



Peat ecosystem: Teachers' knowledge and perception, and its integration in learning biology





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ARTICLE INFO	ABSTRACT
<p>Article history Received February 10, 2021 Revised April 22, 2021 Accepted June 24, 2021</p> <p>Keyword: Biology practical classes Teacher's qualification Biological drawings</p>	<p>The improper uses of peatlands degrade the lands, making them vulnerable to fire. Restoration and conservation of Indonesian peatlands have not succeeded, yet the forest fires tend to increase in severity and frequency. Therefore, it is urgent to have more systematic efforts to conserve the peatlands through education, mainly in schools. This study aims to assess the knowledge and perceptions of high school biology teachers about the peatland ecosystem and identify the potential for integrating peatland-associated materials in learning biology. Data and information were collected through observation, online questionnaires, literature reviews, and focus group discussions. The data were analyzed qualitatively to reveal the biology teacher's knowledge and perceptions about peatlands. Although peatland is a vital resource on the east coast of Jambi Province, most biology teachers in the region do not have good knowledge about peatland. However, the teachers aware of the importance of integrating peatland material in learning biology. They argue that the integration facilitates students to understand the surrounding environment, including the peatland. Therefore, in the long run, they could actively involve in protecting and conserving the peatland. This research has identified several peatlands-associated materials that are relevant to be integrated into biology learning.</p>
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Introduction

Indonesia is one of the countries rich in natural resources; one of them is a peatland. The land mainly stretches on the island of Sumatra, Kalimantan, and Papua. Natural peatland forests can maintain the carbon stock they contain (Murdiyarso et al., 2010; Cole et al., 2015), thereby maintaining climate stability at the global

level. Natural peatlands also play an essential role in conserving biodiversity. Various species of plants, animals, and other organisms live naturally in peatlands (Posa et al., 2011).

In the last decades, peatlands in Indonesia have begun to be utilized, especially for agricultural purposes. Cultivation of food and industrial crops is carried out not only on shallow peatlands

but also on deep peatlands. Farming on peatlands is mainly undertaken by drying up the land; constructing water canals connected to rivers to release water, which usually inundates peatlands periodically. The canal construction is essential to lower the groundwater level to create environmental conditions favoring the crops' growth. However, the canal construction dries up the peatlands, making them very vulnerable to fires, especially during the long dry season. Several large fires have been recorded in Indonesia in recent years, including on peatlands (Albar et al., 2018).

Peatland is a natural resource that can support human life on a sustainable basis. The land should be managed carefully and wisely by considering various aspects related to the peatland ecosystem. Careless use of the peatlands makes them vulnerable to land deterioration by releasing large amounts of carbon reserves into the air (Biagioni et al., 2015), which can trigger climate change (Noor & Sabiham, 2010).

One of the leading causes of unwise peatland utilization and management is the poor understanding of the peatland properties. In Jambi Province, for example, the intensive interaction between the people and peatland has been relatively recent; it just has taken place in the last few decades. Most people who intensively utilize the peatlands are migrants; their knowledge about the peatland ecosystem is relatively low. As a result, they lack knowledge and skill associated with adequate peatland management techniques. Students learning in schools generally also do not obtain any associated peatland materials.

Through several institutions such as the Peatland Restoration Agency (BRG), the government of Indonesia has developed several programs to increase public understanding about peatland. The main groups target of the program are communities (adult) who live in and around peatland. Such a good understanding of peatland is expected to lead to the sustainable management of the peatland. Besides the adults, younger generations, such as school kids, should have good knowledge about peatland. They are generations who will carry out development and define the fate of the country in the future.

Students in school may learn peatland through some learning models. For example, a teacher delivers the knowledge about peatland through a contextual instruction model (approach). Some materials related to peatland close to students' daily lives are inserted to the related subject like biology. Kadir (2013) suggests that contextual learning provides the student with hands-on experience of learned material. Students aware benefits and objectives of learning the material; therefore, it will produce more meaningful learning.

Several studies on contextual learning have shown that this model can improve student motivation and learning outcomes. Pramitasari et al. (2011) show that contextual learning produces positive perceptions of learning implementation; students are increasingly motivated to learn. In mathematics learning, Hutagaol (2013) observes that contextual learning improves students' ability to understand mathematics and improves their ability to analyze, predict, and conclude. Nilasari et al. (2016) also show that contextual learning modules improve thematic learning outcomes in elementary school students.

A teacher can deliver contextual learning by adjusting to the conditions of students, school, and the environment around them. For small classes, Chamany et al. (2008) suggest to take students out of the classroom. Moreover, a teacher can also apply problem-based learning or case studies. Auliandari et al. (2019) observe that such learning can increase student creativity. Fägerstam and Blom (2013) added that learning outside the classroom provides a higher opportunity for interaction between students. Such learning may also provide higher retention of knowledge in long-term memory than students who only learn in class. Regarding learning outside the classroom, Jensen (2014) suggests to employ a guide to facilitate explaining the studied object (material) well. The absence of a competent guide may give a negative perception of the studied object.

Contextual learning inserted with local conditions such as material about peatland ecosystems can only be delivered well if the teachers who facilitate the learning have good knowledge of the peatland. Besides, it is also necessary to have learning instruments that gently integrate the

associated peatland materials in that learning. This study aims to analyze the knowledge and perceptions of biology teachers about peatland and assess its integration in biology learning.

Method

Data collected in this study include qualitative and quantitative data. The research subjects included 21 biology teacher's members of the biology teacher association (MGMP) in the East Tanjung Jabung District, Jambi Province. The research employed several techniques, including observation, in-depth interviews, focused group discussion, and questionnaires to collect the required data.

The research team undertook observations to explore the nature of peatland ecology and biology learning in schools. Due to the Covid 19 pandemic escalation at the beginning of the fieldwork, the observation related to biology learning was performed through online communication using the WhatsApp group application and telephone. Besides aiming to ease gathering initial information, the WhatsApp Group also aims to facilitate communication with the teachers who are the resource persons in this study.

Information collected from the observation was enriched with relevant literature and then developed into a research instrument, including interview guides and questionnaires. The process to develop research instruments began with preparing research grids, covering aspects of knowledge and perception of biology teachers about peatland. In the next step, the researchers employed the grid as a reference for constructing questionnaires' statements and questions.

The knowledge aspect consists of six indicators, including peatland characteristics, peatland functions and benefits, peatland management, peatland conservation, peatland fires, and peatland-based learning. The perception aspect consists of two main variables: the biology teacher's perception of the peatland ecosystem and peatland-based learning. The researchers develop ten indicators that generate perceptual statements and questions in the questionnaire based on those two aspects. The indicators are the importance of peat, peatland clearing, utilization of peat for agriculture,

development on peatland, peat conservation, the need for local resource-based learning, easiness for local resource-based learning, constraints for local resource-based learning, opportunities for local resources based learning, and integration of peat materials into local resource-based learning. The researchers conducted in-depth interviews with biology teachers and other related parties about developing local resources (peatland) based learning model. Key respondents were recruited by employing the snowball technique, starting with the head of the biology teacher association (MGMP) of East Tanjung Jabung District.

Data and information obtained from in-depth interviews were further explored and verified through a focused group discussion involving five senior biology teachers representing biology teachers in the East Tanjung Jabung District.

The survey of respondents was conducted using a valid questionnaire, assessed in terms of face validity (Oluwatayo, 2012) and content validity by two experts. Following Zuriyah (2018), the questionnaire used written questions that respondents also answer in written form. A semi-structured questionnaire was administered online using the google form application.

Qualitative data obtained from the research were processed and presented in tables arranged according to this study's needs and objectives. Furthermore, the data were analyzed descriptively following Miles et al. (2018) to obtain an overview of the peat ecosystem and biological learning in the East Tanjung Jabung District. The quantitative data obtained from the questionnaire was calculated to get an overview of biology teacher's knowledge of peatlands and local resource-based learning. The option answers to the knowledge aspect consisted of two categories (true or false). Simultaneously, the perception assessment was measured using a Likert scale consisting of four response levels, namely very negative, negative, positive, and very positive.

Following Sugiyono (2008) the percentage level of teacher knowledge was calculated using (1).

$$P = \frac{X}{N} \times 100\% \dots\dots\dots(1)$$

P represents a percentage of knowledge, where X is a Total Score, and N

is Total Score Maximum. Furthermore, the teacher's perceptions about local resource-based (peatland) learning were grouped using (2).

$$\bar{X} = \sum \left(\frac{\text{Question Score} \times \text{Score Frequency}}{n} \right) \dots \dots \dots (2)$$

With a scale range (Rs):

$$R_s = \frac{(m-1)}{m} \dots \dots \dots (3)$$

This formula (2 and 3) using the symbol "n" to represent the number of samples, whereas symbol "m" represents the number of alternative answers for each item.

Results and Discussion

Biology teachers who were respondents in this study mostly work, closely interact with, and live-in peatland area. However, most of them did not understand the peat ecosystem well. The average test value of the peatland associated materials was 53 (out of 100; Figure 1). More specific, knowledge related to peatland fires and peatland characteristics was in the medium category. However, for peatland importance, peatland management, and peatland conservation, teacher's knowledge was in a low category. The lack of knowledge about peatland implies that the learning biology in senior high schools in the region was not strongly connected to the existing surrounding environment.

Most people in East Tanjung Jabung, including students and teachers, have high interests in peatland. They depend on peatlands, especially land, to cultivate industrial crops, mainly oil palm and

acacia. Land and forest fire disasters in the last ten years also mainly occurred on peatlands. The fires had a massive impact on the economy, health, and other aspects of life. The fire's impact was suffered by people in the East Tanjung Jabung District and other communities, including people outside Jambi Province.

A professional biology teacher should have a good understanding of the surrounding environment, including the peatland. Also, the professional teacher will ensure a high quality of learning delivery. Several studies show the importance of this professional competence (Suraji, 2012). Moreover, a professional teacher will affect his/her students learning outcomes (Herawati, 2020; Arfah & Muhidin, 2018).

Several institutions such as the Peatland Restoration Agency, WWF, and WARS (a conservation NGO) have carried out peatland restoration and conservation activities for peatlands in East Tanjung Jabung District. The activities included training and other activities to increase community understanding of peatland (e.g. Sitepu & Dohong, 2019). However, these efforts seem to reach only adult people around the burnt peatland sites, such as community leaders and community members directly involved in peatland restoration and forest fire prevention (control). Therefore, it is essential to develop other educational models that are more systematic and sustainable. One of the models could be developed through formal education in schools, especially senior high school.

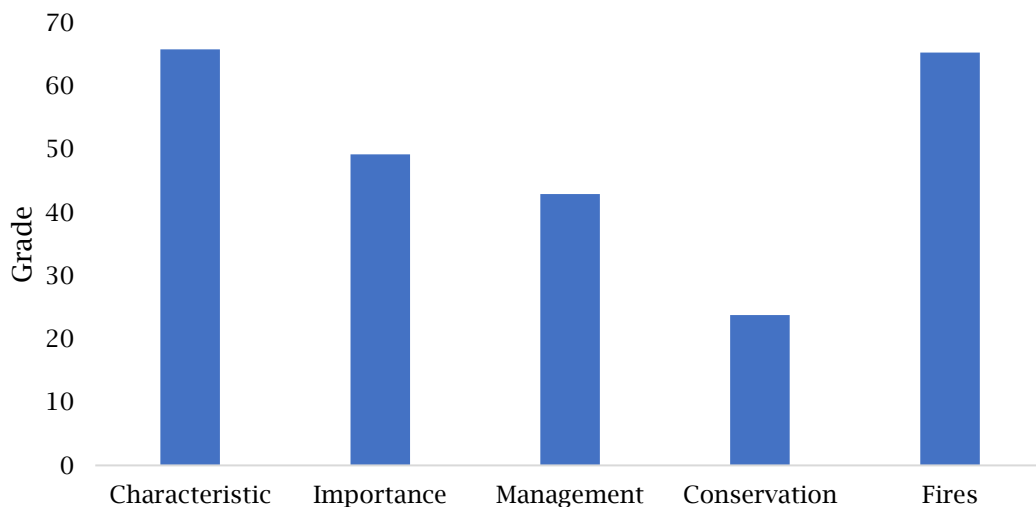


Figure 1. Respondents' knowledge about Peatland

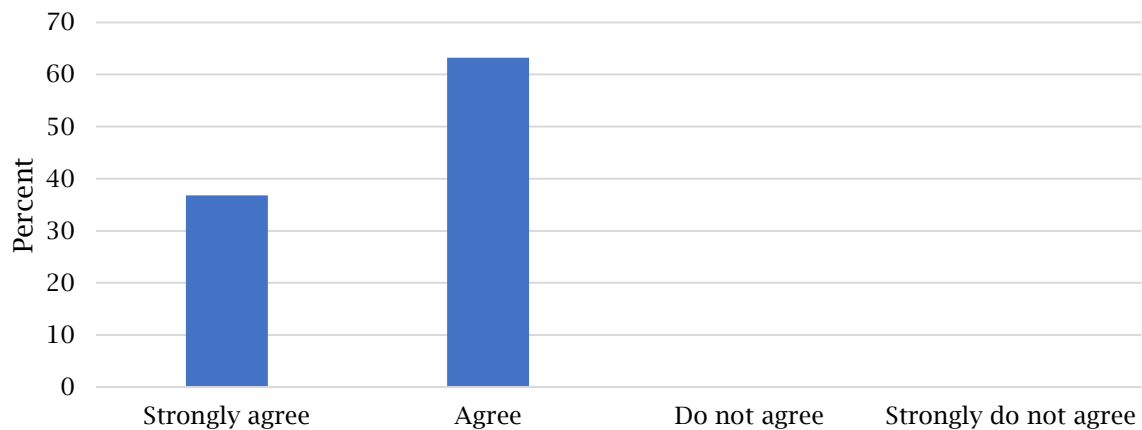


Figure 2. The need to integrate peatland-associated material into biology learning

Senior high school students are the future generation who will later take over (continue) current important positions, either in government, private, non-governmental organizations, or other elements of society. Good knowledge and understanding of peatland are expected to rise future leaders and executives who could formulate policies and development models that promote sustainable peatland management.

To have students' good understand of peatland, teachers, especially biology teachers, who facilitate the learning must have to be equipped with good knowledge and understanding about peatland ecosystem. Deep and thorough knowledge and understanding of peatland will help teachers develop lessons that integrate peatland-associated materials, for example, through contextual learning. In that model, learning is conditioned in such a way that students can connect material learned in school with facts/phenomena encountered in their everyday life.

Contextual learning provides several benefits that ease students to understand the subject matter. According to [Prमितasari et al. \(2011\)](#) contextual learning provides better perceptions of the learning process; students become more motivated to learn. [Kadir \(2013\)](#) adds that the learning model facilitates students to recognize the benefits of the studied materials, how to achieve the benefits, and their role in the learning. Ultimately, students will more easily understand and apply the knowledge they obtained.

Although most biology teachers in East Tanjung Jabung District do not have a good knowledge and understanding of the peatland ecosystem, they realize the need

to integrate peatland-associated materials in school learning, especially biology. All respondents stated that they strongly agreed to integrate peatland associated materials (mean score 3.29; [Figure 2](#)). The continuous and extensive integration of peatland material in biology learning will become a systemic breakthrough that will equip senior high school students with knowledge about the peatland ecosystem's characteristics and importance.

The biology teachers argued that integrating peatland-associated materials into biology learning can help students improve their awareness, ability, and curiosity to recognize their surroundings, both in school and in the environment around the place they live. Besides, the teacher also expected that peatland integration into biology learning would help conserve the peatland in the long run. More importantly, this integration can reduce peatland fires. Their frequency and intensity tend to increase in the last decade. The mean scores for these three aspects are more than 3.1, indicating very positive perceptions ([Figure 3](#)).

The integration of peatland associated materials in biology learning can be undertaken by utilizing the available resources in schools and the surrounding environment. Observation of peatland characteristics can be performed using simple practicum tools such as a light microscope, meter type, and scale. For example, by understanding the peatland ecosystem's unique properties, students can distinguish peat soil from mineral soil. Also, students can see and feel the peatland's properties by themselves and assess the implications and risks of a careless peatland management.

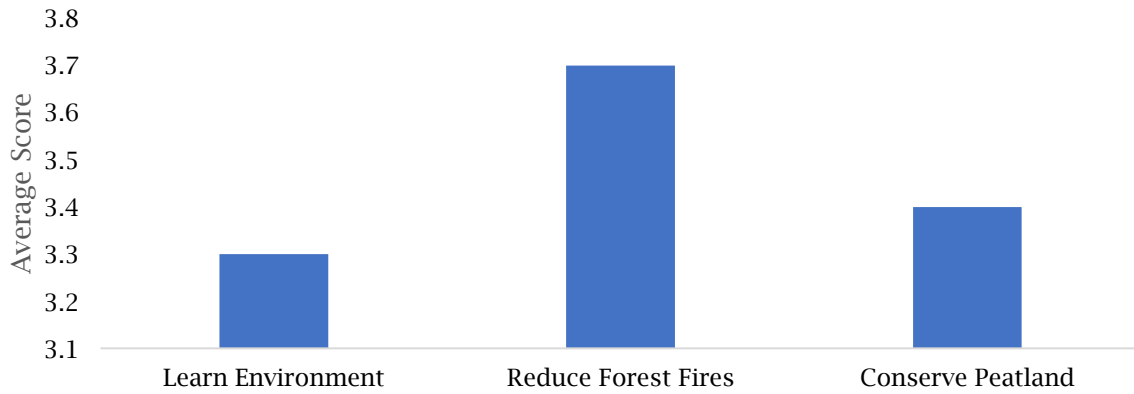


Figure 3. Benefits of integrating peatland associated materials into biology learning

All teachers who were respondents in this study stated that they were very interested in being able to integrate peatland associated materials in biology learning (mean score 3.37; Figure 4). Few teachers (around 27%) have tried to integrate peatland materials in biology learning, for example, by inserting them into biodiversity subjects (animals and plants). The teachers took examples of typical peatland plant and animal species commonly grow on peatland as examples to explain the subject.

Several previous studies also reported the integration of peatland associated materials in biology learning. Fauziah et al. (2018) examined some post-fire peatland plant species' root systems to develop a handout of research-based biology learning. Another study was conducted by Nursal et al. (2018) on vegetation structure after peatland fires. They suggest that vegetation's typical conditions after peatland fires can enrich biology learning material for class X senior high school, especially subject ecosystem components (KD 3.10) and environmental changes impact (KD 3.11).

The focused group discussions conducted with several biology teachers concluded that senior high school biology

subjects could be enriched with peatland associated contents. The subjects include biodiversity (animals, plants, fungi species), growth and development, respiration systems, ecosystems, environment conservation, and pollution. Some examples of material that can be integrated for the subjects are presented in Table 1. Based on the Table 1, the researcher developed examples of learning instruments that integrate appropriate peatland associated materials for each subject.

The integration of peatland material in biology learning is new for most biology teachers, especially in East Tanjung Jabung District. Some teachers were aware that the integration process is quite complicated. Therefore, they need guidance (training) to gently integrate peatland-associated materials into biology learning by considering their respective schools' existing conditions. Sobel (2004) uses the terminology of place-based education to utilize the resources that exist around students' lives to support learning. Furthermore, Powers (2004) concluded that such a model is excellent for learning and also changing teachers' patterns and habits.

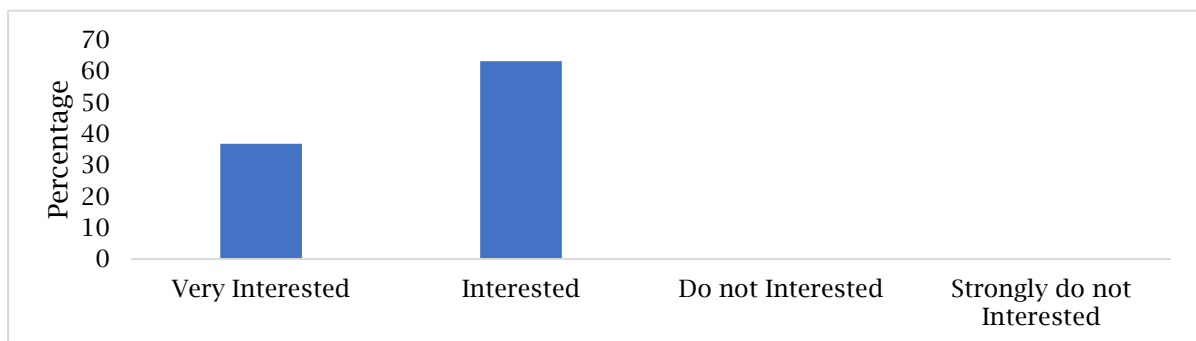


Figure 4. Teachers' interest to integrate peatland associated materials in biology learning

Table 1. Some examples of peatland associated materials that can be integrated into biology learning

Subject	Peatland associated materials
Indonesia's biodiversity (genetic, species, and ecosystem biodiversity)	<ul style="list-style-type: none"> a. Several plant species are typical for peatlands, such as jelutung rawa (<i>Dyera lowii</i>) and ramin (<i>Gonystylus bancanus</i>). The latter species produce high-quality timber, which is usually used to make furniture. This species is included in the IUCN endangered category (red list). b. Natural peatlands are also home to many wildlife, including the threatened and charismatic Sumatran tiger's species (<i>Panthera tigris sumatrae</i>).
Ecology: ecosystems, energy flows, biogeochemical cycles and interactions in ecosystems	<ul style="list-style-type: none"> a. Tropical peatland ecosystem is a unique ecosystem dominated by plant debris that has not been fully decomposed (such as litter). The ecosystem is almost wet and periodically submerged b. Agricultural practices on peatland are commonly carried out by drying up the land. To do so, people develop water canals. The dried peatland makes it very susceptible to wildfires, especially in the long dry season
Environmental or climate change and waste recycling	<ul style="list-style-type: none"> a. Peatlands store huge carbon stock because most of them are composed of organic matter (most plant debris have not been completely decomposed), which have crucial roles in maintaining global climate balance. The releasing carbon from peatlands, for example, due to draining (forest fire), can increase global carbon supply, thereby affecting global climate stability b. Fires in peatland forests burn the trees on them and burn the peatland soils themselves. The fires very severely degrade the peatlands
Structure and function of plant tissue	Peatland is unstable land. Some tree species adapt to the land by developing root structures in the form of buttresses to support tall and large tree bodies on less stable land (similar to "chicken claws" structure on high buildings)
Respiration system	<ul style="list-style-type: none"> a. Haze originating from peatland fires contains a high content of dangerous chemical compounds that can disrupt the respiratory system, including acute respiratory infection (ARI). b. Smog can reduce the lungs' ability to work, causing a person to tire quickly and difficult breathing
Growth and development	Peatlands are deficient in nutrients. However, some plant species such as <i>Nephentes</i> sp. can adapt to such conditions and grows well on peatlands

Regular monitoring is crucial to ensure the effective integration of peatland-associated materials into biology learning. It is essential to ensure that students can adequately understand the delivered materials related to peatlands without reducing the main learned subject's main achievements. [Wijanarti et al. \(2019\)](#) suggest that the integration process will be more successful if supported by good cooperation between stakeholders related to education such as teachers, schools, the community, and local education service.

Conclusion

Peatland is one of the essential natural resources for the people in east Tanjung Jabung District. However, most biology teachers in the region do not understand the peatland ecosystem well. Integrating associated peatland materials into biology

learning is a strategy to foster peoples' understanding of the peatland ecosystem. Such integration will help students understand the environment around them and help protect and conserve peatlands. Given that the integration is quite complex, it is essential to help the teachers not only to be mastering in peatland associated materials and develop and apply the appropriate learning integration model.

This research identifies subject matter that can be enriched with peat material and examples of learning tools to integrate peat material in the biology learning. The resulting model needs to be reviewed periodically to ensure its effectiveness in learning. Teachers need to be encouraged to develop other models that are more appropriate to their respective schools' conditions. Besides, some supporting media are also needed to encourage the successful application of this model.

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