to be supported in balance, the right position and comparable effort are required. Comparable effort requires sufficient energy. Energy is obtained from food through the body's metabolic process ([Wulansari & Admoko, 2021](#)). In addition to traditional dances and rituals, another culture studied in traditional houses in the research of [Jefriyanto et al. \(2022\)](#). This study describes the concept of physics in the building pillars of the Tongkonan traditional house in the Toraja tribe. This traditional house is different from other traditional houses in terms of structural systems, and this traditional house is interesting to be the object of research ([Pakan et al., 2018](#)). The Tongkonan house has parts related to the concept of Physics, namely the bottom, the body, and the roof ([Sir et al., 2015](#); [Sir, 2015](#)). Specifically, this study examines the pole part of the house, which is like a frame structure system where beams and columns reinforce each other, and poles are installed horizontally to hold the Tongkonan from moving when a force is applied. The concept of balance and pressure is the physics concept on the pole of the Tongkonan house. There is a balance on the pole of the Tongkonan house because since it was built, the pole does not experience translational and rotational motion when an external force is applied. This is because there are wooden beams installed crosswise on the pole. Meanwhile, the concept of pressure occurs due to the body and roof of the Tongkonan giving a load to the pillar so that the weight force received by the pillar is then forwarded to the supporting stone, which becomes the cross-sectional area. This phenomenon arises due to the compressive force acting on the object per unit area on the surface perpendicularly ([Halliday et al., 2013](#)).

The next research is the concept of physics in traditional games from Aceh, namely Geulengkue Teu Peu Poe by [Nurmasyitah et al. \(2022\)](#) and *Egrang* game by [Rumiati and Mahardika \(2021\)](#). Traditional games have several benefits, namely shaping children's creativity, growing emotional and social intellect, bringing children closer to nature, fostering children's motor skills, training health, honing children's sensitivity, and others ([Rumiati & Mahardika, 2021](#)). The traditional game Geulengkue Teu Peu Poe is a type of game that uses two pairs of wood, with each as a lever and levered wood. The leveraged wood will move to form a parabolic motion to the ground, so it can be said that this game contains the physics concept of the parabolic principle. Parabolic motion is also called bullet motion because this motion that each bullet will cross-fired upwards takes a curved trajectory and forms a certain angle to the horizontal direction ([Abdullah, 2016](#)). This parabolic motion material is a material that is difficult to understand, so through this game, it can be seen directly how parabolic motion occurs ([Afkarina, 2021](#)). To maximize the nature of physics, it is necessary to relate it to everyday life ([Nurhidayat et al., 2020](#); [Tanjung & Bakar, 2019](#)).

Meanwhile, research on the *egrang* game is a type of traditional game that uses a pair of bamboo or wood of a certain size, and there is a footstool ([Rumiati & Mahardika, 2021](#)). The game is played by stepping on and running according to the goals set in the game. This game contains the physics concept of mechanical energy. Mechanical energy comes from the sum of kinetic energy and potential energy that occurs when moving *egrang*. An object that moves has energy in it ([Abdullah, 2016](#)). The next research is the process of making plaits with Palmyra in South Central Timor ([Tamelan et al., 2021](#)). Plaiting is a handicraft that has a technique in weaving, namely by arranging the basic ingredients in the form of overlapping (applying pressure), crossing, folding, and inserting leaves into existing gaps ([Yulika et al., 2017](#)). Making plaits starts with taking palm leaves from the tree by climbing techniques, then cutting palm leaves and stalks, carrying, drying, and separating the sticks with palm leaves. At this stage, there are Physics concepts of potential energy, mass, force, pressure, effort, equilibrium, Newton's Law, and heat.

Other research related to the process of making food, such as fish smoking, also contains Physics concepts, namely the concept of energy and its changes and the concept of heat. This research was conducted by [Perwitasari et al. \(2016\)](#), who utilized the fish-smoking process to increase students' science literacy. The fish smoking process starts with washing fish, choosing the type of fish, coating the belly of the fish with paper, choosing fuel from nature, burning coconut shells, and smoking waste. In these processes, many energy changes are part of the concept of Physics. Smoking fish must be done in the correct stages so as not to lose the fish's nutritional quality when eaten ([Sirait & Saputra, 2020](#)). Another process that contains the physics concept is making salt in Bunder Village, Pamekasan Regency, East Java ([Hadi & Ahied, 2017](#)). Salt making is done by evaporating seawater with sunlight in a settling pond. In this process, seawater experiences continuous evaporation until iron oxidation and calcium salts are deposited. The evaporation process that utilizes sunlight includes the physics concept of heat transfer by radiation ([Kurniawan et al., 2019](#)). The description of physics concepts from these studies can certainly be used as a source of learning for school students. Indigenous

knowledge can be reconstructed into scientific knowledge to provide science learning for students (Sumarni et al., 2016). Learning resources based on indigenous knowledge encourage students to recognize the cultural wealth and background of the Indonesian nation. Preservation of cultural wealth as an effort to raise awareness of local culture can be done with ethnoscience-based learning (Hikmawati et al., 2020; Fahrudin & Maryam, 2022). Many more physics concepts can be explored from culture, local wisdom, or local potential in Indonesia. This is one of the tasks of educators as the frontline of the success of the learning process, which must be responsive to the diverse learning needs of students and consider the culture that students bring into the classroom. As agents of change, educators must make changes in learning (Ko et al., 2016). Educators are expected to be able to relate learning materials to the culture around students and real-world situations (Asrizal et al., 2017; Rikizaputra et al., 2021; Zubaidah & Arsih, 2021; Demeter et al., 2022; Kavanagh et al., 2020). Especially in physics material that is difficult to understand, educators can use learning resources derived from culture, local wisdom, and local potential to be associated with physics concepts to help students understand Physics material and build their character. Physics learning based on local wisdom can improve students' ability to investigate and explain scientific knowledge (Wati et al., 2020), improve students' generic skills (Sinaga & Harahap, 2021), improve academic achievement, develop cultural competence and facilitate higher-order thinking skills (Chou et al., 2018; Rahmawati et al., 2019), and can even strengthen student character (Anggraini & Kusniarti, 2017). Culture-based learning also shows effective results in critical thinking, which is part of higher-order thinking skills (Matsun et al., 2019; Laos & Tefu, 2020).

CONCLUSION

Based on the literature review, it can be concluded that the cultural aspects studied are still limited to traditional dances and games and traditional houses. Other studies are in the form of local wisdom related to natural phenomena. The aspects of regions or tribes studied are still limited to a few regions, such as Jayapura, Demak, East Java, West Java, Jambi, West Sumatra, Aceh, South Sulawesi, and South Central Timor. The aspects of physics material studied are measurement, waves, sound, reflection and refraction of light, lunar eclipse and solar eclipse, the concept of energy and its changes, heat, density, gravity, Newton's law, equilibrium, effort, force, motion, magnetic and electric fields. Other physics materials can also be researched through cultural studies, local wisdom, or local potential from unreached areas in Indonesia. Based on the analysis, these studies have also been able to describe the concept of physics according to existing theories so that it can be used as a learning resource for students. The findings show that it is necessary to explore more widely and more deeply related to ethnoscience in physics from culture, local wisdom, and other local potential in Indonesia to be implemented in the classroom.

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