Effect Size Analysis of the Implications Ethnoscience Approach to the Improvement of 21st Century Skills in Science Learning

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Abstract. Indonesia has a variety of cultures so it has a variety of local knowledge related to natural knowledge that can be used as a study of scientific knowledge. Local knowledge of natural knowledge is known as ethnoscience. Integration of ethnoscience into science learning can facilitate the various skills possessed by students. This study aims to analyze the effects of ethnoscience approaches in science learning. This research is a meta-analysis study. Research data were obtained by searching for national articles and international articles in 2017-2021 based on predetermined criteria, namely having data pretest and posttest. The search was carried out on google scholar with the keyword "ethnoscience", "science education", "biology education", "chemical education", "physical education", and "local culture". Next, as many as 26 articles were analyzed by measuring the size of the article effect. Based on the results of the data analysis carried out, the results show that the ethnoscience approach in science learning has a positive influence on improving students' abilities and is effectively used in the learning process of science 1.12 with a high category. Knowing the effects of the ethnoscience approach in science learning, it can be a choice of approach that realizes the purpose of learning science in schools and becomes one of the forums for preserving local culture for the next generation.

Keywords: Ethnoscience approach, science learning, meta-analysis

Introduction

Indonesia is a country that has a variety of ethnicities and cultures. The variety of cultures that develop in society cannot be separated from people's knowledge of nature. Local people's knowledge of natural knowledge becomes very interesting if studied in scientific science. Local knowledge related to natural knowledge is known as ethnoscience (Novitasari et al., 2017). Ethnoscience is the integration of culture and local wisdom which is used as an object of learning to make learning more meaningful (Nuralita, 2020).

Based on government regulation number 19 of 2005 concerning National Education Standards Article 14 paragraph (1) which states that an equivalent junior high school curriculum can integrate education based on local culture. In line with the 2013 curriculum, it also states that the 2013 curriculum can include local culture in developing science,
culture, technology, and art that can increase students' curiosity and abilities appropriately (Asrizal, et al., 2019).

The importance of integrating ethnoscience in building students' existing knowledge in developing indigenous knowledge about society and being in the science knowledge learned in schools by integrating local culture-based learning into the learning process (Damayanti, et al., 2017). Indigenous knowledge is seen in local wisdom which includes the fields of science, agriculture, ecology, medicine, and the benefits of flora and fauna (Battiste, 2005) as an understanding of the nature and culture that exists in society. This came to be known as the ethnoscience approach.

The ethnoscience approach is the development of original scientific knowledge in society which is then studied in scientific science (Khoiri & Sunarno, 2018). In line with the understanding of science, which is a science that studies natural phenomena that develop in people's lives, including materials, humans, and interactions between humans and other materials. The ethnoscience approach is a must in maintaining and preserving local culture by applying it in education, especially in learning science which aims to improve students' knowledge, skills, values, and attitudes so that they can play a role in the environment (Atmoko & Wulansari, 2020; Octana, 2020). The benefits of applying the ethnoscience approach in science learning can be seen in (Lestari & Fitriani, 2016; Supriyadi, et al., 2016; Aji, 2017; Yuliana, 2017; Sudarmin et al., 2018; Puspasari et al., 2019). Ethnoscience learning has a positive influence on the classroom and affective learning in increasing student participation in class.

Based on the above background, the researcher is interested in analyzing the effect of the ethnoscience approach in science learning to realize learning objectives in schools and participate in maintaining local culture among students. The details of the research questions that guide the analysis process are as follows: 1. How much influence does the ethnoscience approach have in 21st century science learning by country? 2. How big is the influence of the ethnoscience approach in 21st century science learning based on the material? 3. How big is the influence of the ethnoscience approach in science learning in the 21st century on science and physics learning based on education level? 4. How big is the influence of the ethnoscience approach in science learning in the 21st century on the variables of science learning. So it is hoped that this research can see how much influence the ethnoscience approach in science learning has in improving 21st century skills which can later be used as consideration, reference and views for teachers and related institutions in the world of education in applying the ethnoscience approach in more effective learning.

Methods

This research is a meta-analytic study by reviewing several articles. Data were obtained from articles relevant to the influence of the ethnoscience approach in 21st-century science learning at the elementary, junior high, high school, and university levels. The number of articles analyzed in this study was 26 articles. This meta-analysis was carried out with several procedures, namely: 1) selected articles were researched from national journals using the keys “ethnoscience”, “science education”, “biology education”, “chemical education”, “physical education”, and “local culture”, on google scholar. In this process, 1,500 articles were collected. Then narrowed down using the key "ethnoscience in science learning" as many as 650 articles. Then using the key with the use of the sign (") on the word "ethnoscience in science learning" netted 37 articles.

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2) then 37 articles that have been obtained and then selected with the criteria of articles needed by researchers are articles that contain data before and after the application of the ethnoscience approach in learning; The next criteria for the article is the issue of 2017-2021. Details of the inclusion criteria for articles in this study can be seen in Table 1.

Table 1. Inclusion criteria for the article Implementation of the Ethnoscience Approach in Science Learning

| Category           | Inclusion criteria                                                                 |
|--------------------|------------------------------------------------------------------------------------|
| Publication Type   | Scientific articles published in journals and proceedings                            |
| Publication Year   | 2017-2021                                                                          |
| Field              | Science, physics, chemistry, and biology                                            |
| Types of research  | Empirical (pretest and post-test data)                                              |
| Research subject   | Students and teachers at all levels of Education (Elementary School, Junior High School, High School, and College) |

3) based on the criteria of the researcher, 26 articles were obtained that could be used as samples in this study. The next 26 articles were categorized according to the research objectives and analyzed using statistics to determine the effect size of the articles.

In this analysis, the goal of statistical value for primary research is to get an effect size. Effect size is the difference in effect between the control class and the experimental class. Determining the magnitude of the effect or effect size can use statistical parameters (Becker & Park, 2011).

Table 2. Effect Size (ES) Criteria

| No | Effect Size (ES) | Category |
|----|------------------|----------|
| 1  | 0 ≤ ES ≤ 0,2     | Low      |
| 2  | 0,2 ≤ ES ≤ 0,8   | Medium   |
| 3  | 0,8 ≤ ES         | High     |

(Cohen, 2013)

Results and Discussion

After identifying 26 articles which are international and national articles with different research variables, it can be grouped the ethnoscience approach in science learning in the 21st century based on the calculation of the effect size value of the 26 articles. The effect size of each article can be seen in figure 1. The effect size of each article gives a different conclusion. the higher the effect size, the greater the effectiveness of the ethnoscience approach in science learning.
Based on Fig. 1, it can be concluded that the effect size of the ethnoscience approach in science learning in the 21st century with an average effect size of 1.12 is in the high category (0.8 ES). This means that science learning with an ethnoscience approach can be a solution in improving and developing students' skills needed to face challenges in the 21st century. In addition, ethnoscience learning can also help students understand moral and cultural values (Satriani, 2017; Asrizal, et al., 2018) through prior knowledge of science. Students will more easily understand science learning materials because the learning they follow is related to the everyday culture that they have experienced themselves. This knowledge of local science will also increase students' understanding of why the culture is spread and followed by the community. Students will love their own culture more through an integrated scientific understanding of local culture.

The ethnoscience approach can also instill character values in students (Anwar, et al., 2017; Apdaludin, 2020) so that students do not forget their own culture even though they are entering an era of increasingly rapid technological developments that affect the mindset and local culture. By knowing the scientific science behind local science knowledge in science learning, students will be more active in participating in the learning process. The level of enthusiasm and motivation of students will further increase. In addition, the learning process will be easier because students already have prior knowledge related to local science that has been embedded from previous generations.

**The effect of the ethnoscience approach in science by country**

From the articles analyzed, it was obtained that the average effect size value by country at the level of Indonesia, Russia, and Nigeria from 26 educational articles was obtained by calculating the effect size data for each article. The average value of effect size and its categories can be seen in Fig. 2.
Figure 2. Effect Size of the ethnoscience approach in science learning in the 21st century by country

Based on Fig. 2, about the effect size ethnoscience approach in science learning in the 21st century based the state can be seen there are 3 countries of Indonesia, Nigeria, and Russia. In Indonesia, it consists of 26 articles obtained by 22 articles from 2015 research to 2021. Of the 22 articles effect size is 1.14 with a high category, it can be said that the use of effective ethnoscience approaches is used in science learning understanding.

Compared to other countries, 4 articles were analyzed from countries other than Indonesia, namely Nigeria and Russia obtaining the average effect size of Sebesa 1.71 with a high category. That means it can be concluded that the effective ethnoscience approach is used in teaching IPA content in schools. In both Indonesia and other countries outside Indonesia, the ethnoscience approach has a considerable influence in helping teachers to improve their understanding of the concept of science to students.

This magnitude of this influence can be used as a consideration for teachers in making an ethnoscience approach as an approach that the teacher can use in the science learning process. In line with what (Puspasari, et al., 2019) said that science learning with an ethnoscience approach is one of the recommended approaches in Indonesia. Ethnoscience-based science-based learning can make students closer to their environment and everyday life. Sehingga Learning IPA taught is more effective and meaningful for students (Ariningtyas, et al., 2017; Wulandari, et al., 2018).

The Influence of the ethnoscience approach based on material

From the articles analyzed, the average value of effect size based on science learning materials from 26 educational articles was obtained. Data was calculated for each article. The average value of effect size and its criteria can be seen in Table 3.
Table 3. Effect Size The influence of the ethnoscience approach in science learning in the 21st century based on the material

| Material                                           | Journal Code | Effect Size | Average Effect Size | Category |
|----------------------------------------------------|--------------|-------------|---------------------|----------|
| Natural Science                                    | E6           | 3,03        |                     | High     |
|                                                   | E17          | 1,65        |                     |          |
|                                                   | E21          | 1,23        |                     |          |
|                                                   | E22          | 0,51        |                     |          |
|                                                   | E23          | 0,61        |                     |          |
|                                                   | E24          | 0,44        |                     |          |
| Chemical                                           | E25          | 0,79        |                     | Medium   |
|                                                   | E26          | 0,42        |                     |          |
| Physics                                            | E12          | 1,10        | 1,10                | High     |
|                                                   | E16          | 1,10        |                     |          |
| Biology                                            | E9           | 0,96        |                     | High     |
|                                                   | E11          | 1,87        | 1,10                |          |
|                                                   | E20          | 0,49        |                     |          |
| Heat                                               | E1           | 1,85        | 1,85                | High     |
| Sound Energy                                       | E2           | 3,60        | 3,60                | High     |
| Learning related to the surrounding culture        | E3           | 0,40        | 0,40                | Medium   |
| Physics, science in everyday life                  | E4           | 0,95        | 0,95                | High     |
| membrane transport on the concepts of diffusion and osmosis | E5           | 1,02        | 1,02                | High     |
| "Waste and its Handling".                          | E7           | 0,47        | 0,47                | Medium   |
| Rigid Body Equilibrium                             | E8           | 1,85        | 1,85                | High     |
| IPA Based on Local Wisdom                          | E10          | 0,96        | 0,96                | High     |
| Chemical equilibrium                               | E13          | 1,19        | 1,19                | High     |
| Environmental Theme                               | E14          | 3,30        | 3,30                | High     |
| Classification of Living Things                    | E15          | 0,46        | 0,46                | Medium   |
| Salt Hydrolysis                                    | E18          | 1,13        | 1,13                | High     |
| Theme 7 Sub-theme 1                                 | E19          | 0,65        | 0,65                | Medium   |
Based on the analysis of the articles contained in Table 1 regarding the influence of the ethnoscience approach in science learning in the 21st century, based on the material that there are 17 articles of science learning materials originating from research from 2015 to 2021. Of the 17 journal articles, 12 articles on science and physics learning materials are classified as in the high category and 5 articles on physics materials are classified as moderate, it can be said that the use of the ethnoscience approach is effectively used in understanding science learning.

However, there are still many physics materials that can be integrated or studied using an ethnoscience approach. Be it in the fields of biology, physics, and chemistry that students and teachers can learn by examining local knowledge of the community with scientific knowledge. By streamlining public knowledge with scientific knowledge, it will be able to create meaningful learning that is close to the experience and lives of students. Ethnoscience-based learning will also remind and build students' new concepts related to the knowledge they get at home or from their parents with scientific science knowledge at school (Wibowo & Gunawan, 2015; Prihastari & Ratna, 2018). So that more concrete knowledge will be created and built among students. Increased activity in this learning will also improve understanding of concepts and student learning outcomes. Good student learning outcomes mean that the learning objectives that have been formulated can be said to have been achieved by students.

Understanding the concept of science through an ethnoscience approach can be said to have a high enough influence. Understanding the concept of science through an ethnoscience approach can be said to have a high enough influence. This is in line with Puspaningrum, et al., (2022) who say that the ethnoscience approach can facilitate the improvement of students' understanding of concepts. Ramandanti, (2020) dan Lidyawati, (2021) also mentioned that conceptual understanding can be improved by integrating ethnoscience into learning.

However, the teacher must be able to choose science material that can be related to ethnoscience or local culture, or local science knowledge that students can learn. Not all science materials can be related to the ethnoscience approach. Characteristics of students and learning materials become important points to teach cultural values and local science knowledge to students. So that the learning objectives to be achieved are realized.

**The Influence of the ethnoscience approach based on the education level**

From the articles analyzed, the average effect size value based on education level, namely primary school, junior high school, and senior high school from 26 educational articles, obtained data on the calculation of data in each article. The average value of effect size and its criteria can be seen in Table 4.

Based on the data in Table 2, the effect size of the ethnoscience approach in science learning in the 21st century can be seen at every level of education, namely elementary, junior high, and high school. At the elementary level, it consists of 26 articles, 3 articles are obtained from research in 2020 and 2021. From the three articles, an effect size of 1.5 is obtained with a high category, it can be said that the use of the ethnoscience approach is effective in learning science.
Table 4. Effect Size The influence of the ethnoscience approach in science learning in the 21st century is based on the level of education

| Level of education     | Journal Code | Effect Size | Average Effect Size | Category |
|------------------------|--------------|-------------|---------------------|----------|
| Primary School         | E3           | 0.40        |                     |          |
|                        | E14          | 3.30        |                     |          |
|                        | E17          | 1.65        |                     |          |
|                        | E19          | 0.65        |                     |          |
| junior high school     | E1           | 1.85        |                     |          |
|                        | E2           | 3.60        |                     |          |
|                        | E21          | 1.23        |                     |          |
|                        | E22          | 0.51        |                     |          |
|                        | E23          | 0.61        |                     |          |
|                        | E24          | 0.44        |                     |          |
|                        | E15          | 0.46        |                     |          |
| senior High School     | E4           | 0.95        |                     |          |
|                        | E5           | 1.02        |                     |          |
|                        | E6           | 3.03        |                     |          |
|                        | E7           | 0.47        |                     |          |
|                        | E8           | 1.85        |                     |          |
|                        | E9           | 0.96        |                     |          |
|                        | E10          | 0.96        |                     |          |
|                        | E11          | 1.87        | 1.15                | High     |
|                        | E12          | 1.10        |                     |          |
|                        | E13          | 1.19        |                     |          |
|                        | E16          | 1.10        |                     |          |
|                        | E18          | 1.13        |                     |          |
|                        | E20          | 0.49        |                     |          |
|                        | E25          | 0.79        |                     |          |
|                        | E26          | 0.42        |                     |          |

At the junior high school level, consisting of 26 articles, 7 articles were obtained from research from 2015 to 2021. From the seven articles, an effect size of 1.25 was obtained with a high category, it can be said that the use of the ethnoscience approach is effectively used in science learning. At the high school level, 15 articles were obtained from research from 2017 to 2021. From these 15 articles, an effect size of 1.15 was obtained in the high category. Based on the results of the education level, it can be seen that the ethnoscience approach is very effectively applied in science learning at every level of education, both elementary, junior high, and high school with a high category.

In this case, it can be seen that the ethnoscience approach to science learning has a high enough influence in teaching science concepts. Students are more able and easier to understand science concepts if they are taught with an ethnoscience approach (Hadi, et al., 2019).

The Influence of the ethnoscience approach on science learning variables

From the articles analyzed, the average value of effect size was obtained based on the application of science learning used, namely scientific literacy, learning outcomes, critical thinking skills, science process skills, HOTS, and concept understanding of 26
educational articles obtained data calculation data on each article. The average value of effect size and its criteria can be seen in table 5.

**Table 5.** Effect Size of the ethnoscience approach in science learning in the 21st century based on variables in science learning

| In Study          | Journal Code | Effect Size | Average Effect Size | Category |
|-------------------|--------------|-------------|---------------------|----------|
| Science Literacy  | E1           | 1,85        |                     |          |
|                   | E3           | 0,40        |                     |          |
|                   | E18          | 1,13        |                     |          |
|                   | E22          | 0,51        |                     |          |
| Learning outcomes | E12          | 1,10        |                     |          |
|                   | E13          | 1,19        |                     |          |
|                   | E15          | 0,46        |                     |          |
|                   | E16          | 1,10        |                     |          |
|                   | E17          | 1,65        |                     |          |
|                   | E19          | 0,65        |                     |          |
|                   | E21          | 1,23        |                     |          |
|                   | E24          | 0,44        |                     |          |
|                   | E5           | 1,02        |                     |          |
| Critical thinking | E4           | 0,95        |                     |          |
| skills            | E10          | 0,96        |                     |          |
|                   | E20          | 0,49        |                     |          |
|                   | E25          | 0,79        |                     |          |
|                   | E26          | 0,42        |                     |          |
| Science Process   | E9           | 0,96        |                     |          |
| Skills            | E11          | 1,87        |                     |          |
| HOTS              | E6           | 3,03        |                     |          |
|                   | E7           | 0,47        |                     |          |
| Concept           | E8           | 1,85        |                     |          |
| Understanding     |              |             |                     |          |

Based on the analysis of the articles contained in Table 3. regarding the effect size of the ethnoscience approach in science learning in the 21st century from the level of science learning, it can be seen that there are 6 science learning applications used, namely scientific literacy, learning outcomes, critical thinking skills, science process skills, HOTS, Concept understanding. In literacy learning consisting of 26 articles, 4 articles obtained an effect size of 0.97 with a high category, namely (Nisaâ, et al., 2015; Perwitasari, et al., 2016; Ariningtyas, et al., 2017; Yuliana et al., 2021).

In learning the learning outcomes of students consisted of 26 articles obtained as many as 9 articles from research from 2015 to 2021, namely (Ariningtyas, et al., 2017; Damayanti, et al., 2017; Asrizal et al., 2018; Wulandari, et al., 2018; Amalia & Reffiane, 2020; Adina, et al., 2021; Hermanto, 2021; Khoiriyah & Qosyim, 2021; Sumalong, et al., 2021). From the nine articles, an effect size of 0.98 was obtained, where this figure was in the high category, so it can be said that the use of the ethnoscience approach is effectively effective.
used in science learning. On critical thinking skills, 5 articles were obtained from research from 2016 to 2021, namely (Arfianawati, et al., 2016; Damayanti, et al., 2017; Temuningsih, et al., 2017; Risdianto, et al., 2020). From the 5 articles, an effect size of 0.72 was obtained in the high category.

In learning science process skills, students consist of 26 articles obtained as many as 2 articles (Ibe & Nwosu, 2017; Trianah, 2020) derived from research in 2017. From the two articles, an effect size of 1.26 was obtained and this figure was in the high category.

In the HOTS study, there are 2 articles from research in 2020, namely (Agussuryani et al., 2020; Qori et al., 2020). From the two articles, an effect size of 1.75 was obtained, where this figure was in the high category, so it can be said that the use of the ethnoscience approach is effectively used in science learning.

In learning the understanding of students' concepts, there are 26 articles obtained as many as 1 article from research in 2018. From one article (Dike & Rowland, 2020) effect size of 1.85 was obtained in the high category. Based on the results of science learning, it can be seen that the effect size for scientific literacy, learning outcomes, critical thinking skills, science process skills, HOTS, and understanding of students' concepts is the same, which is in high criteria.

The analysis carried out above can be concluded that the ethnoscience approach can help students improve and develop the skills needed by students in facing the challenges of the 21st Century. Students' abilities, namely science, learning outcomes, critical thinking skills, science process skills, HOTS, and understanding concepts.

**Conclusion**

The conclusion obtained from data analysis conducted on 26 articles is that the ethnoscience approach in science learning influences achieving learning objectives of 1.12 with a high category. The ethnoscience approach also has an impact on increasing students' abilities including learning outcomes, scientific literacy, critical thinking, HOTS, science process skills, and students conceptual understanding. The implementation of the ethnoscience approach is also effectively used at every level of education, both elementary, junior high and high school with a high category. So it can be said that the ethnoscience approach can be used in science learning in realizing more meaningful learning and based on local culture in improving the skills possessed by students.

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