

## Climate Change Education Based on Indigenous Knowledge: Fostering Disaster Literacy in Social Studies Learning

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### ABSTRACT

Climate change is a significant threat to human existence in the 21st century, necessitating the integration of climate change education into the social studies curriculum to equip students with environmental awareness and disaster literacy. This research aims to describe the implementation of climate change strategy materials grounded in Indigenous Knowledge (IK) and to determine students' disaster literacy levels through the StudySaster learning model. Studysaster is a systematic learning paradigm that integrates disaster education into the school environment across the pre-disaster, emergency response, and post-disaster phases. This study uses an exploratory sequential mixed-methods design with a sample of 121 elementary school teacher students at Universitas Ahmad Dahlan, Yogyakarta. Data were collected through observations, interviews, and questionnaires adapted from the disaster literacy framework by Kimura et al. to measure the dimensions of knowledge, attitudes, and skills. The research results show that: 1) the implementation of the Studysaster method reached a convenient category with an average score of 4.5/5.0; 2) the use of interactive learning media SWAY based on Indigenous Knowledge effectively enhances students' disaster literacy; and 3) the students' disaster literacy profile is in the high category, with the highest achievements in the attitude aspect (75% for respect toward the environment) and knowledge (50% for information understanding), while the skills dimension is the weakest competency aspect. These findings imply the importance of making disaster literacy a daily practice and provide a reference for social studies educators in integrating disaster mitigation into classroom learning.

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## 1. INTRODUCTION

Climate change is fundamentally defined as changes in the patterns and intensity of climate elements over a very long period. Climate change occurs naturally and is considered a natural reaction. However, climate change is not a natural phenomenon. Current climate change is driven by excessive human activities (Singh & Ahmad, 2025). These human activities have raised global environmental

concerns in the 21st century, including the release of greenhouse gases. It is important to understand that although climate variability can occur naturally as a response of the planet, the massive ongoing climate change is not merely a natural phenomenon but is primarily triggered by excessive human activity. The impact of this instability threatens various aspects of life, including water quality and the global food crisis. Therefore, systematic educational efforts are needed to equip the younger generation with disaster literacy that includes adaptation and mitigation strategies.

The urgent need to address this crisis has led to greater emphasis on the role of education in raising awareness, understanding, and action to combat climate change (Tang, 2024). The impact of climate change on aspects of human life drives the need for literacy and the strengthening of adaptation and mitigation (Riuttanen et al., 2021). Climate change adaptation is the effort to adjust to anticipate the impacts of environmental change. Climate change adaptation aims to reduce the adverse effects of climate change, enabling people to develop basic ideas and strategies to adapt on their own. Conversely, climate change mitigation is the effort to reduce the impacts of climate change. Based on this, basic material about climate change is necessary in education, especially for the younger generation (Khorasgani & Tavakoli, 2024; Novia & Asrizal, 2023). The current generation of youth will be significantly affected by climate change compared to previous generations (Ross et al., 2021). However, the desire of the younger generation to adapt to changes caused by climate change has been very little researched to date.

An educational foundation is needed for the younger generation as a strategic step and reference, equipping them with knowledge about climate change and disaster literacy through adaptation and mitigation (Shapiro Ledley et al., 2017). As future educators, aspiring teachers will guide children to become resilient learners with strong integrity and the ability to adapt to various changes, including the environmental and social impacts of climate change. The main goal of climate change education is to enhance the awareness, knowledge, attitudes, and behaviours of the younger generation, empowering them to analyse and effectively address the challenges of climate change (Jibola Kadir, 2020). However, the reality on the ground shows that, to date, climate change issues have been limited to specific topics in science education or environmental-related learning content (Carman et al., 2021). Climate change is still an additional topic among the various subjects taught in the curriculum.

Many educational initiatives and curricula have fallen short of effectively enhancing students' understanding of the significance of climate change and environmental issues. Typically, climate change education is integrated into scientific curricula. However, the reality on the ground shows that, to date, climate change issues remain limited to certain topics within science education or environmental-related learning content (Carman et al., 2021). Climate change is still an additional topic among various subjects taught in the curriculum. The reality on the ground shows that climate change issues are still often treated as an additional topic, limited to the science curriculum or to specific environmental content. Many educational initiatives fail to enhance deep understanding due to overly theoretical approaches and a lack of interdisciplinary integration. Social studies learning has strategic potential to address the complexity of this issue by developing critical thinking skills and fostering environmental responsibility. Many educational initiatives and curricula have not effectively enhanced students' understanding of the importance of climate change and environmental issues. Usually, climate change education is integrated into the science curriculum. However, many studies show that a more comprehensive approach is needed, encouraging the inclusion of climate change in cross-disciplinary initiatives and social studies education (Siegener & Stapert, 2020a). One innovative approach is to integrate Indigenous Knowledge (IK) into the social studies curriculum. Grounding education in cultural values not only enhances understanding of climate impacts but also fosters empathy and a sense of belonging toward the environment. Engaging students through social studies can effectively highlight climate change issues and raise their awareness of them. The complexity and abstract nature of climate change align well with social studies education, making it an excellent vehicle for promoting meaningful learning outcomes (Kumler & Vosburg-Bluem, 2014).

Moreover, research shows that the relationship between cognitive understanding of climate change and behavioral outcomes—such as adopting a sustainable lifestyle and increasing environmental awareness—is not straightforward (Dijkstra & Goedhart, 2012). Therefore, motivating students to adopt environmentally friendly practices is crucial to enhancing their understanding of environmental issues and encouraging proactive behaviour (Corner et al., 2015). Raising awareness about climate change presents several challenges. First of all, some concepts related to climate change, such as the greenhouse effect, are not visible to the human eye, making it difficult for students to understand their importance. Second, environmental degradation often occurs in distant locations, creating a psychological disconnect due to physical, temporal, and social distances, which can result in reduced environmental concern among students. Students must understand climate change issues and engage in pro-environmental actions to foster a deeper connection with nature (Bruni et al., 2012; Duan et al., 2022). Lastly, the effectiveness of methods, media, and learning models is crucial; students need access to more efficient ways to acquire information, knowledge, and skills beyond traditional classroom approaches (Molthan-Hill et al., 2019; Rissal & Muhtadi, 2022).

Research shows that integrating Indigenous knowledge into climate change education is crucial for raising awareness about disasters and disaster literacy, especially in the social studies curriculum (Zhang & Nakagawa, 2017). This educational approach deepens the understanding of climate change and highlights the importance of environmental management and cultural heritage. Traditionally, climate change education has focused on scientific facts through understanding and memorization; however, the Indigenous Knowledge system offers a unique perspective that is often overlooked. When climate change education is grounded in Indigenous knowledge, it not only deepens understanding of climate change impacts but also raises awareness of environmental protection through cultural values (Bronen et al., 2020; Mbah et al., 2021). When students are provided with information about climate change, they can understand the implications and associated risks, enabling them to recognize the positive and negative actions that influence it (Onuoha et al., 2021). Many studies have emphasized the urgency of incorporating climate change into higher education through various learning media, innovative approaches, and project-based practices as essential learning activities (Jeong et al., 2021; Mugabe et al., 2022).

Numerous studies have used various learning materials and engaged in both indoor and outdoor activities to encourage behavioral change in response to significant concerns about environmental changes driven by climate change (Cravero, 2020; Siron et al., 2021). Most previous research has continued to focus on the use of educational media, resources, and methods to encourage student engagement with climate change issues. However, there is a significant gap in research examining the effectiveness of the Studysaster learning model in this context. This research investigates the Studysaster learning model, which aims to enhance disaster literacy by integrating climate change content rooted in Indigenous knowledge into social studies classes. Integrating Indigenous knowledge into climate change education further enriches understanding of its implications and fosters environmental protection awareness grounded in cultural values. (Juhadi et al., 2021) emphasize the importance of integrating disaster education with Indigenous wisdom and community practices to make the content more understandable and impactful for students. This approach enhances students' understanding of climate change and strengthens their sense of belonging and cultural identity, thereby improving disaster literacy. In this context, disaster literacy encompasses knowledge, attitudes, and skills (Çallışkan & Üner, 2023; Kimura et al., 2017).

Despite the high urgency, there is a significant research gap in the current literature. First, there is still a lack of empirical evidence regarding the effectiveness of the Studysaster learning model in enhancing climate change disaster literacy. Second, research that comprehensively links Indigenous Knowledge, social studies learning, and the systematic measurement of disaster literacy remains very limited. Most previous research (Devecchi et al., 2025; Habibillah, Daffa Afiz., & Sakurai, 2026; Šosvald et al., 2026) has focused more on general learning media, without specifically measuring the skills dimension through interventions from certain learning models. Based on this gap, this research aims

to investigate the integration of climate change materials grounded in Indigenous knowledge into social studies learning through the Studysaster learning model and to analyze students' disaster literacy levels across the knowledge, attitude, and skill dimensions.

## 2. METHODS

This research aims to investigate the integration of climate change education using Indigenous climate change materials grounded in Indigenous knowledge into social studies learning through the Studysaster learning model and to analyze students' disaster literacy levels across the knowledge, attitude, and skill dimensions. Mixed-methods research combines qualitative and quantitative methodologies (Cresswel, 2013). This study employs a mixed-methods approach combining qualitative and quantitative approaches. The qualitative technique is employed in the initial research phase, whilst the quantitative method is utilised in the subsequent phase. The research design implements an exploratory sequential design. The exploratory sequential design is divided into a first phase with a qualitative approach for data interpretation and a second phase with a quantitative approach for data confirmation and verification.

The study involved participants from the primary teacher education program at Universitas Ahmad Dahlan Yogyakarta, including students and lecturers. Data were collected through interviews, observations, and questionnaires. Among the selected students, purposive sampling was used to select research subjects based on their participation in a social studies course integrating climate change material. The research instruments included a non-test interview guide, an observation sheet, and a questionnaire to evaluate respondents' disaster literacy. To ensure the questionnaire's reliability, researchers conducted pilot testing and sought validation from experts in the environmental sector.

In addition, reliability and validity were evaluated using IBM SPSS Statistics 25.0. Validity testing is the first step taken to ensure the accuracy of the instruments listed on the measuring tool, thereby determining whether the instrument is suitable for further use. Meanwhile, the reliability of research instruments is how consistent they are when used repeatedly. Generally, based on the results of the Alpha Cronbach test with a coefficient value between 0 and 1 and divided into 3 levels, namely low level (not reliable)  $\alpha < 0.60$ ; medium level (accepted/reliable)  $0.60 \leq \alpha < 0.80$ ; and high level (very reliable)  $\alpha \geq 0.80$ . The questionnaire, as a measurement tool distributed to participants, has 3 variables: knowledge (reliability = 0.948), attitude (Alpha Cronbach = 0.931), and skills (Alpha Cronbach = 0.853). These results indicate that the instrument has a very reliable coefficient, as it is at the  $\alpha \geq 0.80$  level.

The validity test yielded a score of 0.72, indicating that the instruments are reliable and valid. The questionnaire was structured into three categories of disaster literacy: knowledge, attitudes, and skills. It consisted of 50 questions and statements assessed on a five-point Likert scale. The questionnaire was translated into Indonesian and distributed via Google Forms, yielding 121 responses from social studies classrooms that incorporated climate change education based on Indigenous Knowledge through the Studysaster learning paradigm. Second, data reduction involves summarizing field data. Climate change education materials were integrated into social studies instruction, and information about the StudyStarter learning model was collected from students and lecturers. Third, data display. Researchers obtained data on climate change education that could be integrated into social studies learning to foster disaster literacy. The disaster literacy questionnaire data analysis employs descriptive statistical tests outlined by Kimura et al. (2017).

The analysis of disaster literacy data is conducted by calculating the percentage of the total questionnaire score achieved. Literacy level categories are determined based on the following thresholds: Very High (>80%), High (61–80%), Moderate/Adequate (41–60%), Low (21–40%), and Very Low (<20%). This assessment uses descriptive statistics to provide an overview of the frequency distribution in each dimension.

### 3. FINDINGS AND DISCUSSION

#### 3.1. Implementation of the Studysaster Learning Model For Climate Change Education Based on Indigenous Knowledge in Social Studies Classrooms

The implementation of the Studysaster model was directly observed during the lecture and further explored through interviews. This model, initially developed in response to online learning during the pandemic, was adapted by lecturers for the context of Climate Change Education. This study introduces the Studysaster learning paradigm, which systematically enhances the learning experience by integrating disaster education across all phases of pre-disaster, emergency response, and post-disaster. Interview results revealed that the main challenge in implementing the Studysaster learning model is aligning the number of learning activities with the available time. Additionally, it was noted that the Studysaster model, especially in climate change materials, is designed to be flexible and adaptable to time constraints. This approach applies to both indoor and outdoor activities or a combination of both.

Based on the interview results, the course lecturer in charge, Lecturer 1 (L1), explained the philosophy behind implementing this model.

*"I do not just translate Studysaster as learning about disasters from books." Nevertheless, how can students feel and analyze disaster risks in their own environment? We try to connect the threat of floods or landslides in their area with the local knowledge they have had since childhood." (Interview, L1, 2025)*

Furthermore, an interview with the course instructor, Lecturer 2 (D2), was conducted about the challenges of implementing the Studysaster learning model.

*"Although there are time constraints, the flexibility of implementing this learning model allows for adaptive learning both inside and outside the classroom." The implementation of the study disaster learning model is effectively carried out using an ecological project. In addition to acquiring theory, students also apply their knowledge in the form of projects." (Interview, L2, 2025)*

Further observational findings support this, showing that the Studysaster learning model is effectively implemented through classroom instruction and outdoor learning experiences, particularly through ecological projects. The results of the observation show that the lectures are no longer centered on the lecturer but rather on exploring climate change issues relevant to students' local context. The lecturer facilitates group discussions to map potential disasters in each student's hometown that may result from climate change. Students not only used scientific data but were also asked to discuss natural signs (*pranata mangsa*) and traditional stories about disaster mitigation.

Observation was conducted over three meeting sessions to monitor the implementation of Studysaster, which consists of six stages: (1) Identification, (2) Search, (3) Planning, (4) Creation, (5) Sharing, and (6) Practice, with social studies learning taking place in both classroom and outdoor settings. In addition, the observational findings reinforce the insights obtained from these interviews. Each step in the learning model is designed to integrate climate change materials based on indigenous knowledge using Microsoft 365 SWAY media. Based on the observation results, the implementation of the studysaster model achieved an average score of 4.5, categorized as very practical. Table 1 provides details of the activities at each stage of the learning model.

**Table 1.** Results of Observations on the Implementation of the Studysaster Learning Model

Learning Steps	Activities Description	Score (1-5)
Identification	Students identify issues related to climate change, carbon footprints, and their impacts on local ecosystems. Students analyze extreme weather phenomena through Sway media.	4,6
Search	Students are collecting data on mitigation and adaptation, particularly exploring IK from various regions of Indonesia as a climate resilience solution.	4,5
Planning	Students are developing an ecological project plan through 5 stages, such as a waste bank scheme, mangrove planting, and the 5R Movement campaign (Reduce, Reuse, Recycle, Replace, Replant).	4,4
Creation	Students realize their plans in concrete actions. Activities are carried out according to the predetermined project.	4,5
Sharing	Students reflect, compile a report on the ecological project activities, and present the results of their real actions and learning to the class using digital media.	4,7
Practice	Students are accustomed to applying disaster literacy and local wisdom values in their daily behavior to strengthen long-term environmental awareness.	4,3

Furthermore, observations during the planning stage of the student study model involved students preparing an ecological project plan consisting of five stages, namely:

- 1) Recognize & Understand: In this initial phase, students gain insight into the connections between the climate crisis, carbon footprints, and the effects of climate change events.
- 2) Investigate: During this phase, students identify their roles in generating and mitigating their carbon footprints and understanding household waste and its relationship to ecosystem balance.
- 3) Find Solutions: In this stage, students explore concepts related to ethics, principles, and benefits that may serve as solutions for reducing climate change impacts and enhancing resilience to climate crises. They also delve into Indigenous knowledge from various regions in Indonesia that offer mitigation and adaptation strategies for climate change.
- 4) Make a Change: Students take concrete actions based on their previously devised project plans. The project plans include assisting coastal residents in planting mangrove trees, conducting training sessions on household waste and plastic management in line with the 5R Movement (Reduce, Reuse, Recycle, Replace, Replant), and establishing a waste bank.
- 5) Share: In the final phase, students reflect on their experiences, share their learning outcomes, compile project activity reports, and create presentations for follow-up actions.

The Studysaster learning model consists of six main components: (1) Identification, (2) Search, (3) Planning, (4) Creation, (5) Sharing, and (6) Practice. The Studysaster learning model introduced in this study aims to systematically enhance the learning experience by improving the integration of disaster education throughout the pre-disaster, emergency response, and post-disaster phases in the educational environment. These findings are consistent with previous research. (Puspitarini, 2021; Suparmita, 2021; Widyasari, 2021) support the idea that the Studysaster learning model positively impacts the classroom environment and serves as a practical framework for teaching knowledge, attitudes, and skills related to disaster prevention and management.

The main finding of this study is how Indigenous Knowledge (IK) is explicitly integrated into the framework of the Studysaster learning model. The results of the interview with the course instructor (L2) show that integrating Indigenous Knowledge (IK) into education is crucial for aligning learning with local cultural values. Interviews with students revealed that this approach makes climate change

material more concrete and contextual. Table 2 summarizes the interview results about integrating IK with 2 lecturers (L1 and L2) and 5 students (S1, S2, S3, S4, and S5).

**Table 2.** Summarizes the Interview Results about Integrating IK

Informant	Integration of IK	Summary of Interview Findings
L1	Values Internalization & Contextualization	The lecturer emphasized that climate change competency cannot be developed solely through traditional classroom instruction, but rather requires the internalization of local cultural values. The integration of Indigenous Knowledge (IK) into Social Studies materials helps align learning with local cultural values, making it more relevant to students. This makes it possible to elaborate on IK from many regions in Indonesia, as students come from various regions, such as Sumatra, NTT, NTB, Kalimantan, etc.
L2	Digital Media Flexibility	The use of the Microsoft 365 SWAY platform based on IK is considered very effective for collecting and organizing ideas, as well as for presenting climate change materials practically, including audio, visual, and audiovisual materials.
S1	Increased Engagement & Understanding IK	Learning media in SWAY based on IK enhances engagement because the information is presented clearly and easily understood.
S3	Environmental Awareness	The integration of local wisdom into learning fosters deeper empathy for the environment and motivates students to take action to conserve natural resources and combat climate change.
S2,4,5	Practical Implementation	Through the Creation stage, students are encouraged to apply the previously analyzed IK in ecological project plans, such as mangrove planting on the coast and household waste management through the 5R movement.

The results of the interviews with Social Studies lecturers (L1 and L2) agree on the importance of integrating climate change education into Social Studies learning.

*"In Social Studies learning, it is necessary to discuss materials on climate change education to develop students' competencies in this field. It was further explained that such competencies cannot be developed solely through traditional classroom teaching; they require internalization, appreciation, and opportunities to apply the acquired knowledge. To instill a culture of climate awareness, systems, habits, and behaviors must be based on an understanding of the climate crisis." (Interview, L1 & L2, 2025)*

The emphasis on climate change awareness aligns with previous studies that show awareness begins with consciousness and understanding, which can be nurtured through education, ultimately encouraging positive habits to adapt to and mitigate climate change (Moreno-Fernández, 2020; Nepraš et al., 2022; Sibanda, 2025). Regarding the integration of climate change education into social studies, the lecturer stated that students need to understand the environmental implications of climate change, comprehend its relevance to their context, and explore concrete steps they can take. In addition, students must contribute to community efforts to maintain a sustainable, resilient environment amid climate change.

While topics related to the environment, sustainability, and climate change are increasingly featured in social studies, the focus on these subjects varies greatly. The results of this study are supported by previous research showing that cognitive learning predominates over social-emotional, action-oriented, or practical learning approaches (Sherpa, 2021; Tibola da Rocha et al., 2020). Thus, climate change education has emerged as an important component of the social studies curriculum (Anyanwu & Njoku, 2023). Therefore, there is an urgent need to strengthen the integration of climate change and sustainability in social studies education. Educators play a crucial role in enhancing this integration by applying appropriate teaching methods, models, and learning resources.

In addressing climate change, education plays a crucial role in three aspects. First, education empowers individuals by increasing their awareness and capacity to mitigate and prevent climate change (Morote & Olcina, 2023). Second, education contributes to building adaptive capacity to respond to the impacts of the climate crisis we have experienced (Teixeira & Crawford, 2022). Third, it encourages lifelong learning, enabling individuals to access the latest, most accurate information on the climate crisis and respond effectively (Rahmah, 2022).

The results of this study also align with previous research (Mandikonza, 2019), which states that IK arises from the unique experiences of specific communities or ethnic groups, often reflecting perspectives that others may not possess. This knowledge has been tested and developed over a long period, often in line with the historical existence of these communities. However, the values inherent in Indigenous knowledge can significantly enhance the relevance and effectiveness of educational practices (Bronen et al., 2020).

Integrating climate education into social studies aligns the aspirations and creativity of lecturers and students, creating an engaging learning environment for designing ecological projects. This approach aims to promote individual and collective responsibility among students. Consistent with previous research, the project-based learning model can enrich learning activities, stimulate innovation in educational programs, and offer invaluable real-world experiences for students (Caprari et al., 2024; Katyeudo & de Souza, 2022; Senevirathne et al., 2022).

### **3.2 Learning media SWAY Microsoft 365 based on Indigenous Knowledge and student perceptions**

This research focuses on a specific product within Microsoft Office 365, the learning media SWAY based on IK. This learning media enables lecturers to collect, organize, and share ideas, resources, and presentations on climate change. The SWAY application enables educators to seamlessly integrate text, images, documents, videos, graphics, and other content based on IK. Analysis of interview data collected from students in the elementary school teacher education program at Ahmad Dahlan University shows that the learning media SWAY based on IK received positive feedback.

*"Students reported that the SWAY platform enhances the learning environment, increases engagement, is user-friendly, presents information clearly, and is a practical learning resource." (Interview, Students 1 and 4, 2025)*

Observations show that lecturers use various learning resources to enhance students' scientific literacy. Students are provided with various reading materials; the lecturer supports this with digital and interactive learning media, specifically learning media SWAY based on IK in the classroom. The presented local wisdom content includes adaptation practices in Indonesian society, such as traditional disaster mitigation systems, which make abstract climate change more tangible for students. These efforts aim to enhance students' access to information about climate change, adaptation strategies, and effective mitigation techniques through various formats, including print, visual, audio, and digital resources. The goal is to expand students' knowledge and understanding in order to minimize the risks associated with climate change disasters.

The results of interviews with two lecturers indicate that the Studysaster learning model is reinforced by the development of learning media utilizing Microsoft 365 SWAY based on IK. This approach is further supported by observational findings during the learning process, which show that the lecturers effectively present climate change content using IK-based SWAY learning media. The IK content presented includes adaptation practices in Indonesian society, such as traditional disaster mitigation systems and climate change adaptation measures, which make the abstract topic of climate change more tangible for students.

Analysis of interview data from 5 students shows that the students responded very positively to the use of this media. Students reported that the SWAY platform enhances the quality of the learning environment, increases engagement, and serves as a practical and easy-to-use educational tool. Table 3 summarizes students' perceptions of the use of Learning Media SWAY based on IK.

**Table 3.** Summary of Interview Results on Student Perceptions of The Use of SWAY Learning Media Based on IK

Informant	Perception Indicators	Description of Interview Findings
S1,2,3	Usability	Students stated that the SWAY media interface is very user-friendly and easily accessible through various devices.
S2&4	Clarity of Information	The climate change and IK material is presented in a structured, clear, and contextual manner, accompanied by real-life examples.
S4&5	Engagement	Interactive elements in SWAY (audio, video, and graphics) enhance interest in environmental issues, increasing curiosity and inquisitiveness.
S1,2,5	Content Relevance (IK)	The integration of IK helps students understand the impact of climate change in context. The content in the SWAY media is very relevant and broadens students' horizons and knowledge. At first, I didn't know, but eventually I understood that in Indonesia, there are many IKs related to climate change mitigation and adaptation.

The results of this study align with trends in digital literacy and environmental education over the past five years. The use of interactive media such as SWAY has proven capable of minimizing technical barriers in both remote and in-person learning (Primaniarta & Wiryanto, 2022; Rulviana et al., 2022). Furthermore, integrating local wisdom into digital media is a crucial strategy for addressing students' "psychological distance" from climate change issues. These findings reinforce the research by (Bronen et al., 2020) and (Mbah et al., 2021), which asserts that when climate change education is rooted in local wisdom, students' understanding not only increases at the cognitive level but also deepens their environmental protection awareness grounded in cultural values. The integration of IK in SWAY provides a unique perspective that is often overlooked in conventional science. By combining modern technology and traditional knowledge, this media successfully creates an in-depth learning experience, helping PGSD students—as future educators—to have strong disaster literacy before entering the field.

### ***3.3 Measuring Disaster Literacy Dimensions in Social Studies: Assessing Knowledge, Attitudes, and Skills***

Climate change education is crucial for fostering disaster literacy. It equips students with the Knowledge and skills necessary to effectively address the challenges posed by climate change education (Teixeira & Crawford, 2022). By adopting an integrative curriculum, engaging in experiential learning, and utilizing culturally relevant approaches, educators can empower students to become informed and proactive members of society. Incorporating climate change education rooted in Indigenous Knowledge into social studies can significantly enhance individual resilience and foster a collective commitment to sustainability and disaster preparedness (Siegnier & Stapert, 2020b). Based on this research, the link between climate change education and disaster literacy is clear: as climate change education promotes resilience through lessons on risk assessment, emergency preparedness, and recovery strategies, disaster literacy demonstrates how to prepare for, respond to, and recover from disasters.

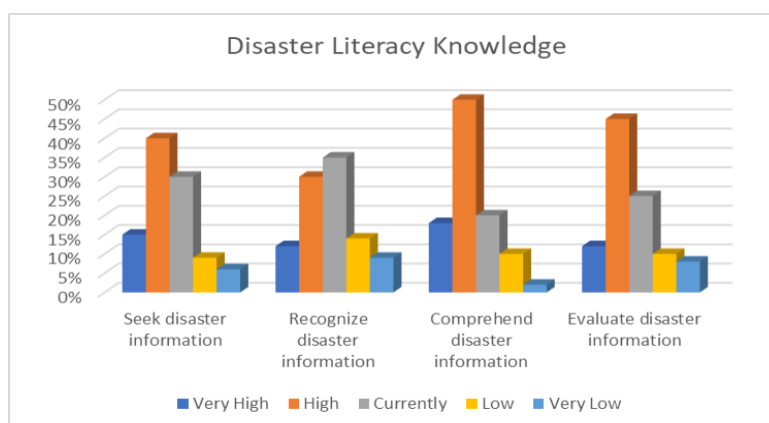
Disaster literacy is the capacity to address disaster threats through a comprehensive knowledge framework that enhances disaster risk mitigation (Kimura et al., 2017). This concept has been integrated into social studies education, as evidenced by observations of the learning process. In social studies, disaster literacy encompasses several dimensions, including disaster awareness, preparedness, and response knowledge. Another crucial aspect of disaster literacy is attitudes towards disasters, which entails understanding prevention, the values associated with prevention, and a sense of responsibility. The key components of disaster literacy include preparedness actions and response behaviors.

Social studies education has significant potential to improve disaster literacy, encompassing a comprehensive understanding of natural disasters and effective prevention and mitigation strategies. Research indicates that social studies curricula can incorporate essential elements of climate change and disaster issues. Additionally, the Studysaster learning model can be effectively utilized to enhance students' understanding, attitudes, and skills in addressing challenges, adapting to changes, and mitigating the impacts of climate change (Widyasari, 2021).

This study highlights that disaster literacy comprises several key components: knowledge, attitudes, and behaviors. The knowledge aspect includes awareness of disasters, preparedness, and response strategies. The second crucial component involves attitudes toward disasters, encompassing understanding prevention measures, adopting values related to them, and cultivating a sense of responsibility. Ultimately, the primary elements of disaster literacy involve preparedness actions and behaviors exhibited in response to disasters. The results of the disaster literacy evaluation for each component are presented below.

### 3.3.1. Disaster Literacy Knowledge Level

The research findings on disaster literacy include 20 statements related to Knowledge of catastrophes, preparedness, and response. Additionally, the indicators associated with the knowledge dimension encompass various components, mainly how students acquire, identify, comprehend, and evaluate disaster information. Figure 1 illustrates the students' responses regarding their understanding of disaster literacy.



**Figure 1.** Level of Disaster Literacy Knowledge Aspect

Figure 1 demonstrates that the disaster literacy component of knowledge shows students achieving a comprehension of disaster information at 50% in the high category, evaluating disaster information at 45% in the high category, seeking disaster information at 40% in the high category, and recognizing disaster information at 35% in the current category. These findings indicate that students are adept at understanding and assessing global climate change events. This knowledge is a valuable foundation for enhancing awareness of climate change and its mitigation in educational contexts, encouraging participation in efforts to reduce the risks and impacts associated with it. These results align with previous research highlighting the importance of climate change knowledge and the need to integrate it into social studies curricula (Cravero, 2020; Kumler & Vosburg-Bluem, 2014).

### 3.3.2. Disaster Literacy Attitude Level

The research findings concerning attitudes toward disaster literacy comprise 15 statements focused on the principles and significance of prevention and the associated sense of responsibility. Indicators of disaster literacy attitudes include awareness, respect, and environmental stewardship. Figure 2 shows the students' responses regarding disaster literacy in the attitude aspect.

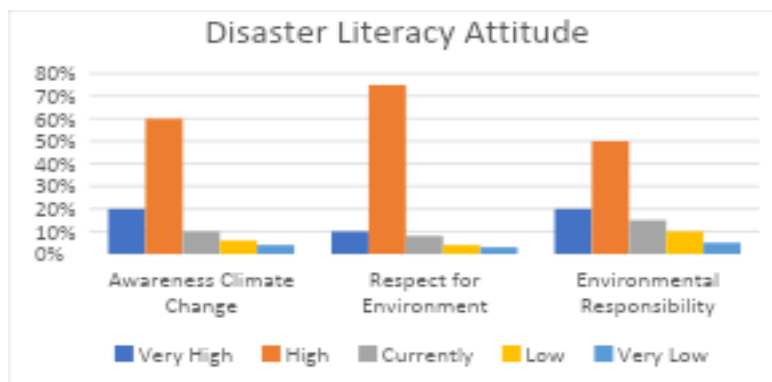


Figure 2. Level of Disaster Literacy Attitude Aspect

Figure 2 shows that students' disaster literacy attitudes toward climate change awareness are 60%, categorized as high; respect for the environment is 75%, also categorized as high; and environmental responsibility is 50%, also categorized as high. The research indicates that students exhibit a robust disaster literacy attitude, particularly regarding the environment. These results suggest that, after participating in social studies classes on climate change informed by Indigenous knowledge, students develop intrinsic values towards nature and actively engage in efforts to maintain, protect, and conserve natural resources to combat climate change. The findings of this study align with previous research indicating that education on climate change informed by Indigenous knowledge cultivates a more profound empathy for the environment (Datta, 2024; Mugabe et al., 2022).

### 3.3.3. Disaster Literacy Skills Level

The research findings on disaster literacy skills encompass 15 statements. The assertions in the research questionnaire focus on specific initiatives related to climate change mitigation and response behaviours. These elements are defined by various indicators, such as the ability to interpret climate change data, evaluate climate change information, disseminate climate change knowledge, formulate mitigation strategies, and implement climate change mitigation initiatives. Figure 3 shows the students' responses regarding disaster literacy skills.

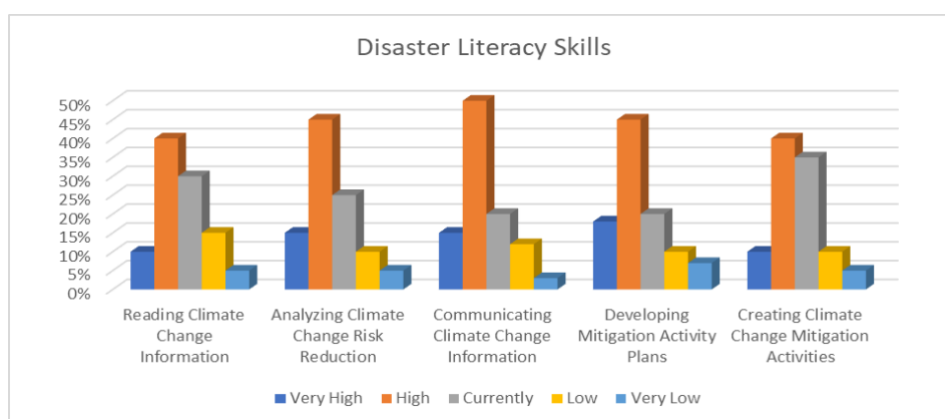


Figure 3. Level of Disaster Literacy Skills Aspect

According to the data presented in Figure 3, students exhibit the following levels of disaster literacy skills: reading climate change information stands at 40%, classified as high; analyzing climate change risk reduction is at 45%, also deemed high; communicating climate change information is at 50%, categorized as high; developing mitigation activity plans is at 45%, classified as high; and creating climate change mitigation activities is at 40%, also categorized as high. These results indicate that students possess advanced disaster literacy, particularly in their ability to communicate information

about climate change. These results suggest that students are well-equipped to disseminate information regarding climate change and its impacts on life. Furthermore, the findings of this study align with previous research, indicating that disaster literacy skills are crucial for the younger generation in effectively addressing environmental challenges and disasters arising from climate change (Alves & Azeiteiro, 2018; Ojala & Lakew, 2017; Siegner & Stapert, 2020a). Furthermore, disaster literacy skills also enhance awareness and preparedness for climate change (Brown et al., 2014).

The findings on students' disaster literacy indicate that attitudes improved more rapidly (reaching 75% on environmental respect) than skills, which ranged from 40% to 50%. This phenomenon occurs because the internalization of values and empathy through local wisdom is more easily formed and effective in a short period of time (Mishra, 2026). On the other hand, mastering mitigation skills requires repetitive practice and more intensive technical habituation. The pedagogical implication is that climate change education should not stop at awareness, but should allocate a greater share to practical simulations and ongoing technical assignments.

#### 4. CONCLUSION

This research concludes that the Studysaster learning model based on Indigenous Knowledge is highly effective in enhancing disaster literacy among prospective elementary school teachers in a university environment. The integration of local cultural values through the interactive media SWAY in Microsoft 365 has proven capable of transforming abstract climate change material into a more contextually relevant form, thereby significantly strengthening students' knowledge and pro-environmental attitudes. The findings indicate a gap in which attitude develops faster than technical skills. To strengthen the skill dimension, the main pedagogical implication is the need to shift from mere affective awareness to intensive practical habituation. Educators are advised to extend the duration of interventions, integrate repetitive practical tasks, and use specific performance assessment rubrics to objectively monitor students' real mitigation skills. This research has limitations, including the short duration of the intervention (only three meetings) and the absence of a control group to experimentally compare the model's effectiveness. Future research should conduct long-term interventions with formal experimental designs and expand the implementation scope of the Studysaster model beyond the university environment, particularly in real classroom practices in elementary schools, to test the scalability and long-term impact of the disaster literacy that has been developed.

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