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Strengthening ecoliteracy through eco comic in peat conservation efforts in Kampung Jati Baru Siak

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Article info

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Abstract

Environmental education plays an important role in developing ecological literacy among primary school students, particularly in regions characterized by unique local ecosystems. However, environmental learning materials often remain disconnected from students' everyday environmental experiences. This study aimed to evaluate the implementation of the Eco Comic program as a contextual learning medium for strengthening ecological literacy related to peatland conservation among primary school students in Kampung Jati Baru, Siak Regency, Riau Province, Indonesia. The study employed a descriptive qualitative approach with a program evaluation design. Data were collected through observations, interviews, documentation, and learning evaluations involving students, teachers, environmental practitioners, illustrators, and village officials. An initial needs assessment involving 30 students was conducted to identify students' prior understanding of peatland ecosystems, while the implementation stage involved 65 students from three elementary schools. The findings revealed that the Eco Comic program was implemented through four interconnected stages: planning, organizing, implementation, and evaluation. During the planning stage, peatland-related environmental issues were integrated into comic narratives that were familiar to students. The study highlights the potential of locally contextualized comic-based learning media to support the development of ecological literacy and strengthen environmental education in primary schools. These findings contribute to environmental education literature by demonstrating how local peatland ecosystem knowledge can be integrated into visual learning media for young learners.

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1. Introduction

Peatland ecosystems play a critical role in maintaining global environmental sustainability through their functions in carbon storage, biodiversity conservation, and hydrological regulation (Leifeld & Menichetti, 2018). Although peatlands cover only a small proportion of Earth's terrestrial surface, they store approximately one-third of the world's soil carbon, making them among the most important natural carbon sinks (Xu et al., 2018). In Indonesia, peatlands are particularly vulnerable to degradation caused by land conversion, drainage, and recurrent fires, which contribute significantly to greenhouse gas emissions and biodiversity loss (Mishra et al., 2021). Riau Province, including Siak Regency, has repeatedly experienced peatland fires, posing significant threats to ecological sustainability and community well-being. These fires contribute to ecosystem degradation, biodiversity loss, increased greenhouse gas emissions, and a range of social and economic impacts on local communities (Adni et al., 2025; Rossita & Hein, 2023). Such conditions indicate the need for sustainable peatland conservation efforts that integrate ecosystem restoration, environmental awareness, and community participation in maintaining natural resource sustainability (Hergoualc'h et al., 2018). Therefore, fostering environmental awareness and responsibility from an early age represents an important strategy for supporting sustainable peatland management and promoting long-term environmental stewardship among future generations.

Increasingly complex environmental challenges demand educational efforts that can foster ecological awareness and responsibility from an early age. Primary education plays a strategic role in shaping students' knowledge, attitudes, and behaviors toward the environment, as it is during this stage that learners begin to develop an understanding of the relationship between humans and nature. Research by Ardoin (2020) demonstrated that environmental education introduced at the primary school level can enhance students' environmental awareness. Otto (2019) found that early environmental learning contributes to the development of pro-environmental behavior among children. Similarly, Xiong (2025) reported that environmental education strengthens students' capacity to understand ecological issues within their local contexts. Therefore, primary schools serve as an important setting for instilling sustainability values and equipping students with the competencies needed to address future environmental challenges.

One important competency that needs to be developed through environmental education is ecological literacy. Ecological literacy involves understanding ecological concepts, recognizing the relationship between human activities and environmental sustainability, and making responsible decisions for nature (Favor, 2026). Individuals with strong ecological literacy tend to show greater environmental concern, be aware of the impact of human activities on ecosystems, and be better prepared to participate in environmental conservation efforts (Napitupulu et al., 2025; Villarosa, 2025). Therefore, strengthening ecological literacy among elementary school students is an important step toward building a generation able to understand, sustainably manage, and utilize natural resources.

The development of ecological literacy in elementary school students requires a learning strategy that connects the subject matter to the environmental conditions they encounter in their daily lives. Various studies have shown that learning experiences grounded in authentic environmental issues and real-world environmental problems can increase student engagement, strengthen environmental understanding, and encourage more meaningful participation in sustainability learning activities (Brahma, 2025; Homer et al., 2026). In addition, the use of interactive, locally relevant media supports the development of critical thinking, problem-solving, and decision-making skills necessary to address future environmental

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challenges (Ozden, 2020). Learning that departs from the reality of the environment around students also provides greater opportunities to foster care, responsibility, and active participation in maintaining environmental sustainability.

One instructional medium considered suitable for supporting the development of ecological literacy among primary school students is comics. By combining visual illustrations, textual information, and narrative structures, comics can present complex scientific and environmental concepts in a more accessible, engaging way for young learners. Research has shown that comics facilitate learning by enhancing students' motivation, conceptual understanding, and engagement through visual storytelling that supports knowledge construction and retention (Farinella, 2018). A recent literature review further highlighted the growing use of science comics as educational tools due to their ability to simplify abstract concepts, promote active learning, and increase learners' interest in science-related topics (Ford-Baxter, 2025). In addition to supporting cognitive learning, comics can foster emotional engagement with environmental issues by presenting relatable characters and contextualized narratives that connect scientific knowledge with students' everyday experiences. These characteristics suggest that comics have considerable potential as instructional media for strengthening ecological literacy and encouraging greater awareness of environmental sustainability among primary school students.

Numerous studies have demonstrated the potential of visual and contextual learning media to support environmental and science education among school aged learners. Comics, in particular, have gained increasing attention as educational tools because they combine visual representations, narrative structures, and scientific content in ways that facilitate students' understanding and engagement. A recent literature review highlighted that science comics can enhance learners' interest, support conceptual understanding, and promote active participation in the learning process (Ford-Baxter, 2025). Similar findings were reported by Murdianingsih (2022), who found that comic-based learning media contributed to the development of critical thinking skills and environmental care among students. In addition, studies on environmental education have emphasized the importance of connecting learning experiences with local environmental realities to foster ecological understanding and responsibility (Loaiza, 2024). Research on primary school students has further shown that ecological literacy plays an important role in developing awareness of biodiversity and environmental sustainability from an early age (Balážová et al., 2024). These findings suggest that integrating visual learning media with locally relevant environmental content offers considerable potential for strengthening students' ecological literacy. However, existing studies have primarily focused on broad environmental themes and general ecological issues. Research examining comic-based learning media that specifically incorporate local ecosystem characteristics to promote ecological literacy among primary school students remains limited. This gap is particularly evident in peatland regions, where students often have a limited understanding of the ecological functions and conservation importance of the ecosystems surrounding them (González et al., 2026).

A similar situation can be observed in Kampung Jati Baru, Siak Regency, where many students have limited understanding of the ecological functions of peatlands despite living in an area dominated by peatland ecosystems. Furthermore, there is a lack of contextual learning materials specifically designed to introduce primary school students to the characteristics and conservation of peatland ecosystems. This situation highlights the need to develop instructional media that connect ecological literacy with the peatland environment, which is closely related to students' everyday lives. The development of instructional media that connects local environmental issues with students' learning experiences has been widely recommended as an effective strategy for strengthening ecological literacy and environmental awareness from the

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primary school level (Ninsiana et al., 2024; Ricoy & Sánchez-Martínez, 2022). Various educational innovations have been introduced to support this goal, including digital media, interactive multimedia, and experiential learning approaches grounded in the environment (Pratama et al., 2026). However, studies examining the use of ecological comics that specifically incorporate local peatland ecosystems as learning resources remain scarce. The novelty of this study lies in the development and implementation of an Eco Comic based on the peatland ecosystem of Kampung Jati Baru, serving as a contextual learning medium to strengthen primary school students' ecological literacy. This study aims to evaluate the management of the Eco Comic program through the stages of planning, organizing, implementation, and evaluation in supporting the development of students' ecological literacy. The findings are expected to contribute to the advancement of contextual learning media, environmental education, and science and social studies instruction in primary schools.

2. Literature review

2.1. Ecological literacy theory

Ecological literacy has emerged as a fundamental concept in environmental education, emphasizing individuals' capacity to understand ecological systems and their responsibility for environmental sustainability. Previous studies consistently highlight that ecological literacy extends beyond the acquisition of environmental knowledge and encompasses the development of ecological awareness, environmental ethics, and responsible behavior. It is argued that ecological literacy is fostered through environmental learning experiences that encourage students to critically engage with environmental issues and interact directly with natural settings. Similarly, Hartono (2020) emphasized that ecological literacy serves as an important indicator of educational success in sustainability-oriented programs because it reflects the development of environmental knowledge, attitudes, and behaviors.

Several scholars have expanded the concept by emphasizing different dimensions of ecological literacy. Putri (2019) found that ecological literacy contributes to students' creativity in addressing environmental challenges, particularly in waste management and resource conservation. In contrast, Code (2019) approached ecological literacy from the perspective of Goethean delicate empiricism, highlighting the importance of deep observation, emotional connection, and sensitivity toward nature. Although these perspectives differ in emphasis, they collectively suggest that ecological literacy integrates cognitive understanding, affective engagement, and practical action in responding to environmental issues.

Recent developments have further positioned ecological literacy as a multidisciplinary framework. Bartosch (2025) argued that ecological literacy encompasses ecological knowledge, environmental ethics, ecological empathy, and sustainable lifestyles. This perspective aligns with previous studies that view ecological literacy as a holistic competence that enables individuals to understand ecological interdependence while developing the capacity to make environmentally responsible decisions. In addition, Johns and Pontes (2019) emphasized the role of environmental education settings in enhancing ecoliteracy, particularly by connecting learners with ecological processes and human roles in environmental change. Across these studies, a common pattern emerges: ecological literacy involves three interconnected dimensions, namely ecological knowledge, environmental attitudes, and pro-environmental behaviors. Despite the growing body of literature on ecological literacy, most studies have focused on conceptual frameworks and general environmental education contexts. Limited attention has been given to how ecological literacy can be strengthened through contextual learning media that connect

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students with specific local ecosystems. For primary school students, contextual environmental learning is particularly important because direct connections between learning materials and local environmental issues can facilitate meaningful understanding and strengthen ecological awareness. This gap highlights the need for innovative educational media that link ecological literacy to local environmental contexts, including peatland ecosystems that play a crucial ecological role in many regions of Indonesia.

2.2. Theory of environmental conservation and conservation of peat ecosystems

Environmental conservation refers to systematic efforts to maintain ecosystem functions, prevent environmental degradation, and ensure the sustainable use of natural resources. Within this framework, peat ecosystems are among the most important ecological resources due to their roles in carbon sequestration, biodiversity conservation, hydrological regulation, and climate change mitigation. Consequently, peatland conservation has become a strategic priority in sustainable environmental management.

Previous studies emphasize that effective peat conservation requires an integrated approach involving ecological protection, institutional support, and community participation. Febrianda and Santoso (2023) emphasized that peat conservation policies should be based on regulatory protection, water table monitoring, fire prevention, restoration programs, and the designation of protected peat zones. This perspective highlights the importance of scientific and regulatory foundations in preventing peatland degradation and indicates that successful peat conservation depends on both ecological management and policy implementation.

Beyond regulatory approaches, several studies highlight the importance of collaborative governance in peat ecosystem conservation. Hergoualc'h et al. (2018) emphasized that peatland management requires coordination across local and global stakeholders, while Rossita and Hein (2023) showed that peatland fire regimes are closely linked to broader socio-ecological management challenges in Riau. Although these studies focus on different conservation strategies, they collectively indicate that long-term peatland sustainability requires cooperation among governments, environmental organizations, and local communities.

A common theme emerging from the literature is that conservation cannot rely solely on regulations and restoration programs. Sustainable conservation also requires fostering ecological awareness and environmentally responsible behavior among community members. Environmental education is therefore an essential component of conservation efforts because it helps individuals understand ecosystem functions, recognize environmental threats, and actively participate in environmental protection. For younger generations, particularly primary school students, conservation education can provide an early foundation for developing ecological literacy and environmental responsibility.

Despite the growing literature on peatland conservation, most studies focus on policy implementation, ecosystem restoration, hydrological management, or community-based conservation initiatives. Limited attention has been given to educational approaches that introduce peat ecosystem conservation concepts to primary school students through contextual learning media. This gap underscores the need for innovative educational interventions that connect ecological literacy with peatland conservation. Therefore, the development of Eco Comic based on the peat ecosystem of Kampung Jati Baru provides a contextual learning approach that can support both environmental education and long-term peatland conservation awareness among primary school students.

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2.3. Theory of the effectiveness of environmental education programs in schools

The effectiveness of environmental education programs in schools is generally reflected in their ability to improve students' environmental knowledge, attitudes, and behaviors through meaningful and sustainable learning experiences. Environmental education is not limited to delivering information about ecological issues; it also seeks to foster environmental awareness, encourage responsible behavior, and develop students' commitment to environmental stewardship. Previous studies consistently indicate that successful environmental education programs integrate cognitive, affective, and behavioral dimensions to support long-term environmental responsibility among learners. Research on school-based environmental programs demonstrates that environmental learning becomes more effective when ecological values are embedded within both classroom instruction and daily school practices. Gumanti (2023) found that environmental education programs designed to meet students' needs foster ecological awareness and encourage active participation in maintaining a healthy school environment. Similarly, Tompodung (2018) reported that the *Adiwiyata* program successfully promoted environmentally responsible behaviors through curriculum integration, environmental habituation, and the involvement of the entire school community. These findings suggest that environmental education programs are most effective when they combine formal learning activities with opportunities for students to apply environmental values in real-life situations.

In addition to curriculum and school culture, educational media play a critical role in determining the effectiveness of environmental education. Recent studies have highlighted the potential of comic-based learning media to support environmental learning among primary school students. Murdianingsih (2022) demonstrated that comics can improve students' critical thinking skills and environmental awareness by presenting ecological issues through engaging visual narratives. Likewise, Putri and Wibawa (2023) found that e-comics effectively integrate science learning with environmental character education by combining visual representations, storytelling, and environmental values within a digital learning environment. Although the two studies emphasize different aspects of comic-based learning, they share the common conclusion that visual narratives facilitate students' understanding of environmental concepts and increase learning motivation. A synthesis of previous studies indicates that effective environmental education programs are characterized by four interconnected components: meaningful environmental content, active student participation, supportive school environments, and engaging learning media. Among these components, comic-based and digital comic-based media offer unique advantages because they transform complex ecological concepts into accessible learning experiences that are relevant to children's cognitive development. Through visual storytelling, students can understand environmental issues, develop emotional connections to nature, and strengthen environmentally responsible attitudes.

Despite growing evidence on the effectiveness of environmental education programs and comic-based learning media, most studies have focused on general environmental themes, such as waste management, biodiversity conservation, and environmental character education. Limited research has explored the use of contextual comic-based media that introduce local peatland ecosystems as learning resources for primary school students. Consequently, there remains a need for innovative environmental education programs that integrate ecological literacy, local environmental contexts, and comic-based learning media. This gap provides the rationale for developing the Eco Comic program as a contextual learning medium to strengthen ecological literacy and promote awareness of peatland conservation among primary school students.

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2.4. Theory of school based education program management

School based education program management refers to a systematic process of planning, organizing, implementing, and evaluating educational activities to achieve specific learning objectives. Effective program management is recognized as a key factor influencing the success and sustainability of educational initiatives because it enables the alignment of resources, stakeholders, learning activities, and evaluation processes toward desired outcomes (Hallinger & Kovačević, 2022). This perspective is particularly relevant to environmental education programs, which often involve multiple actors and require coordinated efforts among schools, teachers, students, and community stakeholders. Research has shown that successful environmental education implementation depends on instructional practices, institutional support, program organization, and collaborative engagement among educational stakeholders (Mngomezulu & Ramaila, 2025). Accordingly, the management of the Eco Comic program is examined through the stages of planning, organizing, implementation, and evaluation, which together provide a comprehensive framework for understanding how ecological literacy initiatives are designed, delivered, and assessed in primary school settings.

2.4.1. Planning

Planning constitutes the foundation of an educational program because it establishes the objectives, target participants, learning materials, implementation strategies, and indicators of success. Previous research has emphasized that effective educational interventions begin with a comprehensive analysis of existing problems and the identification of learners' needs (Nurazizah et al., 2025). In environmental education, planning involves identifying environmental issues relevant to students' local contexts and designing learning activities to address them. In ecological literacy programs, planning includes determining learning objectives related to environmental knowledge, attitudes, and behaviors, and selecting appropriate instructional media. Within the context of this study, the Eco Comic was designed as a contextual learning medium based on the peatland ecosystem of Kampung Jati Baru to support the development of students' ecological literacy.

2.4.2. Organizing

Organizing refers to coordinating human resources, responsibilities, and operational procedures required for program implementation. Educational programs generally involve multiple stakeholders who contribute complementary expertise and resources. Abas (2023) demonstrated that successful educational interventions require collaboration among schools, educators, and external partners. Similarly, environmental education programs depend on cooperation among teachers, researchers, school administrators, and local communities. In the Eco Comic program, organizing activities involve assigning teachers as learning facilitators, researchers as program coordinators and evaluators, illustrators as media developers, and community members as providers of local environmental knowledge. Such collaboration ensures the program is implemented effectively while remaining relevant to the local environmental context.

2.4.3. Implementation

Implementation represents the stage in which planned educational activities are translated into practice. The effectiveness of implementation depends on the consistency between program design and classroom practice, as well as on learners' active participation. Studies on environmental education indicate that students are more engaged when learning activities

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incorporate contextual issues, interactive media, and meaningful learning experiences. Therefore, the implementation of the Eco Comic program emphasizes integrating peatland conservation content, visual storytelling, and classroom discussion activities to facilitate students' understanding of local environmental issues. Through this approach, students are expected to develop stronger ecological literacy and environmental awareness.

2.4.4. Evaluation

Evaluation assesses the extent to which program objectives have been achieved and identifies areas for improvement. Educational program evaluation commonly focuses on changes in students' knowledge, attitudes, and behaviors following participation in learning activities. In environmental education, evaluation is particularly important because program success involves both cognitive and behavioral outcomes. The evaluation of the Eco Comic program, therefore, examines students' understanding of peatland ecosystems, their environmental awareness, and their responses to the learning media. The evaluation findings provide evidence of the program's effectiveness and support future improvements to environmental education initiatives.

Taken together, the planning, organizing, implementation, and evaluation stages form an integrated management framework for school-based environmental education programs. This framework provides a theoretical basis for understanding how the Eco Comic program was designed and implemented to strengthen ecological literacy and promote awareness of peatland conservation among primary school students.

3. Method

This study employed a descriptive qualitative approach using a program evaluation design. The approach was selected because the study focused on obtaining an in-depth understanding of the management process of the Eco Comic program for strengthening ecological literacy among elementary school students across the planning, organizing, implementation, and evaluation stages. According to Creswell and Poth (2016), qualitative research aims to understand a phenomenon from participants' perspectives within its natural setting. In this study, the primary focus was not on statistically testing program effectiveness but on examining the implementation process and its contribution to enhancing students' understanding of peatland ecosystems. The study was conducted in Kampung Jati Baru, Bungaraya District, Siak Regency, Riau Province, Indonesia. The research site was selected purposively because the area is dominated by peatland ecosystems that play important roles in carbon storage, water regulation, and biodiversity conservation. Furthermore, Kampung Jati Baru is vulnerable to peatland fires, making the development of ecological literacy among elementary school students an important educational priority through contextualized environmental learning.

3.1 Research participants

The participants were divided into two groups with different roles in the program implementation process. During the initial stage of the study, 30 elementary school students participated in preliminary observations and needs assessment activities. This group was involved in identifying students' initial understanding of peatland ecosystems before the development and implementation of the Eco Comic program. The information obtained from this group served as baseline data for program planning and for designing comic content that reflected students' characteristics and local environmental conditions. Following the

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completion of the planning and media development stages, the Eco Comic program was implemented with 65 students from Grades IV, V, and VI representing three elementary schools in Kampung Jati Baru. These students served as the primary participants in the program's implementation and evaluation. Therefore, the groups of 30 students and 65 students were not used as comparison groups for statistical analysis but rather represented different stages of the program evaluation process. In addition to students, elementary school teachers, the Eco Comic illustrator, environmental practitioners from Belantara Foundation, and local government representatives from Kampung Jati Baru were involved as supporting informants. Informants were selected purposively based on their direct involvement in the planning, development, implementation, and evaluation of the program (Patton, 2015).

3.2 Data sources

The study utilized both primary and secondary data. Primary data were obtained through observations, interviews, and students' learning evaluation results. Secondary data were collected from program documents, Eco Comic manuscripts, student worksheets, activity photographs, implementation reports, and documents related to the social and ecological conditions of Kampung Jati Baru.

3.3 Research Instruments

The research instruments consisted of observation sheets, interview guidelines, documentation records, and student learning evaluation sheets. Observation sheets were used to record student engagement, learning interactions, and the implementation process of the Eco Comic program. Semi-structured interview guidelines were used to gather information regarding students' ecological literacy conditions, environmental learning needs, program implementation, and participants' perceptions of Eco Comic as a learning medium. The student learning evaluation instrument consisted of ten simple questions covering peatland functions, ecological roles of peatlands, threats to peatland ecosystems, and peatland conservation efforts. This instrument was used as supporting data to describe students' understanding before and after program implementation.

Table 1. Indicators of student learning evaluation

Indicator	Question Numbers	Total
Functions of peatland ecosystems	1, 2, 3	3
Ecological roles of peatlands	4, 5	2
Threats to peatland ecosystems	6, 7	2
Peatland conservation efforts	8, 9, 10	3
Total	**1–10**	**10**

The Eco Comic materials and evaluation instruments were reviewed by teachers, environmental practitioners, and the program development team to ensure relevance to Kampung Jati Baru's local context and alignment with the intended learning objectives.

3.4 Research Procedure

The study was conducted through five interconnected stages: preliminary observation and needs assessment, planning, organizing, implementation, and evaluation.

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Table 2. Research procedure

Stage	Main Activities	Participants
Preliminary Observation and Needs Assessment	Observation of learning conditions and identification of students' initial understanding of peatland ecosystems	30 students
Planning	Coordination with schools, Belantara Foundation, and village authorities to develop Eco Comic content and storylines	Researchers and stakeholders
Organizing	Media development, curriculum integration, content validation, and implementation preparation	Researchers, teachers, illustrators, and environmental practitioners
Implementation	Eco Comic activities through reading sessions, group discussions, and worksheet completion	65 students
Evaluation	Program reflection, interviews, documentation, and student learning evaluation	Students, teachers, village authorities, and environmental practitioners

3.4. Data collection techniques

An observation was conducted to examine learning activities, student engagement, the use of Eco Comic media, and program implementation across all stages. Semi-structured interviews were conducted with teachers, village authorities, environmental practitioners, and selected students to obtain information regarding program implementation and ecological literacy development. Documentation was used to collect evidence of program implementation, including photographs of activities, student worksheets, validation documents, activity reports, comic manuscripts, and other supporting records. During the preliminary observation stage, researchers administered ten simple questions to 30 students to identify their initial understanding of peatland ecosystems. Following program implementation, the same evaluation indicators were administered to program participants to provide supporting data on changes in students' understanding of the learning materials.

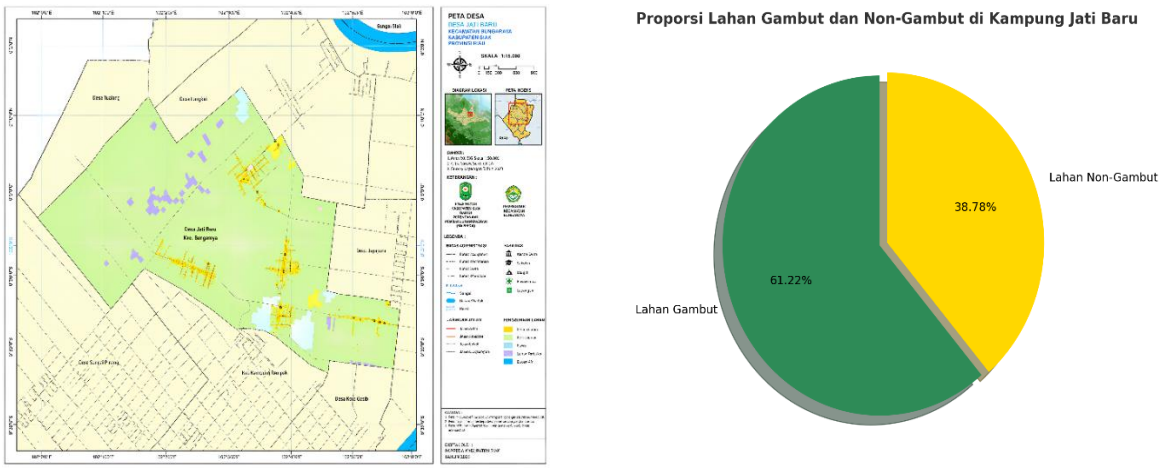
3.5. Data analysis

Data were analyzed using the interactive model proposed by Miles, Huberman, and Saldaña (2014), which consists of data condensation, data display, and conclusion drawing and verification. Data condensation involved selecting, focusing on, and organizing information relevant to the management of the Eco Comic program and to strengthening students' ecological literacy. Data display was conducted through descriptive narratives, tables, and matrices to facilitate interpretation of the findings. Conclusions were drawn through an iterative verification process that compared evidence from observations, interviews, documentation, and student learning evaluation results. To enhance the credibility of the findings, source triangulation and technique triangulation were employed. Triangulation was conducted by comparing information gathered from observations, interviews, documentation, and student learning evaluations to obtain a comprehensive understanding of the implementation of the Eco Comic program in strengthening ecological literacy among elementary school students.

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4. Results

This research was conducted in Kampung Jati Baru, an administrative area in Siak District, Siak Regency, Riau Province. Geographically, this village has distinctive ecological characteristics because peat ecosystems dominate it. Based on village data, the total area of Kampung Jati Baru is 24.5 km^2, equivalent to 2,450 hectares. Of the total area, around 1,500 hectares are peatland, while the remaining 950 hectares are non-peatland areas that are generally used for various socio-economic activities of the community, such as settlements, agriculture, and daily life support facilities. The visualization of Kampung Jati Baru is presented in Figure 1.



(a). (b).

Figure 1. (a) Map of the Kampung Jati Baru area, (b) peatland proportions

As shown in Figure 1, the peatland in Kampung Jati Baru covers **61.22%** of the total area, while non-peatland covers **38.78%.** This proportion shows that the peat ecosystem is the dominant factor determining the condition of the village environment. Although more than half of Kampung Jati Baru is peatland, the study found that elementary school students' understanding of peat ecosystems remains very low. During the observation stage, the researcher observed the learning environment and student interaction in three elementary schools in Kampung Jati Baru and administered a simple test to assess students' basic understanding of peat ecosystems. The test used consists of 10 simple questions covering aspects of function, role, and impact of peat damage. The results indicate that student understanding remains in the low category. Most students answer only 1–3 questions correctly; the highest score is 5, and some students get 0. This condition shows that, even though they live in a fairly large peatland area, students' basic ecological knowledge remains limited and has not been fully developed.

Table 3. Results of the initial test of students' understanding of peat ecosystems

Correct Score	Number of Students	Percentage (%)
0	2	6.7
1–2	12	40.0
3	9	30.0
4–5	7	23.3
Total	**30**	**100**

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Table 3 shows that almost half of the students (40%) answered only 1–2 questions correctly, 30% answered 3 questions, and only 23.3% answered 4–5 questions correctly. In fact, 6.7% of students cannot answer a single question correctly. This data confirms that students' understanding of peat ecosystems remains very limited, even though they live in an area dominated by peatlands covering 1,500 hectares (61.22% of the village's total area). These findings indicate the need to develop more context- and application-based ecoliteracy-based learning strategies so that students can understand the importance of peatlands in their surrounding environment.

The results of this research are presented according to the program management stages that have been designed and implemented in Kampung Jati Baru. Each stage describes a collaborative process among researchers, schools, communities, environmental practitioners, and village officials to develop and implement eco-comic media to promote ecological literacy. The results description focuses on four main stages: strategic planning, organization, implementation, and evaluation. The stages are arranged in sequence to show the logical flow of activities, from the initial idea to the final assessment of the program's effectiveness.

4.1 Strategic planning

At the strategic planning stage, the researcher conducted a series of coordination meetings with various interested parties to support the development of eco comics as an ecological literacy medium. This activity began with communication with principals and teachers from three elementary schools in Kampung Jati Baru to identify learning needs relevant to the curriculum, especially on the theme of the peat ecosystem. The discussion focused on drafting comic script ideas, determining storylines, and integrating science materials with local wisdom that is close to students' daily lives. In addition, the researcher established a partnership with the Belantara Foundation, an institution focused on landscape and ecosystem conservation in Riau. Through this collaboration, researchers obtained technical insights into strategic issues in peat management, as well as input on educational content aligned with an environmental perspective. The partnership with the Belantara Foundation reinforces the program's academic and practical legitimacy and ensures that the materials developed have a strong conservation foundation. Further coordination was carried out directly with the village apparatus and the head of Jati Baru Village. This meeting discussed the village's socio-ecological conditions, the potential for support from village officials, and the mechanisms for community involvement in the program. The village head provides key information on village policies related to peatland management and supports integrating the program into local educational activities. With the synergy among schools, local communities, the Belantara Foundation, and the village government, this strategic planning stage provides a solid initial foundation for implementing the eco comic program in elementary schools.

4.2 Organizing

The organizing stage focuses on aligning comic materials with the elementary school curriculum and structuring the program's supporting elements. After the initial design *of the eco comic* was prepared at the planning stage, a synchronization process was carried out between the peat ecosystem material and the learning competencies in the Natural and Social Sciences (IPAS) subject. This synchronization is designed so that the use of comics is integral to the applicable school curriculum, functioning as part of formal learning.

The development of comic content is enriched by integrating Kampung Jati Baru's local wisdom. The local elements include depictions of community activities around peatlands, the

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use of regional terms, and illustrations of situations close to students' daily lives. One example of the narrative developed is the story of a child's daily journey through a stretch of peatland to get to school. Along the way, he faced various questions about the benefits of peat, why the soil was always moist, and why it was important to maintain it. These questions are then answered in the comic storyline through dialogue with teachers and community leaders, thus fostering curiosity while providing a deeper ecological understanding.

In addition to displaying ecological aspects, comics also raise the economic potential of the community on peatlands. For example, the use of peatland for pineapple cultivation, which is one of the main commodities in Kampung Jati Baru, is presented through a storyline showing how pineapples that thrive in peatlands can be processed into various products, such as pineapple *dodol* or pineapple chips, thereby adding economic value to the community. Another aspect raised was the presence of snakehead fish that can live in peat-soil ponds. Through the children's characters in the comics, it is shown that snakehead fish serves as a source of family food and has the potential to be developed into a sustainable fishery business.



(a) (b)

Figure 2. (a) Comic cover, (b) one page of the comic.

Overall, the visualization in Figure 2 shows that the comic titled *Exploring the Peat World* integrates educational aspects, local relevance, and entertainment in a single medium. The light narrative, combined with contextual illustrations, makes this comic an effective alternative learning tool for improving students' understanding of peat ecosystems.

On the other hand, comics also represent a serious problem that the community often faces: peatland fires that occur almost every year. In the storyline, students are invited to understand the causes of fires, their ecological impact, and the community's role in fire prevention and control. The presentation of content through stories and illustrations was intended to foster ecological literacy from an early age by helping students understand the ecological functions of peatlands, recognize their vulnerability, and appreciate the importance of maintaining ecosystem sustainability. Through this approach, the Eco Comic serves as a learning medium that integrates scientific knowledge, local wisdom, economic potential, and ecological challenges into a coherent learning experience. At this stage, the stakeholders involved in media

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development were also identified, including teachers, researchers, illustrators, and community members who contributed local environmental knowledge to ensure the relevance and accuracy of the learning content. Teachers act as literacy facilitators; illustrators are responsible for visual quality; and environmentalists act as content validators to ensure the accuracy of information about peat ecosystems. The validation process is carried out in detail to ensure the comic's content aligns with scientific data while remaining interesting to students. As a form of accessibility innovation, *the eco comic was finalized in digital format, with a barcode link added*. Through this feature, students and teachers can easily access comics on school devices, both in the classroom and during independent learning activities. This organizing strategy makes the media more systematic, locally grounded, scientifically validated, and ready for use during implementation.

4.3 Implementation

The implementation stage is the core of the ecological literacy program through eco-*comic* media. At this stage, a digital comic titled **"Exploring the Peat World"** was applied in three elementary schools in Kampung Jati Baru with a total of 65 students, consisting of grades IV, V, and VI. The activity was implemented at one of the schools, which received additional facilities support from the village apparatus in the form of several laptop units. This is very helpful in the learning process because comic media can be opened in a digital format. Students are then divided into small groups of 5–6. This strategy was chosen to facilitate discussions, create a collaborative learning atmosphere, and ensure that all students can access and read comics in turn.

To expand access, facilitators and neighborhood communities also lent mobile phones with internet connectivity. Digital comics can be accessed via the provided barcode, so students can open the comic on their phone screens. This method makes activities more flexible, interactive, and in line with the limited infrastructure in village schools. Implementing activities also involves various stakeholders. Local environmental communities, such as SIC, SKLEAS, and Ramah Gambut, serve as companions and reinforce the ecological message in the comics. In addition, the activity was witnessed directly by the Principal of Kampung Jati Baru Hamlet and three Principals from partner schools. Their presence shows real support for digital media-based ecological literacy programs and gives strong legitimacy to the activities. These community leaders actively contributed to the program by motivating students and participating in discussions with facilitators about strategies to sustain it beyond its initial implementation. The implementation activities are shown in Figure 3.



Figure 3. Implementation of Eco Comic media and student worksheets (LKPD).

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After reading the comic, students completed evaluation questions and a Student Worksheet (LKPD) to provide supporting information regarding their understanding of peat ecosystem concepts. The responses indicated that students were generally able to explain the ecological functions of peatlands, identify environmental threats affecting peat ecosystems, and describe the importance of peatland conservation. These findings suggest that the Eco Comic facilitated students' engagement with locally relevant environmental issues and supported their understanding of the concepts presented during the learning activities. A summary of students' responses is presented in Table 4.

Table 4. Distribution of students' comprehension test results after reading comics

Test Scores	**Students**	**Percentages** (%)
10	25	38.46%
9	38	58.46%
8	2	3.08%
Total	**65**	**100%**

Table 4 shows that most participating students demonstrated a strong understanding of the concepts presented in the Eco Comic. The majority of students answered most evaluation questions correctly, indicating they could recognize the ecological functions of peatlands and explain the importance of conservation efforts. These findings provide supporting evidence that the Eco Comic served as a meaningful learning resource for introducing peat ecosystem concepts within the local context of Kampung Jati Baru. Students also revealed that they are beginning to realize the importance of peat ecosystems, both as a support for daily life and as ecological assets that need to be maintained.

4.4 Evaluation

The evaluation stage was conducted to review the overall management process of the ecological literacy program through Eco Comic media, including planning, organizing, implementation, and evaluation activities. The evaluation focused on alignment between the initial objectives and field implementation, the relevance of the learning media, and the completion of administrative processes, such as ISBN registration, which support wider dissemination and formal documentation of the comic. Evaluation findings indicated that students participating in the program were generally able to explain the functions of peatlands, identify environmental threats to peat ecosystems, and describe basic peatland conservation efforts. Observations and learning evaluation results suggested that students demonstrated a stronger understanding of peat ecosystem concepts after participating in Eco Comic learning activities. It should be noted that the initial assessment and program implementation involved different participant groups and served different purposes within the program evaluation process. The preliminary assessment involved 30 students and was conducted as part of the needs assessment stage to identify students' prior understanding of peatland ecosystems. Findings from this stage indicated that students' initial ecological knowledge was relatively limited, despite living in an area dominated by approximately 1,500 hectares of peatland. Most students were only able to answer one to three questions correctly, with the highest score being five and the lowest score being zero.

Following the implementation of the Eco Comic program, learning evaluation activities were conducted with 65 students from three elementary schools in Kampung Jati Baru. The evaluation

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results showed that most participating students answered most of the questions on peatland functions, environmental threats, and conservation practices. More than 96% of participating students achieved scores above eight, indicating a strong understanding of the concepts presented in the Eco Comic. These findings provide supporting evidence that the Eco Comic served as a meaningful learning resource for introducing peat ecosystem concepts within the local context of Kampung Jati Baru. Interview findings further revealed that students perceived the learning activities as interesting and easier to understand because environmental concepts were presented through visual narratives and situations that reflected their daily experiences. Teachers also reported that the use of contextual comic-based media encouraged student participation during discussions and facilitated communication about environmental issues that were previously difficult to explain through conventional instruction.

The evaluation also highlighted the importance of collaboration among schools, village authorities, environmental practitioners, local communities, and the Belantara Foundation in supporting program implementation. Environmental practitioners emphasized that future revisions should further strengthen the representation of local peatland characteristics, including the Siak River, village activities, and local conservation practices, to enhance the contextual relevance of the learning materials. These recommendations indicate opportunities for further refinement and wider dissemination of the Eco Comic as a contextual environmental learning resource for elementary school students.

5. Discussion

The findings indicate that the Eco Comic program in Kampung Jati Baru was implemented through interconnected stages of planning, organizing, implementation, and evaluation. The systematic management of these stages enabled environmental learning activities to be closely linked to the local context of peatland ecosystems. Unlike many environmental learning materials that present ecological concepts in a general manner, the Eco Comic incorporated environmental issues directly experienced by students, including peat water characteristics, pineapple cultivation on peatlands, and the impacts of peatland fires. This contextualization appears to have helped students connect abstract ecological concepts to their everyday experiences.

During the planning stage, local environmental conditions became the primary basis for developing the comic storyline and learning content. Previous studies have shown that learning materials grounded in local environmental and cultural contexts tend to be more meaningful because students can relate new knowledge to familiar situations (Hite et al., 2020). The findings of the present study extend this perspective by demonstrating that local peatland ecosystems can serve not only as learning content but also as a narrative framework that supports the development of ecological literacy among primary school students.

The organizing stage highlighted the importance of collaboration among multiple stakeholders. Teachers, village officials, environmental practitioners, illustrators, and the Belantara Foundation contributed expertise in various forms during program development and implementation. This finding suggests that contextual environmental education cannot rely solely on classroom instruction but requires broader community participation. Similar observations have been reported by Aryani (2025), who found that collaborative development processes strengthen the relevance and quality of educational media. In the present study, stakeholder involvement also ensured that the environmental information presented in the Eco Comic reflected local ecological realities and conservation practices.

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The implementation stage revealed that visual storytelling played an important role in supporting students' understanding of peat ecosystem concepts. Observations and interview findings indicated that students were actively engaged during reading and discussion activities because the comic format was perceived as interesting, familiar, and easier to understand. Previous studies have reported that comics facilitate learning by combining visual representations and narratives, helping students process complex information (Matuk et al., 2021). The present findings support these conclusions and further suggest that the effectiveness of visual narratives may be strengthened when environmental content is directly connected to students' local surroundings. The integration of peatland issues into the storyline enabled students to recognize ecological relationships they encounter in their daily lives but may not have previously understood scientifically.

The evaluation findings indicated that students demonstrated a stronger understanding of peatland functions, environmental threats, and conservation practices after participating in the program. Rather than viewing this outcome solely as the result of comic-based instruction, the findings suggest that the combination of contextual content, visual storytelling, and collaborative implementation contributed to students' engagement with ecological concepts. These findings support previous studies that have reported the contribution of comics to environmental learning and ecoliteracy development (Hudhana, 2025). However, the present study contributes additional evidence by demonstrating how comic-based learning can be adapted to a specific local ecosystem context, namely peatlands, which remains relatively underexplored in environmental education research.

An important contribution of this study lies in addressing the gap identified in previous literature. Existing studies have generally focused on environmental comics related to waste management, biodiversity conservation, or environmental awareness. Research integrating local peatland ecosystem characteristics into comic-based learning media for primary school students remains limited. By incorporating peatland conservation issues into visual narratives and classroom learning activities, the Eco Comic program demonstrates how local ecological knowledge can be integrated into environmental education. This approach may support students' ecological understanding while fostering greater awareness of environmental challenges within their own communities.

Nevertheless, several limitations should be acknowledged. The study was conducted in a single village context and involved a limited number of schools. In addition, the research focused primarily on program implementation and students' immediate responses to learning activities. Future studies could explore the long-term development of ecological literacy, compare implementation across different environmental contexts, and examine how contextual environmental media influence students' environmental behaviors over time.

6. Conclusion and implications

This study found that the Eco Comic program in Kampung Jati Baru was implemented through four interconnected management stages, namely planning, organizing, implementation, and evaluation. During the planning stage, the comic content and storyline were developed by incorporating local peatland characteristics and environmental issues familiar to students, thereby supporting contextual learning experiences. During the organizing stage, collaboration among teachers, village officials, illustrators, and environmental practitioners helped develop learning materials that were relevant to both the curriculum and local environmental conditions. The implementation stage included guided reading, group discussions, and worksheet activities

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that encouraged student participation and engagement with concepts of the peat ecosystem. Findings from observations, interviews, and learning evaluations indicated that students demonstrated improved understanding of peatland functions, environmental threats, and conservation practices after participating in the program. These findings suggest that Eco Comic has the potential to foster ecological literacy by connecting environmental concepts with students' local experiences and everyday lives. The study also highlights the importance of collaboration among schools, local communities, environmental organizations, and village governments in developing contextual environmental education programs. The integration of local environmental issues into visual storytelling media offers students opportunities to engage more meaningfully with ecological concepts directly related to their surroundings. The findings contribute to the growing literature on contextual environmental education by illustrating how locally relevant comic-based learning media can be integrated into elementary school learning. However, this study was conducted within a limited geographical setting and focused primarily on program implementation. Future studies may involve broader participant groups and explore the long-term development of ecological literacy across different educational contexts.

7. Limitation

This study has several limitations that should be considered when interpreting the results. First, the scope of respondents is limited to elementary school students in grades IV-VI in Kampung Jati Baru, so the generalizability of the findings to other regions with different socio-ecological characteristics needs to be carefully considered. Second, the program's implementation is relatively short, so the impact on ecoliteracy sustainability and long-term changes in pro-environmental behavior cannot be fully measured. Third, data collection instruments, such as questionnaires and simple tests, may be influenced by students' reading literacy skills and social desirability tendencies, leading some responses to reflect expected perceptions rather than actual conditions. Fourth, this study has not fully controlled for external factors that can affect ecoliteration, such as family support, exposure to environmental information in the media, personal experiences related to fire/haze, and variations in teachers' teaching strategies across schools. Fifth, the research focuses more on describing the program management process and measuring results in knowledge and attitudes, so the aspect of *action competence* in protecting the environment has not been comprehensively measured.

Credit authorship contribution statement

Viony Syafitra: Conceptualization, Methodology, Formal analysis, Data curation, Writing original draft, Supervision. **Wilasari Arien**: Methodology, Investigation, Project administration, Writing review & editing. **Desi Yusnita Mailinda**: Resources, Data collection, Validation, Writing review & editing. **Lutfiana Arbiah**: Investigation, Data curation, Visualization. **Masyitha Ramadhani**: Investigation, Documentation, Data validation. **Ningrum Melihayatri**: Funding acquisition, Formal analysis, Validation, Writing review & editing.

Ethical Statement

This study adhered to the ethical principles of educational research involving human participants. Informed consent was obtained from all participants prior to their involvement in the study. For elementary school students, permission was obtained from school authorities and parents or guardians. Participants were informed of the study's objectives, the research procedures, and their right to withdraw from

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participation at any time without consequences. All data were collected, stored, and reported anonymously to ensure participant confidentiality and privacy.

Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to ethical considerations and the involvement of minor participants, the data are not publicly available.

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Declaration of AI Use
Portions of this manuscript were edited using ChatGPT (OpenAI) solely to improve grammar, language clarity, and readability. The AI tool was not used for data collection, data analysis, interpretation of findings, or the generation of research results. All AI-assisted content was reviewed, revised, and verified by the authors, who take full responsibility for the accuracy, originality, and integrity of the final manuscript.

Conflict of Interest
The authors declare that there are no conflicts of interest regarding the publication of this study. The authors have no financial, professional, or personal relationships that could have influenced the research process, data interpretation, or reporting of the findings.

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