

CHARACTERISTICS OF ECOSYSTEM MATERIAL IN BIOLOGY LEARNING

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ABSTRACT

The article is a literature review that discusses the characteristics of ecosystems as learning material. Ecosystems are broad general knowledge regarding living systems, so they need to be studied by students. The purpose of the literature review in this article is to analyze the characteristics of ecosystem materials, ways of empowering ecosystem materials, and learning media that can be used to meet the characteristics of ecosystem materials. The method used is a systematic literature review related to the characteristics of ecosystem material. The literature studied from 2012 to 2023 was selected based on several criteria. The literature obtained based on the criteria amounted to 100 articles. After analysis based on abstracts, keywords, methods, discussions, and finally, 19 articles were selected that could be used as study material. The results of the literature review show that ecosystem material has several characteristics. That can be met with an active learning approach with a problem-based learning model and requires learning media innovations that can accommodate conceptual learning through the presentation of material in the form of visual as well as audio-visual and contextual exploration of the surrounding environment.

Keywords: *ecosystem, biology, active learning, problem-based learning*

1. INTRODUCTION

Ecosystem material is one of the general knowledge that is broad and concerns life in the environment around us (Begon & Townsend, 2021). So it needs to be studied at the formal education level. Some countries require children to understand the surrounding ecosystem early through formal education in primary schools. Ecosystem material is a learning subject that can be taught in all fields of science because it is one that a person must understand the relationship between living things and their environment (Hawley, 2017). In biology subjects, the sub-materials that need to be studied include components of biotic and abiotic ecosystems, interactions between components in ecosystems, food chains, and food webs in ecosystems.

Ecosystems are a basic concept related to the reciprocal relationship between biotic components consisting of living beings and abiotic components consisting of non-living beings (Verma, 2018). Ecosystem materials are classified as easy materials but have high complexity (Lemke, 2021). The discussion in each subtopic of ecosystem material is very large, so there are often many misconceptions experienced by students regarding ecosystem material at all levels of education. Students often find vegetation that indicates a type of ecosystem, but they don't recognize it. The existence of ecosystems is related to the impact of the emergence of problems in the surrounding environment, such as the occurrence of natural disasters, how to overcome disasters by creating artificial ecosystems, the consequences of ecosystem damage that disrupts

the stability of other ecosystems, and much more, so students need to understand (Cramer et al., 2018).

Learning biology, especially in terms of ecosystems, is expected to be able to learn directly in the field so that students can know first-hand how ecosystems are formed and know the types of interactions in these ecosystems (Giannakos et al., 2016b). Ecosystem material in biology learning studies various phenomena of life that exist around humans. But in its implementation, the teacher has not connected the biology material studied with the environment around the student. The learning of ecosystem materials is often only a theory through textbooks, students do not directly study the environment in which the ecosystem is formed (Guerretaz & Johnston, 2013). In fact, by learning directly about the environment, students can find out various types of ecosystem components and can directly interact with these components. Thus they get a hands-on learning experience that will make their science processing ability better and be able to relate the material being studied to the conditions in the environment.

For this reason, the right learning media is needed so that the biology learning process in ecosystem materials can be more meaningful. In the ecosystem material, there are many concepts that students must learn well. This can be done by students learning directly where the ecosystem is located or through learning resources found on the internet. Studying ecosystem objects directly in the field will make students quickly aware of the facts about what they are learning (Giannakos et al., 2016b). Then they can reinforce those facts with various concepts that they can find on the internet, ranging from the process of observing, collecting data, and observing. So that they can know what they are learning and can determine how they learn it so that their metacognitive knowledge will be more honed.

Ecosystem material is contextual, so it requires direct observation of the surrounding environment. The use of the surrounding environment is very necessary for students to be able to understand the subtopics in the ecosystem material (Giovannella et al., 2020). In Surakarta and surrounding areas, many environments can be used as a place for direct exploration of learning about ecosystems. In addition, the development of learning media that collaborates between technology and the surrounding environment can be the best alternative to deliver material about ecosystems.

The purpose of this literature study is to reveal the characteristics of the ecosystem as learning material. The characteristics of ecosystems as learning materials are discussed in: characteristics of ecosystem materials, ways of empowering

learning ecosystem materials, and learning media on ecosystem materials.

2. METHODS

The method used is Systematic Literature Review (SLR). The guideline used in the literature review of this study is PRISMA. PRISMA provides methodological standards for selecting usable literature. SLRs are performed to identify, analyze, and interpret all available information. The SLR stage begins with determining the formulation of the research problem. The formulation of the research problem is 1) What are the characteristics of ecosystem materials in biology learning?; 2) How to empower ecosystem materials in biology learning?; and 3) How is the selection of appropriate learning media to meet the material characteristics of ecosystems in biology learning?

The literature search is carried out by determining the criteria relating to the material of the ecosystem. The initial literature obtained is selected based on predetermined criteria, namely: 1) English-language and internationally reputable articles; 2) Articles are collected from an electronic database (Google Scholar) using

the following keywords: "ecosystem material in biology"; 3) Search is limited to articles published from 2012 to 2023; and 4) The article contains a clear identity such as title, author, year, and material characteristics of the ecosystem.

The selection of articles that fit the criteria is carried out by filtering titles, abstracts, and keywords. The literature results based on the requirements amount to 100 articles. However, after being analyzed based on the discussion, 19 articles were finally selected that can be used as study materials following the research objectives. This article discusses the characteristics of ecosystem materials, how to empower the learning of ecosystem materials, and learning media on ecosystem materials.

3. RESULTS & DISCUSSION

3.1 Results of Literature Review

This research discusses the characteristics of ecosystem materials, how to empower the learning of ecosystem materials, and learning media on ecosystem materials. The list of articles used in the literature review can be seen in Table 1.

Table 1. Literature Review

No	Authors	Title	Year	Review
1	Billie Eilam	System thinking and feeding relations: learning with a live ecosystem model	2012	Ecosystems at large have complexities that must be studied, so it is necessary to have ecosystem models on a limited scale so that students can easily understand.
2	Su-Ju Lu & Ying-Chieh Liu	Integrating augmented reality technology to enhance children's learning in marine education	2014	Learning related to nature, such as ecosystems requires student engagement with the environment through instruction and assignments from teachers.
3	M. N. Giannakos, J. Krogstie, & T. Aalberg	Video-based learning ecosystem to support active learning: application to an introductory computer science course	2016	Learning about the ecosystem is carried out by means of active learning. Active learning can be done using a problem-based learning model, besides that students will better understand the ecosystem material if the learning is carried out in groups (collaborative learning).
4	M. N. Giannakos, J. Krogstie, & T. Aalberg	Toward a Learning Ecosystem to Support Flipped Classroom: A Conceptual Framework and Early Results	2016	The concept of ecosystems requires an approach to nature that can be applied in learning in order to be able to provide an overview of the role of different components.
5	Hannah Reid	Ecosystem- and community-based adaptation: learning from community-based natural resource management	2016	Ecosystems are materials related to learning about adaptation between living things.
6	V. Crysty, B. Manurung, & S. Syafiruddin	Development of MINI-LAB activities on ecology and environment topics for High School Students	2017	Ecosystem learning requires learning media that can visualize ecosystems on a small scale.
7	S. Ngabekti, A. P. B. Prasetyo, R. D. Hardianti, & J. Teampanpong	The Development of STEM Mobile Learning Package Ekosistem	2019	Topics in ecosystems require the use of the surrounding nature as an authentic learning resource.

8	A. Musyaddad & S. Susanto	Evoking the four dimensions of student knowledge in ecosystem: effectiveness of real object, web, and blended learning	2019	Ecosystem material is related to the surrounding environment, so it requires a way of delivery based on real objects around students. Real object-based learning media has a significant increase in value compared to internet-based learning media.
9	M. Gilissen, M. Knippels, R. Verhoeff et al.	Teachers' and educators' perspectives on systems thinking and its implementation in Dutch biology education	2020	Students' understanding of ecosystems can be taught with contextual representations combined with practice or direct exploration in nature.
10	C. Giovannella, P. Marcello, & P. Donatella	The effects of the Covid-19 pandemic on Italian learning ecosystems: The school teachers' Perspective at the steady state	2020	Exploration is needed in learning ecosystem materials.
11	D. S. Rini, Adisyahputra, & D. V. Sigit	Boosting Student Critical Thinking Ability through Project Based Learning, Motivation and Visual, Auditory, Kinesthetic Learning Style: A study on Ecosystem Topic	2020	Topics in ecosystem materials have many issues that can be explored.
12	M. Hecht & K. Crowley	Unpacking the Learning Ecosystems Framework: Lessons from the Adaptive Management of Biological Ecosystems	2020	Learning about ecosystems is a dynamic interaction between learners, places, and elements of the ecosystem.
13	W. Sagala, I. Chastanti, & D. A. Harahap	The Profile of Using Grass Field as a Learning Resource on Ecosystem Materials	2021	Ecosystems are one of the objects in biology subjects that are difficult because they do not only study in the classroom but also study in the surrounding environment and make observations in the natural environment..
14	W. O. Fauzia, Jahidin, & M. Sabilu	Improving critical thinking skills of student of Kendari Senior High School on ecosystem materials through problem-based learning	2021	The problem-based learning model can be used to improve students' critical thinking skills in ecosystem materials.
15	L. Nyoman, P. Kusuma, I. Astawan et al.	Ecosystem Learning with Filmora Application-Based Audiovisual Learning Media for Elementary School Students	2021	Ecosystem learning materials can be more easily understood by students through audiovisual presentations.
16	F. Sholihah, & S. Prihatiningtyas	Creating miniature ecosystem to increase student learning outcomes through guided discovery learning	2021	Ecosystem learning requires simple observations about problems in the surrounding environment in order to be able to understand the concept of components in the ecosystem.
17	Hutagaol, J., Wicaksana, E.J., Siburian, J.	Development of electronic handouts for class X high school	2022	Electronic-handouts can be used as an alternative medium for learning ecosystem materials, because the delivery of topics is easy for students to understand.

		ecosystem materials for online learning		
18	Dedy Afriza	Comparison of The Learning Outcomes of Junior High School Students Utilizing Audio-Visual and Chart Learning Media to Study Ecosystem	2022	Learning media in audiovisual form can increase students' understanding of ecosystems because ecosystem materials require an overview of examples or demonstrations so that students can understand.
19	T. Aminatun, B. Subali, Y. Yuningsih et al.	Developing Android-Based Mobile through Local Ecosystem Materials to Improve Thinking Skills of High School Students	2022	Learning about ecosystems can be given through examples based on the natural conditions around students, it will affect students' understanding which is consequential not only conceptual.

3.2 Characteristics of Ecosystem Materials in Biology Subjects

Ecosystem materials have characteristics that teachers must understand to carry out appropriate learning. Characteristics in ecosystem materials, among others:

- Ecosystem matter has a wide complexity (Eilam, 2012).
- Requires active student engagement (Lu & Liu, 2015).
- Learning about ecosystems needs to be done with active learning (Giannakos et al., 2016b).
- The concept of ecosystems requires an approach to nature (Giannakos et al., 2016a).
- Ecosystems are materially related to learning about adaptation between living things (Reid, 2016).
- Ecosystem learning requires learning media that can visualize ecosystems on a small scale (Crysty et al., 2017) or can be audiovisual (Afriza, 2022; Nyoman et al., 2021).
- Topics in ecosystems require the use of the surrounding nature as an authentic learning resource (Aminatun et al., 2022; Ngabekti et al., 2019).
- Requires a way of delivery based on real objects around students (Musyaddad & Suyanto, 2019).
- It requires contextual representation combined with practice or direct exploration in nature (Gilissen et al., 2020; Sagala et al., 2021; Sholihah & Prihatiningtyas, 2021).
- It has many issues that can be explored (Rini et al., 2020).
- Dynamic interactions between learners, places, and ecosystem elements (Hecht & Crowley, 2020).

Ecosystem learning is described as material that requires various approaches in the learning process. Learning focuses on the learning process and considers the characteristics, needs of students, and the potential and interaction between students and students. In addition, ecosystem learning requires an environment and learning resources. Thus, the concept of ecosystem learning provides an ideal foundation for organizing various tools and practices in the best way.

3.3 How to Empower Ecosystem Materials

How to empower ecosystem materials is carried out by applying an active learning approach, where students actively carry out activities to obtain information about the material being studied. Students are given the responsibility to learn to be able to master the learning objectives.

Some learning models that include active learning include project-based learning, flipped learning, and problem-based learning (Giannakos et al., 2016a). Active learning in ecosystem learning involves students in the learning process through discussion activities, involves group work, and activeness in practicing (Giannakos et al., 2016b). Problem-based learning is one of the active learning that can empower students' understanding of ecosystem materials (Fauzia et al., 2021).

The ill-structured problem-based learning model can provide opportunities for students to think through simple observations of the problems of the surrounding ecosystem (Tan, 2003). Problem-based learning can provide space for exploration for students to fulfill active learning activities (Drăghicescu et al., 2014). In this learning model, teachers are expected to be facilitators who can guide students to achieve an understanding of ecosystem material.

3.4 Learning Media on Ecosystem Materials

Based on the material characteristics of the ecosystem, it can be overcome using several ways and learning innovations. The main thing that must be fulfilled based on the description of the material characteristics of the ecosystem is the observation or exploration of ecosystems, even on a small scale (Aminatun et al., 2022; Crysty et al., 2017; Gilissen et al., 2020; Ngabekti et al., 2019; Sagala et al., 2021; Sholihah & Prihatiningtyas, 2021). The exploration will introduce students directly to the surrounding natural state. The natural conditions around students can reveal the concept of ecosystems contextually so that students can more easily understand.

The selection of teaching materials and the way of delivering the material effect on students' understanding of ecosystem materials (Hung et al., 2017). The teaching materials used must be able to meet the characteristics of the ecosystem system materials. Some characteristics that are closely related to teaching materials, namely, ecosystem material can visualize the state of the surrounding ecosystem (Afriza, 2022; Nyoman et al., 2021). Visualization can be in the form of images or videos on teaching materials which is one way to make it easier for students to understand complex ecosystem materials (Eilam, 2012).

Teaching materials in ecosystem materials can be embedded in learning media. Learning media can be arranged in such a way that they can meet learning objectives (Williamson et al., 2020),

especially in ecosystem materials. The learning media developed must be able to increase students' understanding of ecosystem materials. Up-to-date learning media can be developed by utilizing technology. For one, we can leverage technology to illustrate the complexity of ecosystems (Giannakos et al., 2016b). The use of technology in ecosystem materials is used as a combination of the conceptual framework of the ecosystem with the contextual framework through instruction so that students can explore the surrounding environment.

4. CONCLUSION

Based on the assessment of literature related to ecosystems as learning material with various characteristics. Therefore, empowerment is needed by innovating the approaches, models, teaching materials, and learning media used. The learning approach used is active learning combined with a problem-based model. Learning media innovations are used by embedding contextual teaching materials combined with contextual exploration in the surroundings utilizing the ecosystem in the area around Surakarta City.

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