River Ecosystem as a STEM-Based Science Learning Resource

Dian Samitra[1(✉)], Fitri April Yanti[2], and Yunita Wardianti[1]

[1] Universitas PGRI Silampari, Lubuklinggau, South Sumatra, Indonesia
dian.samitra@gmail.com
[2] Universitas Bengkulu, Bengkulu, Indonesia

Abstract. This research aimed to explore the experience of science teachers in using rivers as learning resources and integrating rivers as science learning resources in STEM-based learning tools. The research method used is descriptive qualitative. Subjects consisted of 33 teachers. The research instrument was in the form of a questionnaire sheet. The Data analysis used descriptive qualitative. 81.21% of teachers have prepared lesson plans by using the river as a learning resource; 24.24% of teachers use the river as a direct source of learning; 63.36% of teachers choose pollution material in using the river as a learning resource. 100% of teachers stated that safety is a barrier to using the river as a learning resource. The results of the 2013 curriculum mapping have four topics that can be integrated, namely classification, living things, and the environment, environmental pollution, and energy.

Keywords: Learning Resource · River Ecosystem · STEM · Science Learning

1 Introduction

Quality science learning aims not only at learning outcomes but also at learning processes [1]. Because by emphasizing the process, students will be motivated, feel happy, and be more active during the learning process [2, 3]. Students will feel and experience directly the stages of learning to make learning more meaningful [4]. An educator needs to prepare and design the learning process as well as possible so that the activities that will be carried out by students become more focused and meaningful. The learning process can be assisted by learning media, learning resources, and learning methods [5].

Learning resources are important in learning. Learning resources are all things in the form of information or tools that can help the process of increasing the intellectual and emotional capacity of students [6]. The environment as a learning resource has a positive effect on conceptual understanding, and creativity [7]. In addition, it can help the learning process and increase students' awareness of the environment [8].

Teachers can use the STEM approach in the science learning process. Advances in technology led to the emergence of the term Science, Technology, Engineering, and Mathematics (STEM). The existence of STEM marks a new era in the application of innovative and motivating teaching and learning processes [9]. STEM in learning is

M. Kristiawan et al. (Eds.): OCERI 2023, ASSEHR 775, pp. 199–206, 2024.
https://doi.org/10.2991/978-2-38476-108-1_19

defined as an interdisciplinary teaching method that integrates science, technology, engineering, mathematics, and skills [10]. The application of STEM in science learning is considered important to improve the quality of learning activities [11]. Through STEM students are allowed to be able to solve problems, become innovators, and inventors, have self-confidence, logical thinking, and have technology literacy [12].

However, there are still educators who only focus on printed books and student worksheet available in schools as learning resources. This is following research from Puspitarini, where teachers always use books as learning resources so that students get bored and have difficulty understanding the material [13]. Whereas textbooks are only one tool that helps teachers achieve educational goals [14]. Learners need to improve and link skills with relevant knowledge in society and their environment. One of the things teachers can do is to use the river as an integrated STEM learning resource.

The river has the potential to be used as a science learning resource. Rivers have a STEM aspect. Science aspects in the river, there are concepts of knowledge that students can learn. Aspects of technology and engineering in the river, students can find information and design the technology used as a solution to a problem. In aspects of mathematics, students calculate, design, and even evaluate the information they get. This is because rivers contain sources of information that teachers can use to learn. In addition, the river is also an interesting thing for students and easy to find so it will provide a real experience for students. The use of rivers as a source of science learning by teachers will make students feel direct and meaningful experiences in learning so that they can make students able to connect their knowledge and skills with real situations experienced. However, not all teachers use the river as a source of learning. Therefore, this study aims to explore the experience of teachers in utilizing rivers as learning resources and integrating rivers as science learning resources in STEM-based learning tools.

2 Methods

The research method used is descriptive qualitative. The subjects were 33 teachers in Lubuklinggau City and Musi Rawas Regency, South Sumatra. The research instrument was in the form of a questionnaire sheet. Data analyzed descriptively.

3 Results and Discussion

1) **Teacher's Experience using Rivers as a Learning Resource**

The results of distributing questionnaires obtained information that 81.21% of teachers had prepared lesson plans by using rivers as learning (Fig. 1). 24.24% of teachers use the river as a direct learning resource (Fig. 2); 63.64% of teachers choose pollution material in using the river as a learning resource (Fig. 3). 100% of teachers stated that safety was an obstacle in using the river as a learning resource.

The results showed that the teacher had prepared a lesson plan before starting the lesson, whether or not the river was used as a learning resource. An effective teacher is a teacher who prepares learners for learning [15]. Teachers are required to prepare learning plans (learning tools) before carrying out teaching and learning activities. Lesson plans

can assist teachers in narrowing the gap between theory and practice, encourage teachers to achieve learning goals, and serve as educational archives that can be reopened when needed [16]. In addition, lesson plans help teachers become references or guides in their activities and get feedback from supervisors [17, 18].

Generally, teachers use the river as a learning resource in the form of photos and videos, but only a small number of them use the river as a direct learning resource (Fig. 2). Photos and videos are visual learning aids. Visual aids are sensory objects or images that support learning [19]. Visual media allows students to learn from entities that are not real but have actual concepts [20]. Visual media has a positive effect on students by providing opportunities to grow scientific ideas [21]. Visual media also affects students' procedural knowledge and concepts when used in inquiry learning [22]. Teachers can use visual media in science learning by guiding the characteristics of science learning so that learning will be meaningful. These characteristics are observation, exploration, and conclusion [23].

Teachers using rivers as learning resources are dominated by polluted materials (Fig. 3). This can happen because the teacher has not been able to map learning resources for learning materials. In addition, it may happen because it is still the process of choosing to adjust learning materials, and making simple media takes a little longer.

Teachers utilizing the learning river are directly hampered by student safety. There are many ways to overcome these obstacles, such as choosing a river that is easily accessible, not deep, asking adults for help as activity facilitators, and bringing samples of river materials to class. Today's technology can bring the environment into the classroom with the help of augmented reality and virtual reality.

2) **River Integration as a STEM-Based Learning Resource**

The results of the 2013 SMP/MTs curriculum mapping analysis show that science materials that can be integrated with STEM-based River learning resources

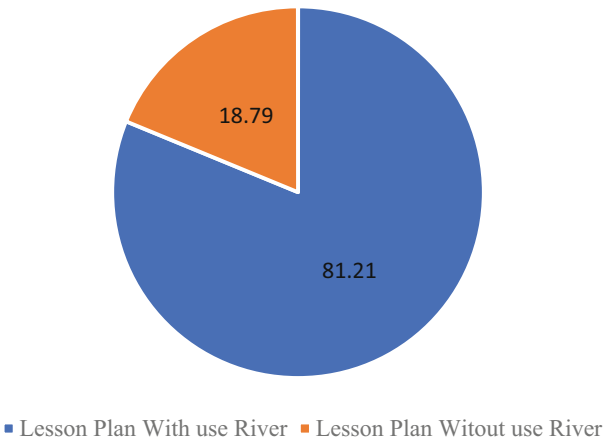

Fig. 1. Teacher's experience in preparing lesson plans

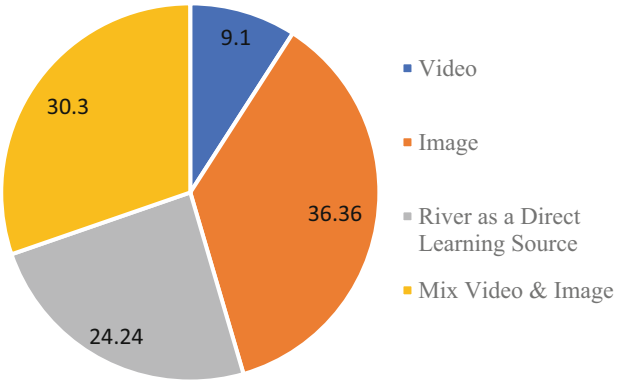

Fig. 2. Learning Media

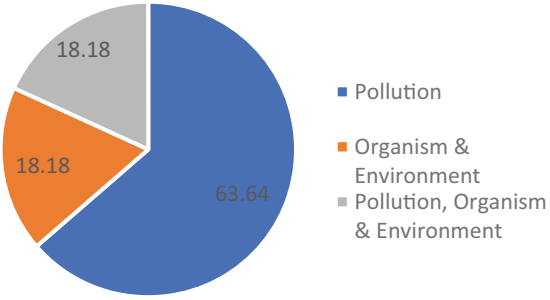

Fig. 3. Topics that use Rivers as Learning Resource

are: classification, energy, living things, the environment, and environmental pollution (Table 1).

The process of integrating rivers as a source of STEM-based learning begins (Fig. 4) with an analysis of the 2013 SMP/MTs curriculum. A science curriculum analysis was carried out at each grade level. The results of the analysis obtained four materials that can be used as a source of learning. Then arrange STEM-based learning tools.

The process of integrating rivers as a source of STEM-based learning starts with analysing the 2013 curriculum for junior high schools, analysing materials, and compiling learning tools (Fig. 4). There are three approaches to integrating STEM into learning, namely silo, embedded, and integrated approaches [24]. This article integrates STEM in learning with the silo Approach. The STEM with silo approach refers to isolated instruction within each individual STEM subject.

A learning plan is prepared based on STEM (Fig. 5). STEM is an approach that does not have a learning step, so learning includes elements of Science, Technology, Engineering, and Mathematics in the learning objectives. Teachers in formulating learning objectives need to use Bloom's taxonomy as an operational verb. River integration as a STEM-based learning resource in the lesson plan in Table 2.

Table 1. Mapping of Materials

No	Basic Competencies	Topics	Class
1	3.2 & 4.2	Classification	7^{th} grade Junior High School
2	3.5 & 4.5	Energy	
3	3.7 & 4.7	Organism & Environment	
4	3.8 & 4.8	Pollution Environmental	

Fig. 4. River Integration Process as a STEM-based learning resource in Science Materials

LEARNING IMPLEMENTATION PLAN

School	: Junior High Schoool	Class/ Semester	: VII / 2
Mata Pelajaran	: Natural Sciences (IPA)	Time Allocation	: 120 Minutes
Materi Pokok	: Pencemaran Lingkungan		

A. LEARNING OBJECTIVES

After following the learning process, students are expected to be able to:

- Identify the factors that cause pollution in the Kelingi River and the Residential Environment
- Explaining the impact of pollution on the Kelingi River and the living environment
- Providing solutions to overcome pollution of the Kelingi River and the living environment

Learning Media & Learning Resources		
❖ Media	:	Worksheet
❖ Tools/Materials	:	pH, thermometer, plastic cups, stationery, and notebooks
❖ Learning Resources	:	Science Book Class VII Kemdiktud, other supporting books, internet, Kelingi River

B. LEARNING ACTIVITIES

3rd Meeting	
Introduction (15 minutes)	
1. Opening with greetings and praying to start learning, checking the attendance of students as a discipline attitude.	
2. Linking the material/theme/learning activities that will be carried out with the experiences of students with the material/ previous themes/activities and ask questions to remember and relate to the next material.	
3. Practicum Activities Pollution.	
4. Explaining things to be studied, competencies to be achieved, and learning methods to be taken.	
Core Activities (90 Minutes	**LITERATURE ACTIVITIES**
	• Students are given motivation and guidance to see, observe, read and rewrite it. They are given shows and reading materials related to Pollution
	CRITICAL THINKING
	• The teacher provides an opportunity to identify the factors that cause pollution, the impact of pollution and provide solutions to pollution in the Kelingi River and the environment where they live.
	COLLABORATION
	• Learners are formed in several groups to discuss, collect information, re-present, and exchange information about Pollution
	COMMUNICATION
	• Students present the results of group or individual work classically, express opinions on the findings obtained during observations.
	CREATIVITY
	• Students make posters related to pollution.
closing (15 minutes)	
1. Students make a summary/conclusion of the lesson about the important points that emerged in the new learning activity.	
2. The teacher makes a summary/conclusion of the lesson about the important points that appear in the new learning activity.	

C. ASSESSMENT OF LEARNING

- **Knowledge Assessment:** Essay
- **Skill Assessment:** Rubric for critical thinking, collaboration, communication and creativity

Fig. 5. Example of a Lesson Plan

Table 2. River integration as a STEM-based learning resource in the learning plan

Topics	Science	Technology	Engineering	Mathematics
Classification	Students can classify living things in rivers.	collect information about living things that exist in the river	designing a building that can keep living things in the river.	counting the number of living things and projecting the number in the event of a disaster.
Energy	Students can identify the energy produced in rivers.	students look for data and information related to the use of rivers as an energy source	Design a tool for energy sources from rivers	students process data and information on the use of rivers as energy sources
Organism & Environment	students can identify living things, food networks that occur in rivers	collect information about problems that occur between living things and the environment	creating a structure that can maintain environmental balance	students process data and information about problems that occur between living things and the environment
Pollution Environmental	Students identify sources of river pollution.	students look for data and information related to technology to overcome river pollution.	Making designs to overcome environmental pollution	students process data and information on environmental pollution

4 Conclusion

The teacher does not use the river as a direct learning resource, but is assisted by videos and images. River integration as a STEM-based learning resource, on topics i.e classification, energy, organism & environment and pollution environmental.

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