Ethnoscience learning on science literacy of physics material to support environment: A meta-analysis research

Dwi Nurcahyani1*, Yuberti1, Irwandani1, Henita Rahmayanti2, Ilmi Zajuli Ichsan2, Md. Mehadi Rahman3

1Universitas Islam Negeri Raden Intan Lampung, Lampung, Indonesia
2Universitas Negeri Jakarta, Jakarta, Indonesia
3University of Dhaka, Dhaka, Bangladesh

* Corresponding author: dewinurcahyani81@gmail.com

Abstract: Recently, Ethnoscience learning has become the focus of researchers in various regions. It provides a mixed-nuance of culture and science. This learning is a breakthrough in the world of education because it combines science and culture. This research aimed to identify the influence of Ethnoscience learning on students' scientific literacy. The method employed was a meta-analysis. This data source was ten research articles obtained from the Scopus database based on specific search criteria. The analysis was done through 5 stages, namely Orientation, Conceptualization, Investigation, Discussion, and Conclusion. Based on the analysis of the research results, Ethnoscience learning significantly increased students' scientific literacy. Therefore, Ethnoscience learning in schools is very important to improve students' scientific literacy skills in developing science education for students in the 21st century and to keep environment.

Keywords: Ethnoscience, meta-analysis, scientific literacy.

1. Introduction
Science learning in Indonesia currently implements the 2013 curriculum, therefore, science subjects in schools refer to the 2013 curriculum [1]. One of the main contents of the 2013 curriculum is the love of culture and the nation [2]. Culture has a strong influence on students’ background knowledge of science [3]. Broadly speaking, the 2013 curriculum directs students to learn actively and independently. One thing that can be achieved from the 2013 curriculum is that students can seek information, explain a phenomenon that exists in everyday life, and solve existing problems and provide solutions to a problem [4]. Science education is nature and observation-based study which ensures students cognitive development in an appropriate way.

According to Sudarmin, the recommended learning approach in the world of science education in Indonesia today is Ethnoscience because this learning combines students’ culture and science [5]. Besides, by using the participant culture-based education, students can carry out direct observations so that they can identify scientific problems, explain scientific phenomena, and draw conclusions regarding natural conditions as well as natural changes through human activities [6]. This matter is in line with the 2006 PISA statement which defines 3 aspects of competence or the process for increasing scientific literacy in students using the Ethnoscience approach.
Scientific literacy plays an important role in the development of the current era of globalization and must be mastered and developed by students [7]. Scientific literacy is knowledge and understanding of scientific concepts and the ability to identify a question and draw some conclusions based on identified evidence [8]. The results of the PISA evaluation since 2000 show that the average score of Indonesian students was far below the international standard, for example, one of the PISA results in 2012 shows that the average score of Indonesian students was 382. Indonesia was ranked 64 out of 65 participating countries [9]. The results of this research show that the science literacy skills of Indonesian students have increased [10].

The community thinks that the formal learning process is separated from the cultural acculturation process. Not only that, many residents think that the education process in schools has a bigger role compared to local cultural traditions which are meaningless and considered lower [11]. Small perspectives often create little knowledge. Thus, the one-sided perspective of culture, in this case only the original science, will not improve the mindset [12]. In reality, science education which reveals cultural facts in students' real-life is still rare [13].

Research by Yuliama (2017) shows that Ethnoscience-based education can improve scientific thinking skills in the local culture. Ethnoscience-based learning is good for education and can enhance the local culture perspective [14]. In several previous studies, Ethnoscience-based education can improve science process skills as well as students' appreciation of the growing local culture [15]. Research related to Ethnoscience has been conducted at the elementary, secondary, to university levels. However, the results of this research only show changes in the relationship between the concept of science and local culture, learning achievement, science process skills, and appreciation and assumptions toward local culture.

This article aimed to discuss the development of Ethnoscience learning, to improve students' scientific literacy towards science learning, and to relate it to culture. Referring to the research results, there was an increase in student learning outcomes through the Ethnoscience approach because Ethnoscience-based science education made students more interested, enthusiastic, and happy [16].

2. Research Method
This research employed the meta-analysis method by reviewing 10 international journals to determine whether Ethnoscience learning can affect students' scientific literacy. The meta-analysis method involved mixed literature reviews as well as the conclusions reinterpreted from the research in a particular field [17]. This research was focused on several previous journals using the analytical method. In carrying out the meta-analysis research, there are several steps according to De Coster (2009), including ensuring and pursuing the research topic to be summarized, finding and collecting research on predetermined topics and selecting them, carrying out the effect size calculation, recognizing whether there is a heterogeneity in the effect size, and drawing conclusions and interpreting the results [18].
International journals in the last five years had been searched by first looking for some research results on Ethnoscience through the web of science and the Scopus database using the keyword ‘Ethnoscience’. Then, these keywords were associated with the student learning achievement, students' scientific literacy skills through the ‘science literacy’ keywords. From the results of searching, 15 articles were found. To find a detailed description of the impact of Ethnoscience learning, the analysis was focused on the results of research that employed the experimental or quasi-experimental designs. This research was focused on the meta-analysis by researching several research findings on Ethnoscience and explored their impacts in various forms of scientific disciplines.

The technique of data collection was an observation of the components to be examined in 5 research reports and then grouped them into the analysis unit group. The instrument used in collecting the information was an observation sheet using data coding [19]. The variables used for the coding process and producing the information needed to calculate the magnitude of the influence of Ethnoscience on students' scientific literacy skills were the name of the researcher, the year of research, the country of the researcher, the level of education, the variables, and the research design [20]. The effect size was calculated using the Glass formula:

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UE = \frac{\text{Effect}_{\text{Experiment}} - \text{Effect}_{\text{Control}}}{s_{d}}
\]

Table 1. Effect Size Criteria

| Effect size | Correlation Coefficient |
|-------------|-------------------------|
| Very small  | \(\leq 0.15\)           |
| Small       | \(0.15 \leq \text{effect size} \leq 0.40\) |
| Moderate    | \(0.40 \leq \text{effect size} \leq 0.75\) |
| Large       | \(0.75 \leq \text{effect size} \leq 1.10\) |
| Very large  | \(1.10 \leq \text{effect size} \leq 1.45\) |

3. Result and Discussion

The numbers of the obtained articles related to Ethnoscience, in general, were 157. The data was then analyzed and selected in detail to search for things related to science learning and physics learning. It was found that 10 articles discussed the Ethnoscience in science learning. The obtained results were then analyzed comprehensively on the integration of physics and science studies and how Ethnoscience learning affected every level of education (primary, secondary, and higher education). Table 1 shows the research material, the effect of learning, and the effect size in detail.

| Researchers | Country | Material | Levels | Variable | Total Respondents | Size Effect |
|-------------|---------|----------|--------|----------|-------------------|------------|
| Sarwi, et. al (2020) | Indonesia | Science | Elementary school | Science Literacy | 56 | 0.58 |
| Researchers                                      | Country          | Material                          | Subjects                                      | Level of education | Effect Size  | Notes                                      |
|--------------------------------------------------|------------------|-----------------------------------|-----------------------------------------------|--------------------|--------------|--------------------------------------------|
| Yovita Yuliana Gunawan et al (2020)              | Indonesia        | Force field (Physics)            | Senior high school                            | Critical thinking skills | NA           | NA                                         |
| Setyo Eko Atmojo et al (2019)                    | Indonesia        | Science                           | Elementary school                             | Science literacy and scientific character | NA           | 0.81                                       |
| Cici Dwi Tisa Haspen and Syafriani (2020)        | Indonesia        | Integrated Ethnoscience one-module. (Physics) | Senior high school                           | Motivation to learn physics | NA           | 0.72                                       |
| Kurniawan and Syahfriani                         | Indonesia        | Physics                           | Senior high school                            | Finding physics concepts according to the needs and conditions of students | NA           | 0.66                                       |
| Used and Risda Amini (2019)                      | Indonesia        | Science                           | Junior high school                            | Student competence  | NA           | 1.9                                        |
| S. Sudarmin et al (2018)                         | Indonesia        | Mathematics and science           | Islamic senior high school                    | Critical thinking skills | NA           | 0.70                                       |
| Eko Risdiyanto (2020)                            | Indonesia        | Physics                           | Senior high school                            | Critical thinking skills | NA           | 1.49                                       |
| Sudarmin et al (2017)                            | Indonesia        | Science                           | Islamic Junior high school                    | Learning outcomes   | 32           | 0.90                                       |
| PW Hastuti et al (2017)                          | Indonesia        | Science                           | Junior high school                            | Scientific learning and student science literacy | 64           | 0.73                                       |

Table 1 displays the searched data that covered the identity of researchers, country, material, subjects, level of education, total respondent, and the effect size. The average effect size was 0.84 which means Ethnoscience learning had a high influence on science learning. Ethnoscience learning
had a positive impact on science learning in schools. At the primary school level, the application of local wisdom in learning can help students to develop positive characters. Atmojo's research results showed that the application of local wisdom-based learning improved students’ learning outcomes and scientific literacy skills [21]. The intermediate level, Ethnoscience learning affected critical thinking skills and increased students’ competence based on their knowledge and attitudes of science because the research case was focused on the application of Ethnoscience learning in the daily-life. It made students more motivated because the students often experienced the studied material directly so that the learning became meaningful [22]. At the upper secondary level, students can be directly involved in concept discovery and explain phenomena in the environment so that they can think more critically about the findings. This also affected the correct learning attitude towards the mastery of science concepts (physics) and students' scientific literacy. Ethnoscience knowledge generates from the community which can test the truth through literature review, scientific explanation, work and scientific processes; therefore it can be used as a source of innovative and applied to learn about science learning in the classroom [23].

Students' low scientific literacy can be improved by using effective learning. According to [24] the application of science teaching and learning with ethnoscience approach can be possible if the ability of teachers can combine indigenous knowledge with scientific knowledge. But most of the science teachers don’t have this ability. As teachers have limitations in linking concepts, processes and contexts of science and scientific knowledge, so in school science, learning gets less attention to local culture that developed in the community [25]. A teacher is required to master the skills and abilities, adapt to the current era of new technology, use media, choose a learning model that is suitable for the 21st-century, and develop instruments that will be used during the learning process [26]. The focus of science teachers should be on enhancing students’ ability to think critically, rationally and creatively which can only be possible when teachers are ready to actively engage students in constructivist scientific discussion [27].

The application of Ethnoscience learning is very influential in improving students' scientific literacy skills. Students can achieve science process skills more easily if teachers use ethnoscience strategy. Teachers should use the information and involve the students actively in the teaching and learning process through adequate use of ethnoscientific paradigms [28]. In the field of science and physics, Ethnoscience can be a solution to overcome the problem of students' low scientific literacy skills because it is a strategy for producing learning areas and designing learning experiences that integrate the culture as an educational process. The increase in scientific literacy and scientific characters of students shows that the education that has been implemented is efficient in increasing scientific literacy and student scientific characters [29].

It can be concluded that Ethnoscience affects students' scientific literacy skills because it connects education in the classroom with students' daily lives and motivates students to actively participate in the educational process. The implementation of Ethnoscience in education is dependent on the environment where the students live. Therefore, teachers who want to practice Ethnoscience in class are required to master the local wisdom. The knowledge that comes from beliefs passed down from the community's ancestors. For instance, the culture in the southern seaside area can be used to improve teaching materials that are integrated with ethnic groups. This learning is aimed to introduce the fact or phenomenon that grows in the community that can be related to science (physics) so that students can be easier to master the education because students can see and feel it directly.

Environmental learning have a role to support students knowledge about ethnoscience in physics context. It was because environmental learning have a role to improve students knowledge about environment. Students can be learn about environment, especially in this context about ethnoscience. Students knowledge about environment can be improve by learning media [30-35]. Another environmental learning aspect that can be support about ethnoscience was about sustainable development concept. The understanding of students and society related to ethnoscience is actually related to the concept of sustainable development. This is because sustainable development prioritizes the use of environmentally friendly goods [36-42].
4. Conclusion
From the results of the meta-analysis in this research, it can be concluded that the use of Ethnoscience learning is very influential on student competence as seen from the realm of knowledge and attitudes. In the world of education, it is still rare to use Ethnoscience learning in physics material, more often than not, using science material from the elementary and junior high school levels. Integrated learning based on local wisdom and environmental learning can be carried out by developing science teaching materials.

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