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LITERATURE ANALYSIS: MEASURING TOOL FOR ENVIRONMENTAL LITERACY IN PEATLAND INTEGRATION SCIENCE LEARNING

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Abstract

Peatlands play a crucial role in maintaining environmental balance and mitigating global climate change. Peatland damage due to human activities continues to occur. One of the efforts to deal with this problem is to improve students' environmental literacy through science learning that integrates peatlands. This study aims to analyze the dimensions and indicators used in the development of environmental literacy measurement tools in peatland integration science learning. The method used is Systematic Literature Review (SLR). The results of the analysis show that environmental literacy measurement tools generally cover four main dimensions, namely environmental knowledge, attitudes towards the environment, cognitive skills, and environmental behavior or participation, with specific indicators in each dimension. The majority of existing measurement tools have not specifically integrated the peatland context. However, some recent studies have begun to develop environmental literacy measurement tools by integrating the peatland context. One example is the development of a questionnaire specifically designed to measure environmental literacy in peatland areas. The development of peatland-integrated environmental literacy measurement tools in science learning to increase students' understanding and concern for peatland conservation is urgently needed.

Keywords: Environmental Literacy, Measurement Tools, Science Learning, Peatland

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INTRODUCTION

Indonesia is an archipelago that has abundant natural resources and faces great challenges in preserving the environment. Indonesia has tropical peatlands covering 13% of the world's total peatlands, spread across the islands of Sumatra, Papua and Kalimantan. (Gumbricht et al., 2017) Peatlands are formed from piles of organic matter that decompose incompletely in conditions without oxygen (Wijedasa et al., 2017) Peatlands play an important role in maintaining environmental balance through their large capacity to store carbon, thus helping to reduce greenhouse gas concentrations in the atmosphere (Putri et al., 2023). In addition, peatlands also regulate the hydrological cycle with their ability to absorb large amounts of water and release it slowly, helping to prevent floods and droughts (Masganti et al., 2017) In the local context, peatlands provide benefits and functions for the community in three aspects of environmental resilience: ecological, economic, and social (Irma et al., 2018).

Peatlands are currently facing serious threats from human activities. Peatland destruction occurs through various practices such as land clearing for oil palm plantations, mining, and settlements (Muslim et al., 2017), land burning (Anhar et al., 2022), excessive drainage, and illegal logging. The impact of peatland destruction is extensive and long-term. In addition to causing loss of biodiversity (Saharjo & Wasis, 2019), peatland destruction also contributes to the release of greenhouse gases, particularly carbon dioxide and methane, which increase global warming (Page & Hooijer, 2016).

It is crucial for students to learn about these threats to peatlands for several reasons. Firstly, understanding the impact of human activities on peatlands can foster a sense of environmental responsibility among the younger generation. Secondly, knowledge of peatland threats equips students with the necessary information to make informed decisions about environmental conservation in the future. Lastly, studying peatland issues can help students connect abstract scientific concepts to real-world environmental challenges, thereby enhancing their overall scientific literacy and problem-solving skills.

Facing this problem requires comprehensive efforts from various parties, including increasing environmental literacy among the community, especially the younger generation. Environmental literacy includes the knowledge, skills, attitudes, and behaviors needed to understand and address environmental issues (Nasution, 2016). The formation of environmental literacy needs to be done from an early age so that the attitude of caring for the environment can become an attitude that is inherent in the generation and eventually embedded in society at large (Al-rosyid et al., 2023).

In the context of education, science learning is the right tool to improve students' environmental literacy (Damayanti et al., 2021). Several studies related to science learning that integrates the context of peatlands have been conducted, such as "Development and Validation Model of Peatland Conservation through Interdisciplinary Science Learning" (Santiani, Ngabekti, et al., 2023), "Collaborative Problem-Solving in Sustainable Introductory Physics with Peatlands-Smart Project Course Semester Learning Plan" (Santiani, Annovasho, et al., 2023), and "Science interdisciplinary learning approach: a study of interdisciplinary thinking skills and literacy environment" (Santiani et al., 2024).

However, there is still a gap in research on environmental literacy measurement tools specific to the peatland context in science learning. The majority of existing measurement tools have not specifically integrated the peatland context. One of the studies that tried to bridge this gap was the research of Santiani et al. (2020) who developed the P-PSEL (Palangka Raya Peatlands Sustainable Environmental Literacy) questionnaire to measure environmental literacy in peatland areas (Santiani, Rusilowati, et al., 2023).

Given the importance of environmental literacy in the context of peatlands and the lack of specific measurement tools, this research aims to analyze the dimensions and indicators used in the development of environmental literacy measurement tools in peatland integration science learning. Through systematic literature analysis, this research is expected to provide a comprehensive overview of the dimensions and indicators of various existing environmental literacy measurement tools, as well as how they are applied in the context of peatland integrated science learning.

The results of this analysis are expected to serve as a reference for teachers and researchers in selecting or developing environmental literacy measurement tools that suit the needs of peatland integration science learning. Furthermore, this research is expected to contribute to efforts to improve students' environmental literacy, especially related to peatland conservation, so that it can support conservation efforts and sustainable management of peatlands in Indonesia.

METHOD

This research uses the Systematic Literature Review (SLR) method. This method is a systematic approach used to collect, critically criticize, regroup, and synthesize research findings related to

the desired subject, question, or research topic (Gegentana, 2011). According to Krath et al. (2021), bringing together and integrating the results of various concurrent studies to provide a more comprehensive and balanced presentation from various perspectives, as expressed by Thorne (2004) as one of the benefits of the Systematic Literature Review method (Kirchner-krath et al., 2021).

This study has several steps, namely: 1) formulating research problems, 2) conducting a literature search, 3) setting inclusion and exclusion standards, 4) selecting appropriate literature, 5) presenting data, 6) processing data, and 7) drawing conclusions.

Searches were conducted through online databases such as Research Gate, and Google Scholar using the Publish Or Perish application. The search results were then selected using inclusion and exclusion criteria. The inclusion criteria used are articles that discuss environmental literacy measurement tools that can support the improvement of environmental literacy in the learning process related to the environment and articles published between 2015-2024. Meanwhile, the exclusion criteria were articles that did not discuss environmental literacy measurement tools, articles that were only abstracts, articles that were not available in full text, and articles published before 2015. The following are the stages in data collection.

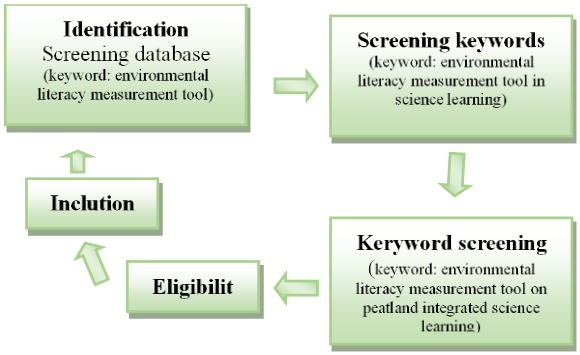

Figure 1. Stages in data collection

RESULTS AND DISCUSSION

Several studies have been conducted to develop valid and reliable measuring instruments in assessing students' environmental literacy. The results of the research are grouped based on the dimensions and indicators of environmental literacy in science learning.

Table 1. Dimensions and indicators of environmental literacy found in the literature analysis

Author	Dimensions and Indicators
(Santiani, Rusilowati, et al., 2023)	▪ Environmental knowledge consists of three indicators ▪ Attitude towards the environment consists of three indicators ▪ Environmental awareness consists of three indicators ▪ Cognitive skills consist of three indicators
(Kusumaningrum & Muslihasari, 2020)	▪ Environmental knowledge consists of one indicator ▪ Attitude towards the environment consists of three indicators ▪ Cognitive skills consist of three indicators ▪ Learners' behavior towards the environment consists of one indicator
(Susongko et al., 2021)	▪ Cognitive Skills consist of one indicator ▪ Environmental competence consists of four indicators ▪ Environmental knowledge consists of five indicators ▪ Attitude towards the environment consists of four indicators
(Nasution, 2016)	▪ Knowledge consists of one indicator ▪ Attitude consists of two indicators ▪ Competence (cognitive skills) consists of three indicators ▪ Behavior consists of one indicator
(Santoso et al., 2021)	▪ Environmental knowledge consists of three indicators ▪ Environmental attitude consists of three indicators ▪ Cognitive skills consist of three indicators ▪ Environmental behavior consists of three indicators
(Hariyadi et al., 2021)	▪ Environmental Knowledge consists of three indicators ▪ Cognitive Skills consist of three indicators ▪ Environmental care consists of three indicators ▪ Pro-Environmental Behavior consists of three indicators
(Tifani et al., 2022)	▪ Environmental knowledge consists of two indicators ▪ Environmental attitude consists of one indicator ▪ Environmental cognitive skills consist of three indicators

Author	Dimensions and Indicators
	▪ Behavior consists of one indicator
(Nasution, 2021)	▪ Knowledge consists of two indicators ▪ Cognitive Skills consist of three indicators ▪ Attitude consists of three indicators ▪ Behavior consists of one indicator
(Fitri & Hadiyanto, 2022)	▪ Knowledge consists of one indicator ▪ Cognitive Skills consist of one indicator ▪ Attitude consists of one indicator ▪ Behavior consists of one indicator
(Mauludah, 2018)	▪ Knowledge consists of one indicator ▪ Cognitive Skills consist of three indicators ▪ Attitude consists of three indicators ▪ Behavior consists of one indicator
(Rabbianty et al., 2022)	▪ Knowledge consists of two indicators ▪ Skills consist of two indicators ▪ Attitude consists of one indicator ▪ Behavior (participation) consists of five indicators
(Istiningsih et al., 2022)	▪ Knowledge consists of three indicators ▪ Skills consist of four indicators ▪ Attitude consists of two indicators
(Irawati et al., 2024)	▪ Knowledge consists of two indicators ▪ Environmental competence consists of three indicators ▪ Attitude consists of three indicators ▪ Behavior consists of three indicators
(Al-Hilmiyah & Suhartini, 2024)	▪ Knowledge consists of one indicator ▪ Cognitive Skills consist of three indicators ▪ Attitude consists of three indicators ▪ Behavior consists of three indicators
(Rokhmah et al., 2021)	▪ Knowledge consists of one indicator ▪ Cognitive Skills consist of three indicators ▪ Attitude consists of two indicators ▪ Behavior consists of one indicator
(Susanti & Hayatu Nupus, 2022)	▪ Knowledge consists of one indicator ▪ Cognitive Skills consist of one indicator ▪ Attitude consists of one indicator ▪ Behavior consists of one indicator
(Rofi'ah & Chusna, 2022)	▪ Cognitive consists of three indicators ▪ Affective consists of three indicators ▪ Behavioral consists of three indicators
(Szczytko et al., 2019)	▪ Ecological knowledge consists of fifteen indicators ▪ Hope consists of twelve indicators ▪ Behavior consists of seven indicators
(Narut & Nardi, 2019)	▪ Environmental care attitude consists of three indicators
(Muna et al., 2023)	▪ Knowledge consists of one indicator ▪ Attitude consists of two indicators

Based on the Systematic Literature Review (SLR) analysis, 20 articles were found that are relevant to the development of environmental literacy measurement tools in science learning. The results of the analysis show that in general, environmental literacy measurement tools include four main dimensions: environmental knowledge, attitudes towards the environment, cognitive skills, and environmental behavior or participation.

Table 1 summarizes the dimensions and indicators used in various environmental literacy measurement tools. The analysis shows that there is consistency in the use of the four main dimensions, but with variations in the specific indicators used. The environmental knowledge

dimension generally includes indicators such as understanding of ecosystems, natural resources and environmental issues. In the context of peatlands, these indicators can be adapted to include specific knowledge of the characteristics, functions and threats to peatland ecosystems.

The attitude towards the environment dimension includes concern, responsibility and commitment to the environment. For the peatland context, specific indicators can be added such as "awareness of the importance of peatland conservation". Santiani et al. (2022) in developing the P-PSEL (Palangka Raya-Peatland Sustainable Environmental Literacy) questionnaire emphasized the importance of specific knowledge about peatlands, including their characteristics and related environmental issues. This is in line with the approach of Diana Kusumaningrum and Adzimatnur Muslihasari (2020) who included indicators of knowledge of environmental basics in their instrument for primary school students. In the context of science learning, Ruqoyyah Nasution (2016) integrates ecological knowledge as one of the main indicators.

The cognitive skills dimension includes the ability to identify, analyze, and evaluate environmental issues. Purwo Susongko et al. (2021) developed a higher-order thinking skills test to measure environmental literacy, focusing on the ability to analyze and evaluate environmental pollution problems. Ratna Farwati et al. (2018) included indicators such as the ability to investigate the causes of air pollution and design ways to overcome it. In the context of peatlands, Santiani et al. (2022) emphasized the skill of identifying environmental problems in peatlands and analyzing the causes of their damage. The behavioral or environmental participation dimension focuses on concrete actions to preserve the environment. Ruqoyyah Nasution (2016) included an indicator of real commitment (pro-environmental action) in her instrument. Santiani et al. (2022) measured actions to protect peatlands and participation in conservation activities. Ratna Farwati et al. (2018) also included an indicator of intention to act in maintaining environmental balance. In the context of peatland integrated science learning, the instrument developed by Santiani et al. (2022) provides a comprehensive example. They integrated specific knowledge about peatlands, cognitive skills in analyzing peatland issues, attitudes towards peatland conservation, and pro-environmental behavior in the context of peat ecosystems.

Based on the analysis conducted, several implications for the development of an environmental literacy measurement tool in the context of peatland integration science learning can be identified. First, the need to develop peatland-specific indicators in each dimension of environmental literacy. Second, the integration of science concepts with peatland issues in the measurement tool. Third, the development of peatland-based case studies and scenarios to measure cognitive and problem-solving skills. Fourth, adjusting the measurement tools to the local characteristics of peatland areas.

This study has limitations, especially the absence of specific measurement tools for the peatland context in science learning. Therefore, it is recommended to conduct research on the development of environmental literacy measurement tools specifically designed for the context of peatland integration science learning. In addition, it is necessary to test the validity and reliability of the measuring instruments developed in the local context of peatland areas, as well as integrate environmental literacy measuring instruments into the science learning curriculum in peatland areas. The development of a more specific and integrated measurement tool is expected to increase the effectiveness of science learning in building students' environmental literacy, especially related to peatland conservation.

CONCLUSION AND SUGGESTIONS

Conclusions

Through Systematic Literature Review (SLR) analysis, it was found that in general, environmental literacy measurement tools include four main dimensions, namely environmental knowledge, attitudes towards the environment, cognitive skills, and environmental behavior or participation.

The environmental knowledge dimension includes indicators such as understanding of ecosystems, natural resources, and environmental issues. The attitude towards the environment dimension includes concern, responsibility, and commitment to the environment. The cognitive skills dimension includes the ability to identify, analyze, and evaluate environmental issues. While the dimension of environmental behavior or participation focuses on concrete actions to preserve the environment.

However, the analysis shows that the majority of existing measurement tools have not specifically integrated the peatland context in science learning.

This finding underscores the need to develop a more specific environmental literacy measurement tool that is integrated with the peatland context in science learning. The tool needs to include indicators that are relevant to the characteristics, functions and challenges of peatland conservation and integrate related science concepts.

Suggestions

For future research, it is recommended to develop and validate environmental literacy measurement tools that are specifically designed for the context of peatland integration science learning. This measuring instrument must consider the peculiarities of the peatland ecosystem, local issues, and its relevance to the science curriculum. The development of a more specific and integrated measurement tool is expected to increase the effectiveness of science learning in building students' environmental literacy, especially related to peatland conservation. This in turn can contribute to conservation efforts and sustainable management of peatlands in Indonesia.

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