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SOCIAL LEARNING IN THE DEVELOPMENT OF BIOMONITORING MODULE OF THE GAJAHWONG RIVER YOGYAKARTA

Eka Sulistiyowati[1], Dias Idha Pramesti[1]
UIN Sunan Kalijaga Yogyakarta[1]
**eka.sulistiyowati@uin-suka.ac.id*

Abstract - *Community-based river health monitoring requires a biomonitoring module that is easy to understand and can be practically used by the public. This study developed a biomonitoring module using a social learning approach with the aim of involving the community and gaining deeper insights into the ideal module for the general public. The method used includes the stages of Sharing, Constructing, Integrating, Applying, Reflecting, and Evaluation. The participants in this social learning activity were 30 individuals from various sectors. The results show that the social learning-based biomonitoring module was developed in a systematic process. Important feedback from the sharing and integrating stages was compiled and applied to form the module. Reflection and evaluation results indicate that the participants' average rating was in the good category (3.8). Several indicators received very good scores (4.0), particularly in timeliness and ease of use*

Keyword: Biomonitoring, River Health, Module, Social Learning, Rivers.

Abstrak - *Pemantauan kesehatan sungai berbasis masyarakat memerlukan sebuah modul biomonitoring yang dapat dipahami dan digunakan secara praktis di maryarakat. Penelitian ini menyusun modul biomonitoring dengan pendekatan sosial learning dengan tujuan unuk melibatkan masyarakat dan memperoleh insight yang lebih mendalam mengenai modul yang ideal dipakai oleh masyarakat awam. Metode yang digunakan adalah social learning meliputi Sharing, Constructing, Integrating, Applying, Reflecting, dan Evaluation. Partisipan yang mengikuti kegiatan social learning ini adalah 30 orang dari berbagai elemen. Hasilnya, modul biomonitoring berdasarkan sosial learning dapat tersusun dalam tahapan yang sistematis. Masukan yang penting pada saat sharing dan integrating kemudian disusun dan diaplikasikan menjadi sebuah modul. Hasil refleksi dan evaluasi menunjukkan skor rata-rata penilaian peserta berada pada kategori baik (3.8). Beberepa indikator mendapatkan nilai sangat baik (4.0), yakni pada kemutakhian dan kemudahan pengguaan.*

Kata kunci: Biomonitoring, Kesehatan Sungai, .Module, Sosical Learning, Sungai.

A. INTRODUCTION

River health monitoring is a crucial endeavor for identifying and anticipating environmental degradation of rivers at an early stage. According to legislation, river health monitoring is a government responsibility as outlined in Government Regulation No. 82 of 2002. This regulation classifies rivers as Class 2 and 4 water bodies, designated for purposes beyond just raw drinking water. Water monitoring, as specified in the regulation, employs standardized chemical, physical, and biological parameters. However, this monitoring approach has significant drawbacks, as it requires substantial funding and can only be conducted by experts in the field (Kachroud et al., 2019). Furthermore, the frequency of sampling and the number of samples taken greatly influence the outcomes of water quality assessments (Stansfield, 2001).

The challenges faced in existing water quality monitoring can be addressed through biomonitoring. Biomonitoring involves using biological agents, specifically organisms that are sensitive to pollution(Cairns & Pratt, 1993) (Batzias & Siontorou, 2006; Cairns & Pratt, 1993). These biological agents can include animals and plants capable of detecting declines in river health. One commonly used group for such detection is freshwater invertebrates, often referred to as bioindicators (Johnson dkk., 1993).

Additionally, biomonitoring can be conducted in a participatory manner, involving the community, as the indicators utilized are relatively simple, accessible, and cost-effective. This encourages participatory river health monitoring utilizing biomonitoring techniques. The idea of employing participatory biomonitoring has been implemented by the UIN Sunan Kalijaga Community Service Team since 2019 through a participatory water quality monitoring program supported by information technology (Sulistiyowati & Uyun, 2024). This monitoring program initially utilized a web-based system, www.statusair.com, which received intellectual property rights (HAKI No. EC00202302505) on January 9, 2023. However, previous monitoring programs have had limitations, notably the absence of modules to assist the community in learning about river health monitoring techniques.

Therefore, river stakeholder communities greatly require biomonitoring modules developed with a social learning approach. This is intended to ensure that the community understands the purpose, objectives, and content of the module from the outset. Involving the community in the development of the module from the beginning can help enhance knowledge and awareness, promoting collaborative practices for water quality monitoring. According to Firmansyah & Saepuloh (2022) a social learning process is essential before communities can fully adopt a program, necessitating appropriate learning media. Social learning is defined as "a process of social change in which people learn from each other" (Reed dkk., 2010). This process is vital for community involvement in participatory environmental management and must be facilitated through adequate training and resources. Moreover, activities related to river and environmental health monitoring outside formal educational settings are often perceived as non-academic endeavors.

To help the community understanding the role of environmental monitoring, we worked closely with the Gajah Wong community. The community lives adjacent to the Gajah Wong river. The river is one of the major rivers flowing through the urban area of Yogyakarta and plays an important role in supporting the livelihoods and environmental quality of surrounding communities. Along its riverbanks, various community-based initiatives have emerged, including

the Gajah Wong Community, which actively engages in social and environmental activities such as river clean-ups, environmental campaigns, and urban river advocacy. However, community involvement has largely been limited to awareness-based actions and voluntary activities, without being supported by adequate technical capacity to conduct systematic and scientifically informed river health monitoring.

One of the key challenges faced by the Gajah Wong Community is the limited capacity of its members to monitor river health using ecological and biological indicators. Most community members lack sufficient knowledge of aquatic ecology, practical skills in biomonitoring techniques, and access to participatory learning tools that translate scientific concepts into applicable community practices. As a result, community-based river management efforts tend to rely on visual observations and general perceptions, rather than on evidence-based data that could strengthen environmental decision-making and advocacy.

This condition highlights a critical need for participatory learning instruments that function not only as educational materials but also as tools for community empowerment. In this context, the river biomonitoring module developed in this study is positioned as a form of knowledge service and capacity-building instrument designed to strengthen community engagement in river conservation. The module aims to enhance the ability of river communities to understand ecological processes, apply simple biomonitoring methods, and independently assess river health in a structured and sustainable manner.

The development of this biomonitoring module is closely aligned with the mandate of community developmnent which positions communities not merely as beneficiaries but as active subjects of learning and agents of change. By integrating scientific knowledge with participatory learning approaches, the module serves as an empowerment tool that supports community-based environmental monitoring and fosters more meaningful community participation in urban river management. Therefore, the novelty of this research lies in its effort to develop biomonitoring modules that involve user communities in the social learning cycle. In this context, social learning is considered both a process and a method for engaging communities in environmental management, particularly in the monitoring of water quality. The more specific objectives are: 1) to develop a biomonitoring module, and 2) to enhance public understanding of biomonitoring through social learning.

B. METHOD

Social learning is a process through which individuals acquire new behaviors by observing and imitating others, either directly or indirectly. This theory was first introduced by Albert Bandura and has become one of the most influential learning theories in social psychology. Social learning involves several stages:

Stage 1: Sharing – Participants share knowledge and experiences related to biomonitoring.

Stage 2: Constructing – Together, participants build a shared understanding of the concept of biomonitoring based on the knowledge shared.

Stage 3: Integrating – Integrating the constructed understanding with the framework of the initial module.

Stage 4: Applying – This stage involves applying the developed module in case studies or simulations. Field practice was conducted in this stage to implement biomonitoring techniques. The field practice took place across three segments of the Gajahwong River.
Stage 5: Reflecting – This stage focuses on reflecting on the learning process and the outcomes achieved. After the field practice, participants were invited to attend a reflection session and contribute to the development of the biomonitoring module. During this phase, participants were encouraged to provide feedback and assessments of the module.

All stages were conducted during the social learning cycle which took place the State Islamic University (UIN) Sunan Kalijaga, Yogyakarta. Several discussions were held to implement the social learning cycle. We have invited 30 participants from various youth organizations, including the Botany Study Club, MAPALASKA, Water Forum, Yandara Foundation, students from Gadjah Mada University, and several students from UIN Sunan Kalijaga. Out of the 30 participants, 27 completed the first three stages, while three dropped out during the initial stages. In stages 4 and 5, 20 participants remained and completed the entire cycle.

C. RESULTS AND DISCUSSION

This study adopts Bandura's concept in the implementation of social learning. The concept involves several stages, namely: Sharing, Constructing, Integrating, Applying, and Reflecting. The study utilized workshops and focus group discussions (FGDs) on Social Learning Biomonitoring held in September-October 2024.

Sharing and Constructing

In the sharing stage, participants from various youth and community elements shared their current knowledge. This stage was facilitated by a moderator and successfully uncovered several insights from the community, which are summarized in Table 1.

Table 1. Examples of initial knowledge about rivers and health assessment

Participant codes	Institution	Initial knowledge
1M	Yayasan Pandara	- Rivers in Yogyakarta are polluted by waste. - Pandara Foundation has conducted river clean-up events several times, but participation is very low.
2P	Mapalaska	- Monitoring of river health has never been conducted, so the community often does not know what actions to take.
3A	Graduate School, UGM	- Riparian vegetation points can be identified using GPS, making the process easier - Riparian vegetation can filter water, benefiting ecosystem restoration.

After gathering participants' initial knowledge, the study proceeded to the second stage, Constructing. At this stage, participants were provided with version 1 of the biomonitoring module draft, asked to review it, and provide feedback. Generally, several sections were co-constructed based on participants' input. The results of the review and improvements in the constructing phase are detailed in Table 2.

Table 2. Knowledge construction from respondents for module improvement

Participant's code	Participants' suggested improvements
1	The addition of a glossary; grouping invasive and non-invasive species into a single table instead of by flow, to make distinctions easier; use terms like native and invasive in local context.
2	Emphasize community guidance or workshops to clarify issues; clearly define program goals: should it involve community guidance, focus on environmental awareness, or advocacy tools only.
3	Add a glossary; include quantitative indicators for when an object is classified as scarce, abundant, or absent; revise accordingly.
4	Add a glossary; explain specific numbering systems.
5	Define terminology; include diagrams of riparian species flow.
6	Conduct further review before printing; clarify less common explanations with simpler language accessible to the general public.

Participants' feedback Table 2 reveals not only technical suggestions for improving he biomonitoring module but also meaningful indicators of community capacity development. Recurrent requests for the inclusion of a glossary and clearer definitions of ecological terms suggest an increasing awareness of the importance of scientific terminology in environmental monitoring. This indicates a growing level of ecological literacy among participants, particularly regarding distinctions between native, invasive, and non-invasive species within a local context. Participant's feedback shows capacity building dimensions, as the goal of the research (Table 3).

Table 3. Capacity building dimensions of participants' feedback

Capacity dimension	Evidence from participant feedback
Ecological literacy	Requests for glossary, terminology clarification, native vs invasive distinctions
Analytical capacity	Requests for quantitative indicators (scarce, abundant, absent)
Monitoring skills	Suggestions to group species in tables, explain numbering systems
Participatory learning	Requests for workshops and community guidance
Knowledge accessibility	Requests for simpler language and clearer explanations

Tabel 3 highlights that participants' suggestions to include quantitative indicators for classifying species as scarce, abundant, or absent reflect an emerging analytical capacity. Rather than relying solely on qualitative observations, community members demonstrated a desire to apply measurable criteria in assessing river conditions. This shift signifies an important step toward evidence-based community monitoring practices.

The constructing stage highlights that participants had initial knowledge about how the biomonitoring module should be structured and developed. Their feedback included suggestions on terminology and understanding river flow forms. Below is a summary of participants' input during this stage:

1. The importance of a glossary and systematic grouping

Several participants (Codes 1, 3, and 4) emphasized the need for a glossary to provide clear definitions of technical terms. This indicates that terms like "invasive," "native," and "non-invasive" are not fully understood by all, especially if the target audience includes the general public. Additionally, grouping species in more intuitive tables was considered to simplify understanding.

2. The program direction and focus: Community guidance or developing awareness?

Participant (Code 2) proposed clarity regarding the program's ultimate goal: whether it aims to guide communities or simply raise environmental awareness. This feedback indicates the program's objectives had not been explicitly conveyed. Such clarity is crucial as it influences program design, resource allocation, and expected outcomes. As a follow-up, the program now emphasizes community guidance with ongoing training to apply the module.

3. Addition of Quantification and Indicator Standards

Input from Participant (Code 3) underscored the need to include quantitative indicators, such as defining when an object is categorized as "scarce," "abundant," or "absent." This is essential for reducing ambiguity in measurements or evaluations. The social learning approach in the sharing and constructing stages proves to be a powerful method for understanding various events in the community by relying on collective memory rooted in shared experiences. This approach has even been utilized by other researchers, such as Haque et al (2022), to understand resilience in the face of natural disasters.

The feedback provided indicates that participants successfully engaged in the sharing and constructing stages. Coming from diverse backgrounds, their input reflects robust social learning. Theoretically, a strong social learning approach builds collective memory of an event. Thus, social learning assumes that the knowledge already possessed by the community can create social memory. In this study, this was evidenced by participants' active contributions to improving the module based on their specific knowledge and experiences. For instance, a participant from the Yandara Foundation emphasized the need for advocacy tools, highlighting the importance of designing a more hands-on module.

Integrating and Applying

The integrating stage involved accommodating participants' feedback and conducting a review and revision of the initial module draft. The improvements to the module are as follows:

1. The Importance of a glossary and more systematic grouping

Follow-up actions included adding notes on key terms in biomonitoring. Additionally, statements in the instrument were reformulated into questions to make it easier for participants to understand the context and content of the instrument being used.

2. The program direction and focus: Community guidance or developing awareness?

As a follow-up, the program emphasized community guidance, with training sessions conducted to practice the module on an ongoing basis. After initial discussions with resource persons, participants were invited to the field to directly apply the biomonitoring module that had been developed.

3. Addition of Quantification and Indicator Standards

The indicators retained qualitative terms such as "scarce," "abundant," "present," and "absent" to make it easier for participants to provide qualitative assessments. Quantitative assessments require more technical procedures and methods, which were not feasible at this stage.

Reflection and Evaluation

The social learning approach in developing the biomonitoring module provided many insights, though several areas require improvement to make the module more effective. One frequently highlighted issue by participants was the use of scientific terms that are difficult for the general public to understand. Some participants noted typographical errors, a lack of explanations about species, unclear assessment scales, and insufficient instructions for completing worksheets. These issues could hinder participants without scientific backgrounds from fully comprehending the material. Additionally, the importance of including a glossary to help readers understand specialized terms was a key concern. Some participants also suggested that visual explanations, such as more realistic illustrations, could enhance understanding.

Overall, the training provided good insights, but improvements are needed in using simpler language and clearer explanations to make the module accessible to a broader audience, particularly community members directly involved in biomonitoring. Participants evaluated the module using a Likert-scale instrument. The following section presents the results of their assessments.

Table 4. Participant Evaluation Results for the Available Biomonitoring Module

Aspect	Score	Category
Material Coverage and Methodology		
Clarity of presented biomonitoring material	4.0	Very Good
Alignment with objectives	4.0	Very Good
Material coverage	3.5	Good
Material Accuracy		
Efficiency and ease of understanding of the presented biomonitoring material	3.5	Good
Clarity and accuracy of presented biomonitoring concepts	4.1	Very Good
Relevance of images to the presented material	3.8	Good
The biomonitoring material accurately represents the facts presented	4.0	Very good
Linguistic Aspect		
The language used complies with proper Indonesian language rules: 4.0	4.0	Very good
The language is straightforward and easy to understand	3.0	Good
The language is appropriate for the module's users	3.2	Good
Proper use of scientific names/foreign terms: 3.8 (Good)	3.8	Good
Aspect of Timeliness		

The biomonitoring material aligns with the latest developments in biological sciences	4.2	Very good
The material is relevant, engaging, and easy to follow	4.0	Very good
Ease of Use		
The methods presented are easy to understand	3.7	Good
The biomonitoring method facilitates river health assessment	4.0	Very good
The biomonitoring method is easy to practice	4.0	Very good
Average score	**3.8**	**Good**

Based on the evaluation results (Table 4), most aspects of the biomonitoring module demonstrate good quality, though some areas still require improvement. The first evaluated aspect is material coverage and methodology. The clarity of the material and alignment with objectives received a very high score, indicating that the content is easy to understand and well-suited to the training objectives. However, the material coverage scored slightly lower at 3.5, suggesting there is room to expand the topics or present the material more comprehensively.

The accuracy of the material yielded mixed results. The presentation of biomonitoring concepts was rated very well, with a score of 4.1, reflecting clear and accurate explanations. However, some participants felt that the material's efficiency could be improved, as it scored 3.5, indicating that certain sections were still difficult to grasp. Additionally, while the images used were relatively appropriate (score: 3.8), there is room for improvement in selecting visuals that better clarify specific concepts for readers.

In terms of language, while the module adhered to proper Indonesian language standards, the use of straightforward and easy-to-understand language received a score of 3.0. This suggests that some sections of the material employed complex language, which could be a challenge for participants without a scientific background. Moreover, although the use of scientific terms was reasonably accurate (score: 3.8), simplifying these terms or providing additional explanations could further enhance understanding for a broader audience.

On the other hand, the aspects of timeliness and ease of use scored very well, with high marks in both categories. The content was highly relevant to the latest developments in biological sciences, and the proposed biomonitoring methods were easy to understand and could be effectively applied in the field. Although there was some room for improvement in clarifying the method explanations (score: 3.7), the module overall proved to be highly effective in assessing river health. With an average score of 3.8, the biomonitoring module is of good quality. However, improvements in language simplification and visualizations will greatly enhance its overall quality and accessibility.

D. CONCLUSION

This study shows that the social learning–based biomonitoring module serves not only as an educational tool but also as an instrument for empowering river communities and delivering environmental knowledge services. Implemented through six stages, including, sharing, constructing, integrating, applying, reflecting, and evaluation, the module supports participatory learning and enhances community capacity to understand and engage in river health monitoring.

Although improvements are needed in terms of content depth, language simplicity, and clarification of scientific terminology to accommodate diverse participant backgrounds, the module demonstrates strong potential for practical application. Importantly, its adaptable design allows for replication by other river communities and integration into community-based river management and environmental education programs, thereby supporting broader efforts toward sustainable and participatory river governance.

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