The Effect of Ethnoscience-Based Science Environment Technology Society (SETS) Learning Model in Learning Physics and Biology

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Abstract
This study investigates the effect of the ethnoscience-based Science Environment Technology Society (SETS) learning model on learning Physics and Biology. This type of research involves systematic research, literature reviews, and meta-analyses. The data sources were taken from an analysis of 100 international journals published from 2018 to 2023. Tracing data sources through Google Scholar, Eric, ScienceDirect, and ProQuest. The process of selecting data sources must meet the inclusion criteria analyzed by the JSAP application. The inclusion criteria in this study are: 1) the journal must be published in 2018–2023; 2) SINTA and Scopus/WOS must index the journal; 3) The journal uses experimental or quasi-experimental research methods; and 4) it has an effect size that can be calculated. The data collection technique is direct observation through the journal database. The results showed that the average effect size (ES = 0.873) is a large criterion. These findings explain that the ethnoscience-based Science Environment Technology Society (SETS) model significantly affects science learning. Furthermore, this SETS learning model helps students learn physics and biology more actively and creatively. These results are very important in evaluating the implementation of the school learning system. Furthermore, this ethnoscience-based SETS model must be applied in learning biology and physics to stimulate students to think critically.

Keywords: Education; Science Environment Technology Society; Science Learning

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INTRODUCTION
Learning Physics is a subject that studies natural phenomena (Suendarti & Virgana, 2022; Aydede, 2022). Science learning leads students to scientific and systematic thinking (Bantakaol & Poyiem, 2022; Yakob et al., 2021; Zulkifli et al., 2022; Supriyadi et al., 2023). Utami & Astawan (2020) stated that science learning can directly develop students’ thinking skills with the surrounding nature. Science learning encourages students to actively develop scientific processes and attitudes in...
learning (Kristiana & Radia, 2021; VLin, 2021; Wong et al., 2021; Nuryadin et al., 2022). In addition, science learning helps students explore nature through the facts of scientific concepts (Anjelina et al., 2018; Affilia et al., 2023), so students can solve problems in everyday life (Zorlu & Zorlu, 2021; Akdag & Köksal, 2022). In addition, science learning helps improve science literacy.

The level of student science learning in Indonesia is still relatively low (Jufrida et al., 2019; Kristiyanto et al., 2020). The results of PISA 2018 student science literacy in science learning obtained a score of 396, ranked 71 out of 78 members (Elfira et al., 2023; Ichsan et al., 2023; Suhaimi et al., 2022; Widiana et al., 2022). Adiwiguna et al. (2019) mentioned that the results of PISA 2018 student science literacy in science learning obtained a score of 396, ranked 71 out of 78 members (Bayharti et al., 2019; Suharyat et al., 2023; Fitri et al., 2022). Santosa et al. (2021) stated that learning activities are still centered on the teacher, so students are less active in learning. Therefore, an effective learning model is necessary to arouse students' interest in learning, creative and innovative learning (Said & Yerimadesi, 2021; Zulyusri et al., 2023).

SETS is one of the learning models that can improve students' critical and creative thinking skills in science learning. SETS learning model is a learning model that combines Science, Environment, Technology, and Society (SETS) in teaching and learning activities in class (Hidayati et al., 2022). Research results by Yuniastuti (2015) stated that the SETS learning model can encourage student learning outcomes in biology learning. This SETS learning model helps students improve their science process skills (Zahra et al., 2019). Usmeldi et al. (2017) stated that the SETS learning model encourages teachers to improve students' thinking skills in science learning.

In the SETS learning model, students can relate science concepts to the surrounding community environment (Rusilowati et al., 2020). Research results by Suci et al. (2020) showed that the SETS learning model effectively improves students' science learning outcomes at school. Furthermore, the ethnoscience-based SETS learning model improves students' creative and problem-solving skills in learning physics and biology. Research results ethnoscience-based SETS learning models can improve students' understanding of concepts in physics.

Previous research by Gobel et al. (2019) showed that the SETS learning model significantly encourages science process skills in science learning. Sary et al. (2019) research on the process of learning science stated that students must be creative in solving phenomena that occur in life. Research by Ramani (2022) stated that the SETS learning model supports students' thinking process in science learning. However, applying the SETS model in learning activities has not been effective in learning science. Research by Irma et al. (2021) also showed that the application of a good SETS model can improve critical thinking skills in science learning. Based on this problem, this current research investigates the effect of the ethnoscience-based Science Environment Technology Society (SETS) learning model in learning physics and biology.

**METHOD**

This research is a systematic literature review and meta-analysis. The data source for this research comes from the analysis of 100 international and national journals published from 2018 to 2023. The process of selecting journals for meta-analysis using the PRISMA method can be seen in Figure 1. The process of searching for data sources through Google Scholar, Eric, Taylor &
Francis, ScienceDirect, and ProQuest databases. The data collection technique used direct observation through the journal database.

![PRISMA journal selection process](image)

Inclusion criteria for systematic literature review and meta-analysis are: 1) journals must have been published in 2018–2023; 2) SINTA and Scopus/WOS must index journals; 3) journals must use experimental or quasi-experimental research methods; and 4) journals must have an effect size value that can be calculated. The data analysis in the study was qualitative and quantitative statistical data analysis with the help of the JSAP application. Data analysis to calculate the effect size value, Standard Error, and publication bias test of each data set. Effect Size criteria can be seen in Table 1. Furthermore, quantitative analysis was carried out with the Preferred Reporting Item For Systematic Reviews and Meta-analysis (PRISMA) conducted with a random effect model using DerSimonian and Laird with a degree of confidence (95%) based on the random effect model.

Table 1 Effect size value criteria

<table>
<thead>
<tr>
<th>Effect Size</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 ≤ ES &lt; 0.20</td>
<td>Ignored</td>
</tr>
<tr>
<td>0.20 ≤ ES ≤ 0.50</td>
<td>Small</td>
</tr>
<tr>
<td>0.50 ≤ ES ≤ 0.80</td>
<td>Medium</td>
</tr>
</tbody>
</table>

RESULT AND DISCUSSION

From the results of a meta-analysis of 100 national and international journals related to the effect of the Science Environment Technology Society (SETS) learning model in learning physics and biology, only 12 journals met the inclusion criteria. Furthermore, studies that have fulfilled inclusion criteria calculated the effect size and standard error value, which can be seen in Table 2.

Table 2 Meta-analysis of journals based on inclusion criteria

<table>
<thead>
<tr>
<th>Code</th>
<th>Year</th>
<th>Hedge’s g</th>
<th>Standard Error</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>2019</td>
<td>0.71</td>
<td>0.42</td>
<td>Medium</td>
</tr>
<tr>
<td>A2</td>
<td>2020</td>
<td>0.68</td>
<td>0.39</td>
<td>Medium</td>
</tr>
<tr>
<td>A3</td>
<td>2021</td>
<td>1.20</td>
<td>0.72</td>
<td>Large</td>
</tr>
<tr>
<td>A4</td>
<td>2022</td>
<td>0.92</td>
<td>0.57</td>
<td>Large</td>
</tr>
<tr>
<td>A5</td>
<td>2018</td>
<td>1.03</td>
<td>0.70</td>
<td>Large</td>
</tr>
<tr>
<td>A6</td>
<td>2020</td>
<td>0.64</td>
<td>0.44</td>
<td>Medium</td>
</tr>
<tr>
<td>A7</td>
<td>2019</td>
<td>0.28</td>
<td>0.04</td>
<td>Small</td>
</tr>
<tr>
<td>A8</td>
<td>2019</td>
<td>0.85</td>
<td>0.46</td>
<td>Large</td>
</tr>
<tr>
<td>A9</td>
<td>2020</td>
<td>0.90</td>
<td>0.52</td>
<td>Large</td>
</tr>
<tr>
<td>A10</td>
<td>2022</td>
<td>1.34</td>
<td>0.84</td>
<td>Very</td>
</tr>
<tr>
<td>A11</td>
<td>2022</td>
<td>0.58</td>
<td>0.33</td>
<td>Medium</td>
</tr>
<tr>
<td>A12</td>
<td>2021</td>
<td>1.35</td>
<td>0.77</td>
<td>Very</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large</td>
</tr>
<tr>
<td>Average</td>
<td>0.873</td>
<td></td>
<td></td>
<td>Large</td>
</tr>
</tbody>
</table>

Based on Table 2, the average effect size value of each study that has met the inclusion criteria is 0.873 with large criteria. These results explain that applying the Science Environment Technology Society (SETS) learning model has a major impact on students’ Physics and Biology learning. In addition, the search for studies that met the criteria in this meta-analysis was taken from 5 studies from Google Scholar, three from Eric, two from Taylor & Francis, and one from ScienceDirect and ProQuest, which can be seen in full in Figure 2.
Furthermore, a heterogeneity test was conducted to determine the effect size model used in the study, which can be seen in Figure 3.

Based on Figure 3, the effect size value of the entire study has a very significant effect. Furthermore, the p-value <0.05 or 0.00 <0.05 means that the random effect model is better than the fixed effect models. Thus, this study used a random effect model to perform data analysis. The hypothesis test based on the random effect model in Table 3 the application of the ethnoscientific-based SETS learning model significantly affects learning physics and biology compared to conventional learning. The next step was to determine the publication bias of each study. The publication bias test used the results of the funnel plot diagram in Figure 4.

The funnel plot diagram shows that the effect size distribution is not completely symmetrical, so it is necessary to do the FSN test. The results of the FSN test using the FSN application with the help of the JSAP application obtained 322. Furthermore, it is entered in the formula FSN = n / (5k + 10) or 322 (5.12 + 10) = 4.6 > 1. This result explains that the analyzed study is not prone to publication bias, then continued with the Trim and Fill test, which can be seen in Table 3.

### Table 3 Publication bias test results with Trim and Fill

<table>
<thead>
<tr>
<th>Random Effect Size</th>
<th>Omitted studies</th>
<th>Point Estimate</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
<th>Q-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Value</td>
<td>2</td>
<td>0.687</td>
<td>0.310</td>
<td>1.801</td>
<td>72.145</td>
</tr>
<tr>
<td>Adjusted Value</td>
<td>0.480</td>
<td>0.270</td>
<td>1.290</td>
<td>165.901</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that the value of the trim and Fill test results explains the adjusted effect size value of 0.480 and the adjusted effect size value of 0.687. In addition, two studies must be eliminated in the data analysis. In the next stage, the characteristics of the education level, sample size, and year of publication are...
examined to determine the effectiveness of the SETS learning model in science learning. The analysis results based on the characteristics can be seen in Figure 5.

Table 5 shows that the Z-test value of the three characteristics is less than 0.05. These results explain that applying the ethnoscience-based Science Environment Technology Society (SETS) learning model is more effective than conventional learning models. Therefore, the SETS learning model positively impacts learning physics and biology.

The application of the ethnoscience-based Science Environment Technology Society (SETS) learning model provides a significant effect on science learning. The results can be seen from the average effect size value (ES = 0.873) with large criteria. This STES learning model can improve students' critical thinking skills and knowledge in physics and biology (Amanda et al., 2018; Widiantini et al., 2017). Research results by Tiyanto et al. (2013) stated that the ethnoscience-based Science Environment Technology Society (SETS) learning model can improve student competence in learning. SETS learning also encourages students to improve science learning achievement at school (Aprianingtyas & Sumadi, 2016; Irma et al., 2021; Nurhayati et al., 2021; Nurtamam et al., 2023).

Trihastuti et al. (2017) stated that the application of the SETS learning model is very effective in improving students' science literacy skills in learning physics and biology students. Learning requires students to have high science literacy in order to solve phenomena in life (Ozer et al., 2021; Kristiyanto et al., 2020; Kapici, 2022). Therefore, the application of the SETS learning model helps

students in higher-order thinking in science learning (Cınar et al., 2021), thus helping students to be more active in learning (Witdiya et al., 2023; Suryono et al., 2023).

The SETS learning model encourages students to have more fun learning because they interact directly with the community environment (Sari et al., 2022). In addition, this SETS learning model helps students learn directly by applying learning materials to the surrounding environment (Voulvoulis & Burgman, 2019; Celik & Bayrakçeken, 2016). The ethnoscience-based SETS learning model encourages students to be more innovative and creative in linking learning materials with technology. Research results by Pratiti (2015) show that the SETS learning model can improve the mastery of concepts and technology in science learning at school. Thus, this SETS model helps teachers be more creative in conducting science learning activities.

Professional teachers must be more able to adapt learning models that help the rest think scientifically in science learning. The ethnoscience-based Science Environment Technology Society (SETS) model helps students improve their science process skills in learning science (Nugraheni et al., 2013; Wati et al., 2022). Science process skills are very important for students to solve problems in learning (Oktarina et al., 2021; Suharyat et al., 2022). Sudarmin et al. (2020) stated that ethnoscience-based learning will make it easier for students to apply the subject matter to their local wisdom. Learning that connects ethnoscience will increase students' knowledge of the surrounding nature (Idrus, 2022; Mahendrani & Sudarmin, 2015; Sudarmin et al., 2018; Apra et al., 2021).

Teaching and learning activities by applying SETS will make it easier for students to understand and apply science subject matter. Science learning requires
students to think critically and creatively and have problem-solving skills (Damayanti et al., 2017; Wahyu et al., 2020; Agussuryani et al., 2021). Therefore, the ethnoscience-based SETS learning model is very important to be applied in learning physics and biology students.

Ethnoscience-based biology and physics learning helps students more easily understand concepts and subject matter (Rahman et al., 2023; Arfianawati et al., 2016). The ethnoscience-based SETS model creates an interesting learning atmosphere in biology and physics. This is because ethnoscience-based learning makes it easier for students to learn their local wisdom (Rosyidah et al., 2013; Hastuti et al., 2017; Savitri & Sudarmin, 2016). As a result, the ethnoscience-based SETS model is very effective in encouraging students' critical thinking skills in biology and physics materials.

CONCLUSION

From the results of this study, it can be concluded that the average effect size value of all studies related to the effect of the ethnoscience-based SETS learning model in science learning is ES = 0.873 large criteria. These findings explain that the ethnoscience-based Science Environment Technology Society (SETS) model significantly affects learning physics and biology. Furthermore, this SETS learning model helps students to be more active and creative in learning physics and biology. Therefore, the ethnoscience-based SETS learning model has a major positive impact on learning physics and biology.

These results are very important in evaluating the implementation of the school learning system. Furthermore, this ethnoscience-based SETS model must be applied in learning biology and physics to stimulate students to think critically.

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