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The Intersection of Education and Local Environmental Issues: Secondary Students' Views and Actions on Peatland Ecosystems in Global Warming Phenomenon

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Abstract

The escalating degradation of peatland ecosystems, coupled with the urgent global warming crisis, has raised concerns about the role of education in fostering environmental awareness and actionable solutions among younger generations. This study explores secondary students' views and actions regarding peatland ecosystems within the context of global warming. The purpose is to examine how education influences students' understanding of peatlands' role in climate change and the actions they take to mitigate environmental impacts. Using a mixed-methods design, semi-structured interviews and surveys were conducted with 105 students from grades 10 to 12 in Indonesia. Findings reveal that while students possess a strong awareness of peatlands' importance, their actions toward conservation remain limited. Many students express concern about global warming and peatland degradation but face barriers such as insufficient local initiatives and a lack of actionable knowledge. The study concludes that while education fosters awareness, there is a need for more practical, community-based learning opportunities to bridge the gap between knowledge and action. Implications suggest that integrating environmental education with hands-on conservation projects, as well as promoting stronger governmental and community involvement, could enhance student engagement in peatland conservation and other local environmental issues.
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Keywords: Peatland Ecosystems, Views, Actions, Secondary School Students

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INTRODUCTION

The escalating severity of global warming has emerged as one of the most pressing environmental challenges of the 21st century (Lahlali et al., 2024; Raihan et al., 2024). If not addressed, global temperatures are anticipated to rise by 1.4°C to 5.8°C by 2100 compared to 1990 levels (Grose et al., 2023; Olatunde-Aiyedun et al., 2022). In Indonesia, the average temperature has risen by about 0.6°C over the past 40 years, with some areas experiencing more intense and frequent extreme weather events (Hapsari et al., 2022). This phenomenon has led to severe consequences such as extreme weather events, rising sea levels, and biodiversity loss (Muluneh, 2021; Nashier & Lakra, 2020). These impacts underscore the urgent need for coordinated global action to mitigate greenhouse gas emissions and adapt to the ongoing changes. In this context, addressing global warming requires not only political and technological interventions but also educational strategies aimed at fostering a deeper understanding of the issue among younger generations (Kranz et al., 2022; Okada & Gray, 2023). Research by Calculli et al. (2021) has consistently shown that awareness and knowledge about global warming among students are pivotal for driving meaningful societal change.

Secondary school students represent a pivotal demographic in fostering sustainability awareness and preventive actions against global warming (Piscitelli & D'Uggento, 2022; Szeberényi et al., 2022). This age group is uniquely positioned to develop critical thinking skills, environmental ethics, and proactive behaviours that can influence both current and future societal practices (Awdziej et al., 2023; Babalola et al., 2023). However, previous research by Meyer et al. (2024) indicates that students often lack comprehensive knowledge and nuanced views of global warming, particularly its localized impacts and actionable solutions. For example, Lehnert et al. (2020) and Han et al. (2022) found that while students were aware of global warming, their understanding of its scientific mechanisms and mitigation strategies was limited.

Indonesia has vast peatland ecosystems, covering approximately 24 million hectares (Lupascu et al., 2023; Yunus, 2024). One of the provinces in Indonesia with extensive peatlands in South Sumatra, which is home to large swaths of peat swamp forests and wetland ecosystems (Kurdiati et al., 2024). Peatlands play a critical role in carbon sequestration, storing large amounts of carbon in their soil and vegetation (Treby & Grover, 2024; Yusuf et al., 2024). According to research by Merten et al. (2021), peatlands are responsible for sequestering billions of tons of carbon, helping to mitigate global climate change. However, the degradation of these ecosystems, often through deforestation and drainage for agriculture and plantations, has turned peatlands from carbon sinks into carbon sources (Miller et al., 2022). Studies by Rabbi & Kovács (2024) and Mander et al. (2024) shown that the destruction of peatlands contributes significantly to greenhouse gas emissions, with vast amounts of stored carbon being released into the atmosphere, thus exacerbating global warming. These changes in peatland ecosystems have serious implications for the global climate, as they worsen the greenhouse effect and accelerate climate change impacts (Nashier & Lakra, 2020; Salimi et al., 2021).

Peatlands in tropical regions face dual threats: increasing temperatures and anthropogenic activities such as deforestation and land conversion (Lupascu et al., 2023; Rabbi & Kovács, 2024). In Indonesia, particularly in South Sumatra, extensive peatland areas are severely degraded due to land-use changes and frequent fires, releasing massive amounts of carbon dioxide into the atmosphere (Hapsari et al., 2022; Yazid et al., 2024). These combined pressures not only amplify global warming but also diminish the ecological and socio-economic benefits provided by peatlands (Räsänen et al., 2023; Yeny et al., 2022). In that province, peatland degradation has become an urgent environmental crisis. Fires in peatlands are not only a recurring environmental hazard but also a major source of carbon emissions (Graham et al., 2022; McCarter et al., 2024). Peatland fires in South Sumatra have caused widespread damage, with significant incidents recorded in 2019 (Irfan et al., 2024). In that year, approximately 336,798 hectares of peatland burned (KLHK RI, 2019). A similar crisis occurred in 2023, where approximately 132,082 hectares were affected (KLHK RI, 2023).

Local communities, including students, living in proximity to these ecosystems are directly affected by the impacts of peatland degradation, which include health problems, loss of biodiversity, and reduced agricultural productivity. According to a study by Barros et al. (2023), the 2019 peatland fires in South Sumatra led to severe respiratory health issues, with more than 75,000 people suffering from acute respiratory infections (ISPA). The economic losses were also substantial, as agricultural productivity in affected areas (Kabeshita et al., 2023; Wu et al., 2023). Such events underscore the urgent need for sustainable peatland management and education on the critical role these ecosystems play in mitigating climate change. Thus, equipping young learners with the knowledge and skills to address these issues is vital. Education serves as a powerful medium for equipping students with the necessary competencies to navigate and respond to complex

environmental challenges, particularly those related to global warming and sustainability (Kurdiati & Fathurohman, 2024; Ningsih & Akhyar, 2024).

Several studies have explored students' perceptions and actions concerning global warming, offering insights into their awareness and limitations. Chung & Yu (2021) identified misconceptions among Korean students regarding the greenhouse effect, highlighting their struggles to understand its complexity and broader environmental impacts. A previous study in Southeast Asia by Lee (2024), that conducted in Brunei Darussalam, found similar gaps in understanding and misconceptions of the greenhouse effect among high school students, especially in tropical regions where the effects of deforestation and biodiversity loss are more immediate. Similarly, Bott (2020) focused on Indonesian coastal students and found that while they were aware of global warming's effects, such as flooding, their understanding lacked depth and did not lead to actionable steps. Sidauruk et al. (2025) examined university students in fire-prone peatland regions of Kalimantan, where they showed weak awareness of peatland degradation's role in global warming but lacked preventive actions due to insufficient community-based strategies. Furthermore, studies by Zulkarnaen et al. (2023) in Riau Province, it was revealed that students in vulnerable regions are aware of the environmental risks but face barriers in translating knowledge into action due to limited resources and education about local environmental management.

While previous studies have provided valuable insights into students' perceptions and actions on global warming, most have not specifically addressed the intersection of education, global warming, and peatland ecosystems. Existing research has primarily focused on general environmental issues or other ecosystems but has largely overlooked the unique role that peatlands play in global warming. Peatlands are critical in regulating the global carbon cycle, and their degradation significantly contributes to greenhouse gas emissions. However, there is a lack of research focusing on how educational strategies can address these specific challenges. This gap is particularly noticeable in regions like South Sumatra, where peatland ecosystems face significant environmental threats. While studies have explored climate change awareness and actions in various contexts, few have targeted local, region-specific issues such as peatland conservation. This gap in research highlights the need for more localised educational interventions that are tailored to the unique environmental challenges of peatland areas.

METHODS

This study employed an exploratory study design, a qualitative research method aimed at investigating the depth of understanding and the spectrum of actions demonstrated by high school students regarding the role of peatland ecosystems in the global warming phenomenon. Exploratory research is particularly effective for examining complex, underexplored topics, as it allows researchers to gather rich, descriptive data and uncover nuanced insights (Ariffin et al., 2024). The design is well-suited for contexts where prior research is limited or where the goal is to develop a foundational understanding of participants' perspectives and behaviours (Macagno et al., 2024). The research was conducted during the odd semester of the 2024/2025 academic year because it aligned with seasonal discussions on climate issues, providing a rich backdrop for eliciting informed and contextually relevant data.

The participants in this study were selected from State Senior High School 1 Palembang using a combination of stratified sampling and cluster random sampling techniques, chosen to align with the research objectives and accommodate time constraints. Stratified sampling was employed to divide the population into strata based on grade levels

(Olumorin et al., 2022; Wider & Wider, 2023). This approach ensured representation across all grade levels, enabling a detailed analysis of differences in sustainability awareness among the various grades. After stratifying the population, cluster random sampling was applied to select one class from each grade level randomly. The selected classes were 10.1, 11.3, and 12.5, yielding a total of 112 participants, comprising 62 female and 43 male students (N_{lost}=7). This sample size aligns with Dattalo (2008) recommendation that samples of fewer than 150 participants are adequate for exploratory studies, supporting the reliability of the research findings. This carefully structured sampling approach not only enhanced the efficiency of the research process but also ensured robust and generalisable results.

Data collection in this study employed two techniques: questionnaires and interviews. The questionnaire was administered to all 105 participants. At the same time, interviews were conducted with six students representing each grade level (two from grades 10, 11, and 12, consisting of one male and one female per grade). The questionnaire was carefully designed based on a review of existing instruments used in similar studies, ensuring alignment with the study's objectives. Demographic information, including name, age, gender, and class, was gathered through a questionnaire. This questionnaire, which incorporated open-ended questions and semi-open questions, aimed to explore students' perceptions of peatland ecosystems, their role in global warming, and the actions students are taking to mitigate the impacts of global warming in peatland ecosystems, thereby addressing the study's objectives. Semi-structured interviews were conducted with selected participants to delve deeper into their perspectives. These interviews sought to gather students' visions for a more sustainable future for peatland ecosystems, as well as to identify the factors that may hinder their engagement in climate action. Each interview lasted approximately 30–45 minutes, with responses recorded and transcribed for analysis. This dual-method approach enabled a comprehensive understanding of students' views and actions, balancing insights from questionnaires and interviews (Vreˇ & Rožman, 2024). Ethical considerations were maintained throughout the data collection process, ensuring voluntary participation and confidentiality.

The analysis in this study was conducted using qualitative methods to examine the insights gathered from interviews and questionnaire responses. The data were analysed thematically to identify patterns, trends, and key themes that aligned with the study's objectives. This method ensured an in-depth understanding of students' perceptions and actions related to peatland ecosystems and global warming. Responses from the questionnaires were transcribed and categorised based on recurring themes. Thematic coding was employed to systematically organise the data, with codes derived both deductively from the research questions and inductively from the data itself (Locke et al., 2022; Riazi et al., 2023). The coding process enabled the identification of prevalent patterns, such as students' knowledge about peatlands, their role in global warming, and the actions taken to mitigate its effects.

Data from the semi-structured interviews with six participants (two students each from grades 10, 11, and 12, representing both genders) were transcribed verbatim and analysed using the same thematic approach. This process provided deeper insights into students' visions for sustainable peatland management and the barriers they face in engaging with climate action. The interviews offered rich, contextual information, complementing the broader patterns identified in the questionnaire responses. To enhance the credibility and reliability of the findings, data triangulation was applied. Insights from the questionnaire and interviews were cross-referenced to validate the themes and ensure consistency in the interpretation of students' perspectives. This qualitative analytical framework provided a comprehensive understanding of the participants' views and actions, capturing the complexity and depth of their engagement with local environmental issues

and their role in the global warming phenomenon. Ethical considerations were upheld throughout the analysis, ensuring confidentiality and respect for the participants' contributions.

RESULTS & DISCUSSION

Results of Peatland Ecosystems in the Eyes of Students

The analysis of students' responses to open-ended questions revealed a diverse range of perspectives on the importance of peatland ecosystems, showcasing a deep understanding of their ecological value and the urgent need for their conservation. The responses were categorised into various themes that capture the students' awareness, environmental concerns, and aspirations for peatland protection. The coding system applied to the responses allowed for the identification of key themes, providing a comprehensive view of the factors that shape students' attitudes toward peatland ecosystems. Table 1 presents a breakdown of the frequency and percentage of coded responses, categorised by themes such as awareness, conservation, environmental impact, and education.

Following the presentation of Table 1, the data highlights reveal key themes from students' responses. The most frequently mentioned theme, with 38.10%, was the awareness of peatlands' ecological significance, emphasising their role in regulating climate change and maintaining biodiversity. Additionally, 20.95% of students expressed concern about the environmental impact of peatland degradation, including increased greenhouse gas emissions and biodiversity loss. The theme of conservation efforts was also notable, with 28.57% of responses highlighting the need for sustainable management practices and local initiatives. Furthermore, 26.6% of students acknowledged the critical role of education and public awareness campaigns in promoting peatland protection, underlining the growing desire among the younger generation to engage in environmental advocacy through educational and community-based efforts.

Actions Students Take to Combat Global Warming in Peatland Ecosystems

In exploring the actions students are taking to combat global warming, particularly in relation to peatland ecosystems, it is important to assess how they perceive their role in environmental conservation. While many students express awareness of global warming and the importance of protecting peatlands, their efforts to engage in tangible actions vary. The following Figure 1 illustrates the types of actions students are currently taking to address the impact of global warming on peatland ecosystems, as reported by a sample of 105 students. The chart categorises their responses into three main areas of focus: reducing vehicle pollution, using fossil energy resources wisely, and participating in local sustainability efforts.

Table 1. Code counts from students answers (n = 105)

Category Code	Sub-Code	Count of Coded Responses		Description	Example from Students' Answers	Theme Type
		F	(%)			
Awareness	Knowledge of Peatlands	40	38.10	Students' understanding of peatlands, their function, and their importance in ecosystems.	*"Peatlands are essential because they store carbon and prevent floods."*	PT1
	Awareness of Threats	20	19.05	Recognition of the risks peatlands face, including deforestation, fires, and drainage.	*"Peatlands are at risk from fires and land clearing."*	NT1
	Ecological Significance	18	17.14	Students' understanding of the role of peatlands in maintaining biodiversity and ecosystem services.	*"Peatlands are home to many species and keep ecosystems healthy."*	PT2
Conservation	Importance of Peatland Protection	30	28.57	Understanding of why it is critical to conserve peatlands, with an emphasis on environmental balance.	*"Protecting peatlands is necessary to mitigate climate change."*	PT3
	Local Conservation Efforts	15	14.29	Students' thoughts on local conservation efforts and their potential impact on peatlands.	*"We can help by educating people in our area about the importance of peatlands."*	PT4
	Government Responsibility	18	17.14	Views on the role of government policies and actions in peatland protection.	*"The government should enforce laws to stop peatland degradation."*	NT2
Environmental Impact	Climate Change and Carbon Storage	25	23.81	Students' awareness of how peatlands impact climate change through carbon sequestration.	*"Peatlands help absorb carbon and fight global warming."*	PT5
	Impact of Peatland Degradation	22	20.95	Understanding the consequences of peatland destruction, such as increased greenhouse gases and ecosystem collapse.	*"If peatlands are damaged, it will release stored carbon and worsen climate change."*	NT3
	Biodiversity Loss	20	19.05	Awareness of how peatland destruction threatens biodiversity and wildlife.	*"When peatlands are destroyed, species lose their habitat, which affects biodiversity."*	NT4
Education & Awareness	Role of Education in Peatland Protection	28	26.6	The role of education in raising awareness and inspiring action for peatland conservation.	*"We need to teach students about the importance of peatlands in school."*	PT6
	Public Awareness Campaigns	18	17.14	Students' thoughts on the effectiveness of public campaigns for promoting peatland conservation.	*"Public campaigns can help people realise how important peatlands are."*	PT7
	Community Involvement	15	14.29	Opinions on how involving local communities in conservation efforts can help protect peatlands.	*"If communities work together, they can restore and protect local peatlands."*	PT8

Note: PT = Positive Theme, NT = Negative Theme

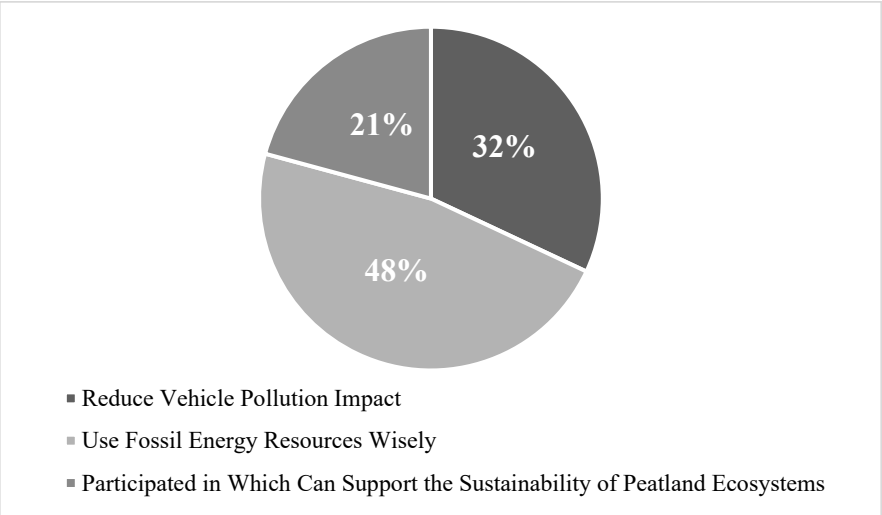

Figure 1. Actions Students Take to Combat Global Warming in Peatland Ecosystems (n = 105)

Figure 1 shows the actions students are taking to mitigate global warming, with 48% focusing on using fossil energy resources wisely, 32% working to reduce vehicle pollution, and 21% engaging in local peatland conservation initiatives. This reflects a growing awareness of energy conservation, transportation's impact on carbon emissions, and community-based environmental efforts. Figure 2 further explores students' specific strategies to reduce vehicle pollution, highlighting their increasing commitment to sustainable transportation choices and practices.

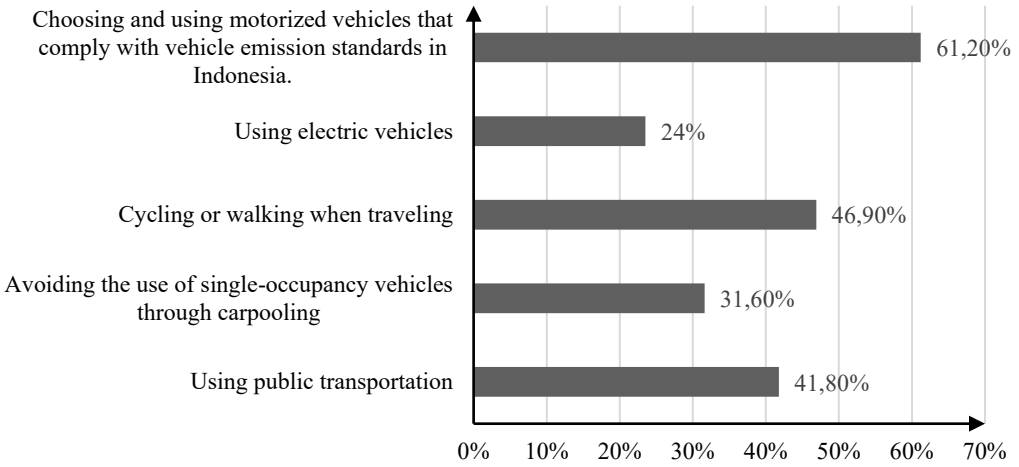

Figure 2. Students' Responses to the Actions Taken to Reduce Vehicle Pollution Impact Students

The data presented in Figure 2 reveals that students are adopting a variety of methods to reduce their transportation-related environmental impact. The most common action taken by 61.2% of students is choosing motorised vehicles that comply with emission standards, demonstrating their awareness of the importance of vehicle regulations. Additionally, 46.9% of students choose cycling or walking for travel, which directly reduces carbon emissions. Public transportation usage and carpooling were also popular, with 41.8% and 31.6% of students, respectively, adopting these options. The lower percentage of students (24%) using electric vehicles highlights the challenges in accessing

and adopting newer, greener transportation technologies. These actions indicate a growing student commitment to sustainable transportation practices, though further efforts may be needed to increase the adoption of electric vehicles.

Beyond transportation, students' actions to use fossil energy resources wisely reflect their understanding of the broader energy challenges associated with global warming. Energy conservation, along with the use of more sustainable sources, plays a crucial role in reducing greenhouse gas emissions. The following Figure 3 illustrates the actions taken by students to use fossil energy resources more efficiently, encompassing behaviours in both personal energy consumption and broader environmental impact.

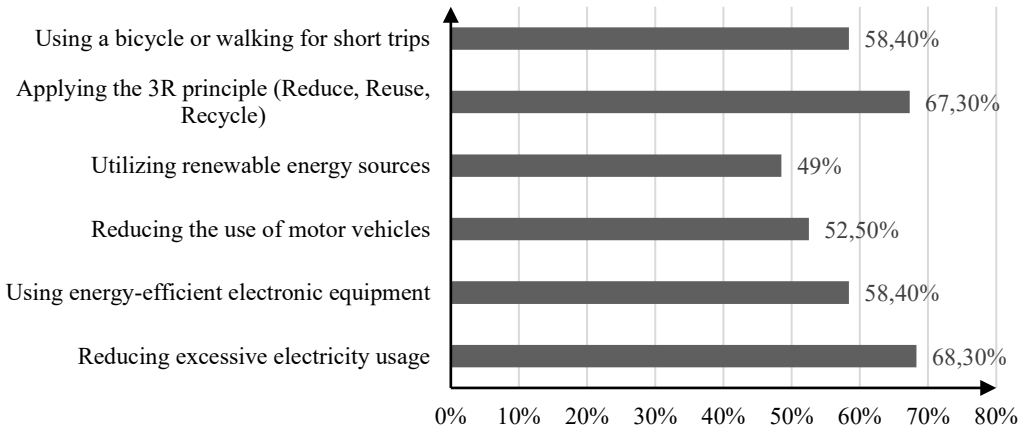

Figure 3. Students' Responses to the Actions Taken to Use Fossil Energy Resources Wisely Environmental

Figure 3 demonstrates a strong student commitment to reducing energy consumption and increasing efficiency. A significant 68.3% of students reported reducing excessive electricity usage, and 67.3% applied the 3R principle (Reduce, Reuse, Recycle), showing an overall awareness of sustainable energy practices. Furthermore, 58.4% of students use energy-efficient electronic devices, and 52.5% reduce motor vehicle use, further contributing to their goal of reducing fossil energy consumption. Utilising renewable energy sources, reported by 49% of students, and opting for walking or cycling for short trips (58.4%) also reflect students' efforts to lower their environmental footprint.

Students' engagement in local conservation efforts is crucial for ensuring the sustainability of peatland ecosystems. While individual actions are essential, collective movements and community involvement are key to long-term ecological preservation. The following figure 4 highlights the types of movements and activities in which students participate to support peatland ecosystem conservation, ranging from reforestation to educational campaigns.

The data in Figure 4 highlights the various ways in which students are contributing to the sustainability of peatland ecosystems. The most common action, with 55.7% of students participating, is involvement in peatland reforestation and rehabilitation activities, reflecting their understanding of the importance of restoring these ecosystems. Other significant contributions include participating in waste-cleaning activities in peatland areas (46.8%) and providing education on peatland protection (40.5%). Tree adoption programs in peatland areas (29.1%) and participation in peatland protection campaigns (35%) also reflect students' efforts to engage in conservation. These results suggest that while many students are actively involved in peatland protection, further expansion of programs like tree adoption and public awareness campaigns could increase overall student participation in peatland sustainability efforts.

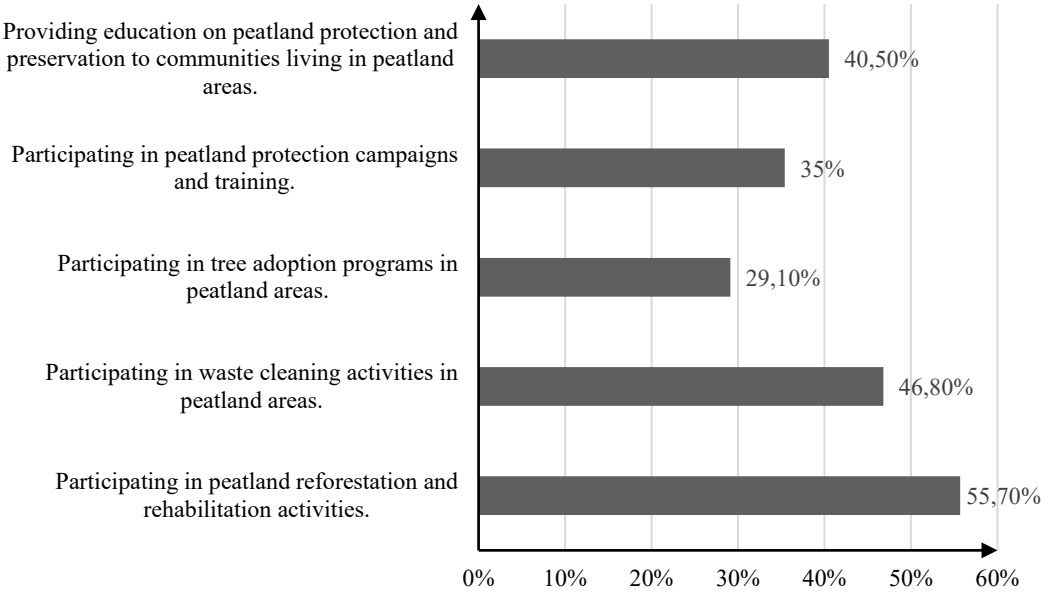

Figure 4. Movements That Students Have Participated in Which Can Support the Sustainability of Peatland Ecosystems

Students' Vision for a Greener Future of Peatland Ecosystems

The interview results on students' visions for the future of peatland ecosystems shed light on the values, concerns, and aspirations of the younger generation regarding environmental sustainability. The responses reveal a collective understanding of the ecological significance of peatlands, as well as innovative ideas for their future preservation. The participants' responses emphasised both the environmental benefits of peatlands and the urgent need for comprehensive conservation efforts. *As one student from grade 12 stated, "Peatlands are crucial for regulating climate change, and we must preserve them to avoid severe consequences for biodiversity and our planet's health." (Participant 12F)*

The interviewees expressed a strong sense of responsibility toward peatland conservation, identifying several strategies to secure a greener future for these ecosystems. A recurring theme across the responses was the importance of sustainable management practices. *One grade 10 participant highlighted the necessity of "implementing strict regulations to prevent illegal land clearing and promote restoration efforts." (Participant 10M)* This response reflects the growing concern among students about human activities that continue to threaten the stability of peatlands. *Furthermore, participants emphasised the potential role of local communities in conservation. A grade 11 male student stated, "Local communities can play a big part in protecting peatlands by being involved in restoration programs and spreading awareness about their importance." (Participant 11M)*

Students also expressed their hope for stronger governmental action to protect peatland ecosystems. Many of the participants highlighted the lack of enforcement of existing environmental policies and the failure to address illegal activities that contribute to peatland degradation. *One female participant from grade 12 noted, "The government must take a firmer stance on protecting peatlands. There needs to be more funding for restoration projects and stricter laws against practices like illegal logging." (Participant 12F)* This sentiment was echoed by other participants, who underscored the importance of

policy intervention in supporting grassroots efforts and ensuring long-term ecological resilience. *"Without clear policies, all the efforts from local communities or environmental organisations will have limited impact," remarked another participant from grade 11. (Participant 11F)*

In terms of educational initiatives, the students stressed the need to integrate more comprehensive environmental education into school curricula. *As one grade 10 female student pointed out, "We need to learn more about the importance of ecosystems like peatlands in school, so we can raise awareness and take action." (Participant 10F)* The students agreed that fostering environmental awareness from a young age is crucial in ensuring that future generations understand the vital role peatlands play in climate regulation and biodiversity conservation. In line with this, several participants advocated for school programs that could actively involve students in hands-on conservation activities, such as local tree planting or restoration projects. This proactive approach to environmental education could contribute to the formation of a more environmentally conscious society.

Despite their concerns about current environmental degradation, the students maintained an optimistic outlook on the future of peatland ecosystems, believing that through collective action, significant progress could be made. *One participant from grade 12 summarised this perspective by saying, "If we all work together—governments, communities, schools—we can create a positive change. Peatlands can still be saved if we act now." (Participant 12M)* This statement reflects the broader sentiment of hope among the students that, through concerted efforts and awareness-building, a greener and more sustainable future for peatland ecosystems is achievable. The interviewees' responses indicate a shift in attitudes toward environmental responsibility, with young people increasingly recognising their role in safeguarding natural resources for future generations.

The students' visions for a greener future for peatland ecosystems are characterised by a blend of concern, hope, and a call to action. Their responses indicate a deep understanding of the ecological value of peatlands and a shared commitment to preserving these ecosystems through sustainable management practices, policy changes, community engagement, and educational initiatives. The importance of including young voices in environmental decision-making underscores the potential for youth-driven movements to contribute to a more sustainable and resilient future for peatland ecosystems. *As one grade 11 male student aptly stated, "The future of our planet depends on what we do today—if we do not protect peatlands now, we will regret it later." (Participant 11M)* This serves as a poignant reminder of the urgency of protecting peatlands and the pivotal role students can play in this crucial endeavour.

What Holds Students Back from Climate Action?

The interview results revealed that the factors that hinder students from engaging in climate action are psychological, social, and systemic barriers. The responses indicated that although the students expressed concern about climate change, they often felt powerless to take meaningful action. A recurring theme in the interviews was the perception that individual efforts would have little impact on the broader environmental crisis. *One grade 10 male student shared, "I know that climate change is a big issue, but I feel like my actions would not really make a difference in the grand scheme of things." (Participant 10M)* This sentiment highlights a sense of helplessness that many young people experience when considering the vastness and complexity of climate change. *Conversely, a grade 10 female student expressed a similar concern but also mentioned feeling overwhelmed by the sheer amount of information available: "I care about the*

environment, but sometimes I do not know where to start. There is so much to learn, and it is hard to know what actually matters." (Participant 10F)

Another barrier identified by the students was a lack of concrete knowledge about how to take effective action. While students were generally aware of climate change and its implications, they often struggled to identify practical steps they could take to contribute to climate solutions. *A grade 11 female student expressed, "I understand the problem, but sometimes I do not know what exactly I can do to help. There is so much information, but not a lot of clear actions for me as a student." (Participant 11F)* This response reflects the need for clearer guidance on actionable steps for young people, particularly in educational settings. Many students mentioned feeling overwhelmed by the complexity of environmental issues and uncertain about where to start in their climate actions. *Similarly, a grade 11 male student noted, "I know it is important, but without any specific suggestions, it is hard to know what I can really do as an individual." (Participant 11M)*

Social and cultural influences also played a significant role in limiting students' willingness or ability to engage in climate action. Peer pressure, family habits, and societal norms were mentioned as factors that made it difficult for students to take consistent, long-term actions. *One participant from grade 12 explained, "It is hard to act on climate change when my friends do not care or when my family keeps using plastic. It is like I am the only one trying to make a change." (Participant 12M)* This response reveals the social dynamic that can often discourage individual action, as students may feel isolated or unsupported in their efforts, especially when surrounded by communities that do not prioritise environmental sustainability. *A grade 12 female student shared a similar challenge: "It is hard to keep going when the people around me are not making an effort. It feels like I am just fighting an uphill battle." (Participant 12F)*

Moreover, many students acknowledged the challenge of balancing climate action with other pressing responsibilities and interests. The demands of school, extracurricular activities, and social life often left little time or energy for pursuing environmental initiatives. *One grade 10 female student remarked, "It is difficult to focus on climate change when I have so much schoolwork, and I am trying to keep up with everything else. Climate change is important, but sometimes it feels like there is just not enough time to do anything about it." (Participant 10F)* This illustrates the time constraints that many students face, making it harder to engage in climate action beyond basic awareness. The pressure to succeed academically often takes precedence over environmental concerns despite the recognition of climate change as a critical global issue. *A grade 11 male student echoed this sentiment, saying, "I want to do more, but I am always stressed about exams and grades. There is just no time left for environmental projects." (Participant 11M)*

A lack of systemic support and structural changes in the education system and local communities was identified as a key factor inhibiting students from taking more significant climate action. Many students expressed frustration with the limited environmental initiatives within their schools and the lack of institutional support for broader, more impactful environmental movements. *As one grade 12 female student noted, "It is hard to get involved in real climate action when our school does not even have recycling bins or sustainable practices. If the school is not doing anything, it is hard to be motivated to make a difference." (Participant 12F)* This response underscores the importance of institutional support in fostering a culture of environmental responsibility. Students expressed a desire for more sustainable practices within schools, such as recycling programs, energy-saving initiatives, and broader environmental education, to help facilitate their actions toward climate change mitigation. *Similarly, a grade 12 male student stated, "We need our schools to be examples of sustainability, not just talk about it. If they do not make any changes, how are we supposed to believe we can?" (Participant 12M)*

The barriers preventing students from engaging in climate action are multifaceted, encompassing personal feelings of powerlessness, a lack of knowledge and clear guidance, social pressures, time constraints, and insufficient systemic support. These factors highlight the complex interplay between individual capacity, societal influences, and institutional frameworks in shaping students' ability to take action on climate change. The research indicates that addressing these barriers requires a multifaceted approach involving clearer environmental education, stronger institutional commitment to sustainability, and fostering a culture of collective responsibility. *As one grade 11 male student succinctly put it, "If schools and communities made it easier for us to act, more of us would get involved. We just need the right tools and support." (Participant 11M)* This emphasises the need for more structured and supportive systems to empower students to take meaningful action against climate change.

Discussion

This study aimed to explore secondary students' views and actions regarding peatland ecosystems in the context of global warming. The results reveal that secondary students are generally well aware of the importance of peatlands in mitigating climate change, but their actions toward peatland conservation remain limited. Despite the high levels of environmental knowledge, students often feel powerless or unsure about how to engage in conservation activities. effectively (Kyambade et al., 2025; Soyer et al., 2024). This aligns with the work of Sidauruk et al. (2025), who found that while students in fire-prone peatland regions of Kalimantan were aware of peatland degradation, they struggled with translating their knowledge into concrete actions due to a lack of local initiatives and community involvement. The gap between environmental awareness and action is also emphasised in the work of Kolenatý et al. (2022), who found that although students exhibit concern about climate change, they often lack the resources or opportunities to act meaningfully.

The results of this study also resonate with research by Fachrie (2020), who found that students in vulnerable regions like Sumatra were aware of environmental risks but struggled to move beyond theoretical knowledge due to barriers such as limited access to educational resources, inadequate institutional support, and a lack of practical guidance. The findings from this study show that students are eager to participate in conservation but require more structured opportunities to do so. This is in line with findings from Djuwita & Benyamin (2019), who noted that Indonesian students, while understanding the impacts of global warming, were often uncertain about the practical steps they could take. This disconnect between awareness and action suggests that education systems need to provide not only the knowledge but also the tools and opportunities to engage in environmental protection initiatives (Cvetković et al., 2024).

A crucial barrier to meaningful student involvement in peatland conservation, as identified in this study, is the lack of local action initiatives. This issue is underscored by the research of Tolvanen et al. (2013), who observed that local conservation efforts in peatland areas often fail to involve students directly, limiting their ability to participate in hands-on restoration activities. Similarly, a study by Ardoin et al. (2020) pointed out that while students are increasingly aware of environmental issues, their lack of involvement in practical conservation projects diminishes the effectiveness of environmental education. Furthermore, many students in this study expressed a desire for government policies that could better support conservation actions, a sentiment echoed by Hassan et al. (2023) and Du et al. (2023), who argued that government involvement is crucial in providing the necessary infrastructure for sustainable local environmental initiatives.

The issue of limited participation is also linked to students' understanding of the complexity of environmental issues. Research by Siggery et al. (2023) emphasized that students often see environmental issues like peatland conservation as complex and overwhelming, which leads to disengagement. This study confirms that while students acknowledge the critical role peatlands play in climate regulation, they also feel helpless in making a tangible impact. This mirrors the findings of Han et al. (2022), who found that students' environmental actions were constrained by their perceptions of the scale of environmental problems and their limited sense of personal efficacy. Therefore, integrating clear, actionable steps into educational curricula and encouraging hands-on participation in local environmental projects could be key to overcoming these barriers.

This study indicates that educational strategies must be multifaceted, combining both theoretical knowledge and practical involvement to foster deeper environmental engagement. This is in line with the work of Hailemariam et al. (2022), who argued that environmental education should not only focus on raising awareness but also on empowering students to take meaningful actions. Moreover, the need for greater community involvement in conservation is consistent with the findings of Darvishmotevali and Altinay (2022), who emphasised the importance of involving local communities in environmental education to increase its relevance and impact. For students, seeing their local communities actively involved in conservation could enhance their motivation and ability to engage in environmental protection efforts (Burgos-ayala et al., 2022; Day et al., 2022).

CONCLUSION

This study aimed to explore secondary students' views and actions on peatland ecosystems in the context of global warming, revealing both a high level of environmental awareness and a gap between knowledge and tangible action. While students demonstrated a solid understanding of the ecological importance of peatlands and their role in mitigating climate change, their involvement in practical conservation efforts remained limited. The findings suggest that environmental education plays a crucial role in fostering concern for climate change and peatland protection among students. However, the lack of widespread participation in conservation activities highlights the need for enhanced access to local, actionable environmental initiatives. The study also emphasises the challenges of moving from awareness to behaviour change, which is influenced by factors such as infrastructure, community involvement, and access to resources. The students in this study expressed a desire for more concrete guidance on how they could contribute to peatland conservation, especially through local initiatives such as reforestation and community awareness campaigns. While a substantial portion of students engaged in actions to reduce their carbon footprint, including using public transportation and conserving energy, participation in peatland-specific movements was less pronounced. This indicates that while environmental education is effective in increasing awareness, it must be complemented by structured opportunities for students to participate actively in conservation efforts. In conclusion, fostering a deeper connection between education and local environmental issues, alongside creating opportunities for direct involvement, is essential for empowering the next generation to take meaningful action in protecting vital ecosystems like peatlands.

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