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ETHNOSCIENCE-BASED SCIENCE TEACHING AND LEARNING TO IMPROVE STUDENTS' COGNITIVE LEARNING OUTCOMES: A SYSTEMATIC LITERATURE REVIEW

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Abstract. This study addresses students' low cognitive learning outcomes in natural science subjects caused by several factors, one of which is the students' inadequacy to analyze and communicate different scientific topics. Ethnoscience-based science teaching and learning, with its direct observation, is therefore viewed as a suitable approach to address the problem as it engages students to identify scientific problems, explain phenomena scientifically, and draw conclusions. The goal of this study is to analyze the importance of the role of ethnoscience-based science teaching and learning in improving students' cognitive learning outcomes. The systematic literature review is selected as the research method. The process of data collection is done through collecting data from many different sources; they are articles and scientific journals indexed by Scopus and accredited journals sinta 1 and 2. The study findings indicate that the ethnoscience-based science teaching and learning improve students' creative and critical thinking skills, and thus increasing the students' cognitive learning outcomes.

INTRODUCTION

Natural Sciences are sciences studying phenomena that occur in nature (Fitriyati et al., 2017). Science is not only a collection of knowledge in the form of facts, concepts or principles, but is also a process of discovery. Therefore, in principle, science teaching and learning emphasize the provision of direct learning experiences. The main goal of the science teaching and learning is to ensure that students are able to understand science concepts in a simple way, and thus being able to apply the scientific method. The science teaching and learning facilitate students to be scientific in solving the problems they face while being more aware of the greatness and power of the creator of nature (Widana et al., 2021). In relation to the science teaching and learning process, the quality of education in Indonesia, especially in the field of science, has been very poor. Being compared to other countries' education, the quality of education in Indonesia is still far behind. The indicators being referred to come to this conclusion are the results of the Program for International Student Assessment (PISA), held every three years, which has always placed Indonesia in the top ten from the bottom, especially in the field of science. Hence, educational institutions are expected to focus more

on the quality of education which is at the moment still considered to be stagnant proven by the Indonesian students' science scores presented in table 1 below.

Table 1. Indonesia Ranking According to PISA

Year of Study	Subject	Average Score		Indonesia Ranking	Number of Study-Participating Country
		Indonesia	International		
2000	Science	393	500	38	41
2003	Science	395	500	38	40
2006	Science	393	500	50	56
2009	Science	383	500	60	65
2012	Science	382	500	64	65
2015	Science	403	500	62	69
2018	Science	396	500	71	79

*Taken dan analyzed from PISA results

One of the efforts to overcome the problem is to implement a teaching and learning approach that can improve students' learning outcomes. The approach implemented has to be adaptable to the science teaching and learning process. In accordance to the gaps portrayed above, teachers need to play an important role in choosing an effective learning approach to develop students' cognitive abilities. One of the approaches that can be implemented to improve students' learning outcomes in natural science subjects is ethnoscience-based teaching and learning process.

Ethnoscience is etymologically derived from the Greek word "ethnos" which means "nation" and Latin word "scientia" which means "knowledge". Ethnoscience, therefore, can be interpreted as knowledge owned by a nation or more precisely ethnic groups or certain social groups (Sudarmin, 2015). In the context of science teaching and learning, ethnoscience can be defined as an activity of transforming the indigeneous science of society into scientific science. The indigeneous science is basically the knowledge sourced from concrete experience obtained through community interaction with their environment, and also through traditional education passed down orally from generation to generation (Suja, 2010). The indigenous science is reflected through the local wisdom as an understanding of nature and cultures that develop among the people.

Science teaching and learning resources can be developed based on the local uniqueness and wisdom. Local-wisdom based science teaching and learning, and its resources, create a more contextual teaching and learning which facilitate students to develop their scientific literacy skills and educate students to integrate the scientific concepts with their everyday lives. The local wisdom-based teaching and learning help students foster sense of belonging and cultural identity (Damayanti et al., 2013), instill conservation values and characters (Sudarmin, 2015), increase students' learning motivation (Munawaroh et al., 2017), improve students' creative thinking skills (Almuharomah et al., 2019), as well as students' scientific literacy skills (Sudarmin, 2015).

Based on the background above, this study aims to analyze the importance of the role of ethnoscience-based natural science teaching and learning in improving students' cognitive learning outcomes.

METHOD

The systematic literature review is used as the research method in this study; it describes the findings of several previous studies, which are used as references, and other theoretical research data. The findings of those previous studies are the foundations for this study to construct an effective ethnoscience-based science teaching and learning that can improve student learning outcomes. Hence, in this study, the researcher acts as a planner, implementer, as well as enumerator and analyst of the different sources of data used.

In the process of collecting the data, different scientific journals and scientific articles sourced from Google Scholar and Scopus are being used as references. In addition, this study uses descriptive analysis as the data analysis technique, through which the data obtained are analyzed and examined thoroughly, systematically, and critically to be later described in a narrative manner so that it can be easily understood and thus being able to provide comprehensible and up-to-date information regarding the problem being researched.

The descriptive data analysis technique used in this study is PRISMA (Preferred Reporting Items for Systematic Reviews and Meta Analysis). Below are the PRISMA-based writing procedures being implemented in this study: (1) defining eligibility criteria, to be eligible for source articles (references), the articles have to be published between 2017 and 2022 and should be written in English or Bahasa Indonesia; (2) defining information sources, sources of data are obtained through journal search application called Publish or Perish version 8; (3) literature selection, is done by determining keywords, which are ethnoscience, local wisdom, indigenous knowledge, and education. The articles being selected are international articles indexed by Scopus and national articles; (4) data collection, by using the Publish or Perish version 8 application to search the keywords, a total of 984 articles are found. The articles are then sorted based on the criterion of those that discuss either ethnoscience or student learning outcomes. The process is done by checking the article title and abstract as well as the reputation of the journal in which the article is published. Through the selection process, 60 articles are found to meet the literature parameters; and (5) selection of data items, a total of 60 articles selected at the data collection stage were further sorted by doing intensive reading of the articles to evaluate the compatibility between the findings and the research objectives. Based on the selection process in this stage, 15 articles are qualified for further analysis

RESULTS AND DISCUSSION

Ethnoscience-based science teaching and learning are teaching and learning process that aim to integrate cultures with science materials. The implementation of ethnoscience-based science teaching and learning at school can be integrated with different instructional models, media, and materials. The materials developed in ethnoscience-based science teaching and learning are cultural environment and cultural knowledge oriented. Ethnoscience-based science teaching and learning are closely related to daily life. As a result, it can facilitate the students in the learning process of natural sciences. The implementation of ethnoscience in science teaching and learning stimulates students to be more aware of the socio-cultural environment, and thus to encourage them to develop and preserve local culture and values.
Based on the PISA results elaborated in the background, students' cognitive learning outcomes in science subjects are considered low. This can be caused by several factors, one of which is the students' inadequacy to analyze and communicate different scientific topics while doing basic interpretations for such explicit concept, not to mention the interpretation

of complex abstract concepts regarding the students' daily lives. The phenomenon happens due to the students' poor thinking skills and the science teaching and learning process that pays little attention to the students' socio-cultural environment. Most of the students are incapable of reflecting scientific concepts on their real lives and fail to grasp scientific concepts during their science learning process. Considering that science puts the emphasis on daily-life related concepts and principals, an effort to collaborate science teaching and learning with the concept of everyday life needs to be done.

The ethnoscience-based science teaching and learning is believed to create the teaching and learning process that effectively associates science and daily life as it encourages direct observation that engages the students to identify scientific problems, explain phenomena scientifically, and draw conclusions. The cultural values being conveyed through the ethnoscience-based science teaching and learning does not only involve local wisdom, but also covers abstract knowledge embodied in the culture itself. An example of cultural values that can be taught by emphasizing both local wisdom and abstract knowledge is the philosophy about social life. The materials can be conveyed through different learning themes to ensure that the cultural values become parts of students' character development. When the characteristics of scientific work and critical thinking skills have been fostered through science teaching and learning, the students become accustomed to developing critical thinking skills and scientific work skills, and thus improving students' learning outcomes.

Table 2 below shows the findings of the anaylsis and summaries of several research journal articles, both domestic and international, related to ethnoscience-based science teaching and learning.

Tabel 2. Research Findings related to Ethnoscience-based Science Teaching Learning

No	Author and Year of Publication	Name of Journal	Research Finding
1.	Zidny & Eilks, 2022	*Education Sciences (MDPI)*	Green and Sustainable Chemistry teaching and learning are enhanced by the integration of indigenous people's (Baduy) culture. Participants of this study found the lesson to be highly interesting and personally relevant to them. Learning chemistry in real life context by adapting materials and values from their cultural environment is seen as a positive experience which helps the participant to develop their scientific knowledge. The participants' practices of comparing and evaluating the advantages and disadvantages of different extraction methods facilitate participants to be directly exposed to the principles of green chemistry and to reflect on the importance, purposes, and advantages of green chemistry.
2.	Patricia et al., 2022	*International Journal of Active Learning*	Problem-based chemistry teaching and learning with an ethnoscience approach is able to develop students' critical thinking skills and creative

No	Author and Year of Publication	Name of Journal	Research Finding
			thinking. The ethnoscience approach in problem-based teaching and learning emphasizes students' active participation in the learning process by integrating the cultural context or local wisdom. The teaching and learning process encourage the students to learn more actively in a more meaningful way that the students' critical and creative thinking skills are improved significantly as they understand the concepts thoroughly.
3.	Risdianto et al., 2020	*Universal Journal of Educational Research*	The implementation of ethnoscience-based Physics teaching and learning with a direct learning model influences students' critical thinking skills. Ethnoscience-based teaching and learning create a more contextual learning by asociating the teaching and learning process with the students' daily experiences. As a result, the students' motivation in participating in the learning process also increases.
4.	Usman et al., 2019	*International Journal of Innovation in Science and Mathematics*	The ethnoscience-based module developed by the researchers is considered very feasible to be used in the science teaching and learning process in terms of the materials and its characteristics. The implementation of ethnoscience-based teaching and learning module improves the students' learning outcomes. The students also gave positive responses to the use of the ethnoscience-based learning module.
5.	Sudarmin et al., 2018	*Journal of Physics: Conference Series*	Direct learning model with ethnoscience-based teaching and learning videos on colloidal topic improves students' cognitive abilities and critical thinking. In addition, the students become more motivated as they are participating in the learning process which integrates ethnoscience-based video.
6.	Damayanti et al., 2017	*Journal of Innovative Science Education*	The ethnoscience-integrated science teaching and learning model developed by the researcher is considered feasible to be implemented in the learning process as it improves students' learning outcomes and creative thinking skills.
7.	Sudarmin et al., 2017	*Journal of Physics: Conference Series*	The module on the additives topic with an ethnoscience approach developed by the researchers meets the very feasible criteria of the National Education Standards Agency in terms of the content feasibility, language feasibility, and presentation feasibility. The implementation

No	Author and Year of Publication	Name of Journal	Research Finding
			of the module developed by the researcher indicates positive outcomes as it gives profound impact on students' learning. It can be concluded that the modules on the additives topic with an ethnoscience approach improves students' learning outcomes and entrepreneurial characters.
8.	Nurcahyani et al., 2021	*Journal of Physics: Conference Series*	The implementation of ethnoscience in Physics teaching and learning significantly influences the students' competences in terms of cognitive and affective domains. Based on this study, there are very few implementations of ethnoscience in Physics subject; it is more common to find the implementation of ethnoscience in the Integrated Science teaching and learning in the elementary to junior high levels. Local wisdom and environmental based Physics and Integrated Science teaching and learning can be integrated into science instructional materials.
9.	Usmeldi & Amini, 2020	*Journal of Physics: Conference Series*	The effect of the local-wisdom based Integrated Science teaching and learning on increasing students' competences can be noticed from both cognitive and affective domains. In relation to the cognitive domain, a significant difference in terms of competence is found between the students who take part in local-wisdom based Integrated Science teaching and learning and the students who are taught under a expository teaching. Based on the research findings, there is a large effect of local-wisdom based Integrated science teaching and learning on the cognitive domain of the junior high school students. In addition the effect of local wisdom-based Integrated Science teaching and learning on the affective domain of junior high school students is considered to be medium.
10.	Iriani & Kurniasih, 2019	*International Journal of Recent Technology and Engineering (IJRTE)*	(1) There is a significant difference in critical thinking skills between the group of students who are taught colloid materials by using the Problem-based learning model assisted by Sasirangan (ethnoscience) worksheet and the group of students who are taught colloid materials by using expository teaching (2) There is a significant difference in the student' learning outcomes in terms of cognitive, affective, and psychomotor domains between the

No	Author and Year of Publication	Name of Journal	Research Finding
			experimental group taught by using the Problem-based Learning model assisted by the Sasirangan (ethnoscience) worksheet and the control group taught by using the expository model, in which the experimental group shows better learning outcomes than the control one. (3) The students claim that Problem-based Learning model assisted by sasirangan (ethnoscience) worksheet is preferable to the expository teaching and learning model in studying colloidal materials.
11.	Utete et al., 2017	*Journal for Studies in Humanities and Social Science*	Ethno-mathematics and ethno-science display a realistic mathematics and science history which refers to various examples of everyday life problems from many different cultures. The process of learning mathematics and science for each individual is unique as it is possible for each individual to associates the process with his/her own living conditions, upbringing, background, skills, and interests. The ethno-mathematics and ethno-science approaches provide many benefits for the education curriculum system, one of which is making students aware of the fact that mathematics, science, and culture are intertwined with knowledge and are manifested in the form of symbols, jargon, codes, myths, as well as reasoning and decision making methods. In addition, ethno-mathematics and ethno-science encourage students to be aware, and thus to acknowledge that all people, either literate or color blind, are contributors to the development of mathematics and science as cultural products.
12.	Dike & Rowland, 2020	*International Journal of Innovative Social & Science Education Research*	The implementation of ethnoscience in the science teaching and learning improves the students' science learning outcomes on energy and sound. It is concluded that the cultural environment plays an important role in the learning process. The findings also indicate that there is no gender disparity in the use of cultural and environmental-based resources in teaching science.
13.	Aderonmu & Adolphus, 2021	*International Journal of Trend in Scientific Research and*	Teachers are viewed as the implementers of the curriculum; it implies that teachers are the key stakeholders who are taken into consideration during the curriculum development and implementation process. It is also concluded

No	Author and Year of Publication	Name of Journal	Research Finding
		Development (IJTSRD)	that physics teachers, both in urban and rural schools, teach Physics on the topics of interaction of matter, space and time, conservative forces, waves motion without material transfer, as well as stationary and moving charges, in line with the demands of the curriculum. In addition, the entire physics materials can be taught using an ethnoscience approach. Teaching Physics by integrating indigenous scientific knowledge increases both students' motivation in learning physics and students' understanding of the physics concepts being taught.
14.	Ibe & Nwosu, 2017	*British journal of Multidisciplinary and Advanced Studies*	Being compared to the teaching and learning process without an ethnoscience approach, the ethnoscience-integrated teaching and learning bring about better science process skills of the students in Biology. This is due to the fact that ethnoscience approach facilitates students to learn from their surroundings, and that makes learning becomes contextual and engaging for the students to participate actively in the process.
15.	Ajayi et al., 2017	*ICSHER Journal*	The students' chemistry learning outcomes on the topic of the separation of mixtures increases with the integration of ethnochemistry with the teaching and learning process. The students' learning outcome improvement is in line with the students' active engagement during the learning process which is the result of the ethnochemistry approach that allows the students to use their existing cultural knowledge in solving problems in class.

Based on the findings of the studies displayed above, some information can be obtained, they are: the ethnoscience teaching and learning approach provides positive learning experiences (Zidny & Eilks, 2022; Usman et al., 2019; Iriani & Indah, 2019), the ethnoscience approach develops students' critical and creative thinking skills (Patricia et al., 2022; Risdianto et al., 2020; Iriani & Indah, 2019), ethnoscience teaching and learning raise students' awareness of the fact that science is a cultural product (Utete et al ., 2017), ethnoscience teaching and learning approach increase students' motivation in learning and improves students' understanding of the concepts being taught (Aderonmu, Temitope S. B Adolphus, 2021), ethnoscience teaching and learning approach improve students' science process skills (Ebere & Appolonia, 2017), and ethnoscience-based teaching and learning improve students' learning outcomes on the affective, psychomotor, and cognitive domains (Usman et al., 2019; Sudarmin et al., 2018; Damayanti et al., 2017; Sudarmin et al., 2017;

Nurcahyani et al., 2021; Usmeldi & Amini, 2020; Iriani & Indah, 2019; Dike & Rowland, 2020; Ajayi et al., 2017).

The ethnoscience provides the opportunities for the students to develop their creativity, and thus improving the students' creative and critical thinking abilities through science teaching and learning process. The students are engaged to be more active in the learning process by the implementation of the ethnoscience-based science teaching and learning as it puts emphasis on discussions and doing experiments. The discussion process provides opportunities for the students to share their ideas and encourages the students to be more active that it develops the students' creative thinking. The implementation of ethnoscience-based science teaching and learning also expands the students' learning potential in discovering their own concepts which is done through identifying local cultural values as learning materials, integrating their own concepts or beliefs that are rooted in cultural science, and developing commenting and problem solving skills which lead to the the development of critical thinking skills (Temuningsih et al., 2017).

Ethnoscience-based science teaching and learning also improves students' cognitive learning outcomes. The improvement is associated with the effectiveness of ethnoscience-based science teaching and learning in increasing students' creative and critical thinking skills, students' science process skills, and students' motivation in participating in ethnoscience-based teaching and learning process. In addition, ethnoscience-based science teaching and learning, with its emphasis on contextual learning, also facilitate students to develop self-understanding, and thus fostering awareness and environmental responsibility culture (Afdalia et al., 2020; Utami et al., 2018). Ethnoscience-based science teaching and learning also provides educators with insight of knowledge about the approach to instill local wisdom values through science teaching and learning (Afdalia et al., 2020; Huda et al., 2020). The integration of ethnoscience creates an authentic and meanigful learning experiences for students (Fitriani et al., 2019). Moreover, ethnoscience-based science teaching and learning broaden the students' vision to see science not just as it is but as a meaningful process that can be experienced. The ethnoscience-based teaching and learning also provides opportunities for students to be enganged in a thought process to construct their own knowledge.

Integrated Science is not the only subject that can be integrated with enthoscience; The branches of natural sciences, such as Physics, Chemistry and Biology, can also be integrated with ethnoscience-based teaching and learning. Table 3 below shows the distribution of the materials that have been studied based on the journals being analyzed.

Table 3. The Integration of Ethnoscience with the Teaching and Learning Process of Integrated and Branches of Natural Science

No	Author and Year of Publication	Research Title	Subject of Study	Topic	Research Method
1.	Zidny & Eilks, 2022	Learning about Pesticide Use Adapted from Ethnoscience as a Contribution to Green and	Students, Baduy area, West Java, Indonesia	Green Chemistry	Quasi-eksperiment

No	Author and Year of Publication	Research Title	Subject of Study	Topic	Research Method
		Sustainable Chemistry Education			
2.	Patricia et al., 2022	Analysis of Studens' Critical and Creative Thinking Skills on the Application of A Problem-Based Learning Model Contained with Etno-Science (Etno-PBL)	Senior high school students, Bengkayang area, West Kalimatan, Indonesia	Chemistry	Quasi-eksperiment
3.	Risdianto et al., 2020	The Effect of Ethno Science-Based Direct Instruction Learning Model in Physics Learning on Student' Critical Thinking Skill	Senior high school students, Bengkulu, Indonesia	Physics	Quasi-eksperiment
4.	Usman et al., 2019	Ethno-Science Based Module Development on Material Substance and its Characteristics to Improve Learning Achievement of Junior High School Students	Junior High scool students, Banda Aceh, Indonesia	Natural Sciences	Quasi-eksperiment
5.	Sudarmin et al., 2018	The Use of Scientific Direct Instruction Model with Video Learning of Ethnoscience to Improve Studens' Critical Thinking Skills	Senior high school students, Gombong area, Central Java, Indonesia	Chemistry	Quasi-eksperiment
6.	Damayanti et al., 2017	Pengembangan Model	Junior high scool	Natural Sciences	Research and Development

No	Author and Year of Publication	Research Title	Subject of Study	Topic	Research Method
		Pembelajaran IPA Terintegrasi Etnosains untuk Meningkatkan Hasil Belajar dan Kemampuan Berpikir Kreatif	students, Pati area, Central Java, Indonesia		
7.	Sudarmin et al., 2017	Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student's entrepreneurship	Junior high school students, Brebes area, Central Java, Indonesia	Natural Sciences and Entrepreneurship	Research and Development
8.	Nurcahyani, et al., 2021	Ethnoscience learning on science literacy of physics material to support environment	Primary to secondary level students, Indonesia	Physics and Environmental Science	Meta-Analysis
9.	Usmeldi & Amini, 2020	The effect of integrated science learning based on local wisdom to increase the students competency	Junior High School in Padang, Indonesia	Physics, Chemistry, Biology and Earth and Space Sciences	Quasi-eksperiment
10.	Iriani & Kurniasih, 2019	The Difference in Critical Thinking and Learning Outcome Using Problem Based Learning Asissted with Sasirangan Ethnoscience	Senior high school students, Banjarmasin, South Kalimantan	Colloid Chemistry	Quasi-eksperiment

No	Author and Year of Publication	Research Title	Subject of Study	Topic	Research Method
		Student Worksheet			
11.	Utete et al., 2017	Exploring how modern sciences impede the development of indigenous knowledge (IK)[Ethno-science and Ethno-mathematics] in the Kavango East region: a case study	Senior high school students, East Kavango area, Republic of Namibia	Natural Sciences and Math	Case Study
12.	Dike & Rowland, 2020	Students' Understanding of Sound Energy Using Ethnoscience Based Instruction in Basic Science	Junior high school students, Abua/Odual area, Rivers State	Natural Sciences	Quasi-eksperiment
13.	Aderonmu & Adolphus, 2021	Thinking through Ethnoscientific Scenarios for Physics Teaching Implication for Curriculum Implementation	Junior high school students and teachers, many different areas of Rivers State	Physics	Quasi-eksperiment
14.	Ibe & Nwosu, 2017	Effects of Ethnoscience and traditional laboratory practical on science process skills acquisition of secondary school biology students in Nigeria	Junior high school students, Nsukka area, Enugu States, Nigeria	Biology	Quasi-eksperiment
15.	Ajayi et al., 2017	Use of ethnochemistry teaching	Senior high school students,	Chemistry	Quasi-eksperiment

No	Author and Year of Publication	Research Title	Subject of Study	Topic	Research Method
		approach and achievement and retention of senior secondary students in standard mixture separation techniques	Ohaozaraarea, Ebonyi State		

Based on the data above, it can be concluded that ethnoscience can be integrated with Physics, Chemistry, Biology, and integrated natural sciences teaching and learning. As there is no limit to the materials that can be integrated with the ethnoscience approach, the opportunities for other researchers to develop ethnoscience-based instructional media and modules for science teaching and learning are wide open. Taking into account the fact that the implementation of ethnoscience-based science teaching and learning bring considerable advantages, especially in improving students' cognitive learning outcomes, the development of instructional media and modules is important for teachers as it can be beneficial for practical use.

Table 3 also shows that ethnoscience-based teaching and learning has been developed in different parts of the world, such as Namibia and Nigeria. This proves the significance of ethnoscience integration with the teaching and learning process. In addition, it indicates that various countries across the world are also aware of the importance of fostering and preserving local culture and wisdom through education.

CONCLUSION

Based on the findings, ethnoscience-based science teaching and learning play a pivotal role in developing the students' problem-solving skills during the learning process. The ethnoscience can be integrated with the natural sciences teaching and learning through the adjustment of the instructional models, materials, and media so that it can emphasize on students' background. In addition, the findings of the study prove that ethnoscience-based science teaching and learning effectively develop the students' creative and critical thinking. In conclusion, the ethnoscience-based science teaching and learning can be implemented to improve students' cognitive learning outcomes as it stimulates students to be aware of their own thought and respond process to problems through understanding the pattern behind each problem. Based on the results of this study, the suggestions given are teachers should create simple ethnoscience learning media for learning can do and in to develop ethnoscience learning, teachers should use local wisdom in their area according to the characteristics of students to train or improve student learning outcomes

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