

How Do Teachers Integrate Disaster Readiness and Risk Reduction Concepts in Grade 9 Life Science?

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DOI: <https://dx.doi.org/10.47772/IJRISS.2026.1026EDU0235>

Received: 17 April 2026; Accepted: 22 April 2026; Published: 13 May 2026

ABSTRACT

This study examined how science teachers integrate Disaster Readiness and Risk Reduction (DRRR) concepts in Grade 9 Life Science learning competencies. Using a descriptive qualitative research design, data were collected through individual interviews, focus group discussions, and document analysis. Findings revealed that teachers employ diverse integration strategies, including health-hazard, environmental, scenario-based, inquiry-based, community-based, and reflective approaches. These strategies enable students to connect scientific concepts with real-life disaster contexts, promoting awareness and resilience. However, the integration is often implicit and not consistently reflected in instructional documents such as Daily Lesson Logs. The study highlights the need for structured teaching guides to support explicit and systematic DRRR integration in science education.

Keywords: Disaster Risk Reduction, Life Science Education, DRRR Integration, Science Teaching

INTRODUCTION

Climate change and the increasing frequency of disaster-related risks have emerged as critical global concerns that threaten sustainable development and human security. Extreme climate events, such as typhoons, floods, and volcanic eruptions, pose significant challenges to communities, often reversing developmental gains and disrupting social and economic stability (Wen et al., 2023). In response, global frameworks such as the Sendai Framework for Disaster Risk Reduction emphasize the vital role of education in building disaster-resilient societies by equipping learners with knowledge and skills necessary for preparedness and risk reduction (United Nations Office for Disaster Risk Reduction [UNDRR], 2015).

Over the past decades, advances in disaster research have enhanced understanding of the complex interactions between natural hazards and societal vulnerabilities. These interactions often result in emergencies, disasters, or catastrophic events, particularly in high-risk regions (Intergovernmental Panel on Climate Change [IPCC], 2016). However, despite the availability of theoretical frameworks and risk reduction strategies, a persistent gap remains between theory and practice, especially in educational settings. The effectiveness of disaster risk management is significantly constrained when these concepts are not meaningfully integrated into classroom instruction (Weichselgartner & Pigeon, 2015).

In the Philippines, this challenge is further compounded by concerns in scientific and environmental literacy. Results from the Programme for International Student Assessment (PISA) reveal that Filipino students consistently perform below global averages in scientific literacy, ranking among the lowest-performing countries (Department of Education [DepEd], 2019; Organization for Economic Co-operation and Development [OECD], 2023). Similarly, environmental performance indicators show that the country continues to face significant challenges in ecological sustainability and resilience (Yale Center for Environmental Law & Policy, 2024). These findings suggest an urgent need to strengthen science education by making it more relevant, contextualized, and responsive to real-world issues such as disaster preparedness and environmental protection.

Integrating Disaster Readiness and Risk Reduction (DRRR) into science education offers a practical and interdisciplinary approach to addressing these concerns. By connecting scientific concepts with real-life disaster

scenarios, DRRR integration enhances students’ understanding of both science and risk awareness, while fostering critical thinking, problem-solving, and decision-making skills (Loquillano et al., 2021). Moreover, national policies such as Republic Act No. 10121 (Philippine Disaster Risk Reduction and Management Act of 2010) mandate the inclusion of DRRR in the curriculum across all educational levels, reinforcing the role of schools as key agents in disaster preparedness.

Despite these mandates, significant gaps remain in the implementation of DRRR integration, particularly in specific subject areas such as Grade 9 Life Science. Existing instructional materials are often general and lack alignment with science competencies, limiting teachers’ ability to effectively incorporate DRRR concepts into their lessons. Studies have also identified challenges faced by teachers, including limited training, insufficient resources, and lack of clear instructional guidance (SEAMEO INNOTECH, 2018). As a result, opportunities to integrate disaster-related concepts into topics such as human body systems, heredity, biodiversity, and ecosystems are often underutilized.

This gap is especially critical in disaster-prone areas such as Legazpi City, Albay, which is frequently affected by natural hazards including typhoons, volcanic eruptions, floods, and landslides. Local initiatives, such as those implemented by the Albay Public Safety and Emergency Management Office (APSEMO) in collaboration with the Department of Education, have made efforts to incorporate disaster preparedness and climate change awareness into the curriculum (APSEMO & DepEd Region V, 2015). However, despite these efforts, the integration of DRRR in classroom instruction remains inconsistent and lacks a structured framework.

Ultimately, strengthening DRRR integration in science education not only improves students’ scientific literacy but also empowers them to become proactive and informed individuals capable of responding effectively to disaster situations. This is particularly important in vulnerable communities, where fostering awareness, readiness, and adaptive capacity among the youth plays a crucial role in building safer and more resilient societies. This study aimed to (a) identify Disaster Readiness and Risk Reduction (DRRR) concepts integrated into Grade 9 Life Science competencies; and (b) describe the pedagogical approaches and strategies used by science teachers in integrating DRRR concepts in classroom instruction.

METHODOLOGY

This study employed a qualitative research design with data triangulation to explore how teachers in Legazpi City integrate Disaster Readiness and Risk Reduction (DRRR) concepts in life science competencies. Data were collected through three primary sources: individual interviews, focus group discussions (FGDs), and document analysis of daily lesson logs (DLLs).

There are 20 teacher participants who are included in this research who handled Grade 9 Life Science classes. Interviews and focused group discussions (FGD) were conducted to gather in-depth insights into teachers’ instructional practices and integration strategies. Document analysis of 12 daily lesson logs was conducted to examine how DRRR concepts were reflected in documents and how it is formally executed in the lessons. Moreover, data were analyzed using Braun and Clarke thematic analysis framework, involving systematic coding, categorization, and identification of recurring patterns across data sources. Triangulation was employed to validate findings by comparing data from interviews, FGDs, and documents, ensuring credibility and reliability of results.

RESULTS AND DISCUSSION

DRRR Integration in Respiratory and Circulatory Systems

DRRR Concept	Integration Approach	Key Integration Focus	Strategies Used
Health risks during disasters	Health-hazard integration	Links body systems with disaster-related health risks (e.g., smoke, ash, pollution)	Contextualized discussion, questioning, real-life examples

Environmental hazards	Environmental health integration	Explains effects of hazards on oxygen transport and circulation	Case studies, multimedia, discussions
Disaster risk awareness	Scenario-based integration	Analyzes body response to limited oxygen during emergencies	Scenario analysis, simulations, problem-solving
Preventive health practices	Health promotion integration	Promotes healthy lifestyle for disaster resilience	Health activities, reflection, presentations
Physiological response to stress	Inquiry-based integration	Investigates body system responses to environmental stress	Experiments, pulse investigations, collaborative inquiry
Community preparedness	Community-based integration	Connects body systems to community health and disaster awareness	Group research, campaigns, project-based learning
Personal responsibility	Reflective integration	Encourages evaluation of personal health practices	Reflection activities, experiential learning

Table 1. DRRR Integration in Respiratory and Circulatory Systems

Analysis of interviews, focus group discussions (FGDs), and documents revealed a health-centered DRRR integration in competency S9LT-Ia-b-26, where teachers link respiratory and circulatory processes with disaster-related risks using multiple approaches (Magnayea, 2025). Teachers emphasized that understanding oxygen transport enables students to recognize how hazards such as smoke, pollution, and volcanic ash affect human survival, as one teacher participant noted, *“when I teach how the lungs and heart work together, I connect it with disasters like volcanic eruptions where ash and smoke affect breathing”* (P1), while another added that *“poor air quality during disasters directly affects how these systems function”* (P2). This is supported by FGD findings stating that *“students become more aware of health risks when they analyze oxygen transport during disasters”* (FGD2).

Environmental and scenario-based integration further strengthen learning, as teachers use real-life examples and disaster situations to illustrate how hazards disrupt oxygen supply (Bernal & Apdohan, 2023). One participant shared, *“I use real-life examples like wildfire smoke or air pollution to show how respiratory problems affect oxygen circulation”* (P5), while another explained, *“I present scenarios such as wildfire evacuation and ask students how smoke inhalation affects breathing”* (P9). FGD participants similarly emphasized that *“we connect lessons to real disasters so students understand how smoke or ash affects breathing and circulation”* (FGD1). Health promotion is also emphasized, with teachers noting that *“healthy lungs and heart help individuals cope better during disasters”* (P13) and that *“we encourage students to practice healthy living because it is part of being prepared for disasters”* (FGD4) (Magnayea, 2025)

Inquiry-based, collaborative, community-based, and reflective strategies deepen understanding and extend learning beyond the classroom (Villanueva et al., 2023). As one teacher explained, *“students investigate how oxygen is transported and analyze how hazards affect this process”* (P17), while another noted that *“students reflect on habits like exercise and smoking because these directly affect their systems during disasters”* (P6). FGD responses support this, indicating that such activities help students connect personal health with preparedness, as *“reflective activities help students connect health with disaster survival”* (FGD5) (Jackarain et al., 2023).

However, document analysis of Daily Lesson Logs (DLLs) indicates that DRRR integration is often implicit, with limited explicit inclusion of disaster preparedness tasks. This reveals a gap between teaching practices and instructional documentation, suggesting that DRRR integration remains more incidental than systematically embedded. (Sanguyu, 2025)

DRRR Integration in Lifestyle and Body Systems

DRRR Concept	Integration Approach	Key Integration Focus	Strategies Used
Health vulnerability during disasters	Health-hazard integration	Links lifestyle habits (e.g., smoking, inactivity) with increased disaster vulnerability	Contextualized discussion, real-life examples, questioning
Environmental hazards and health	Environmental health integration	Explains effects of hazards (e.g., smoke, ash, pollution) on body systems	Case studies, multimedia, discussions
Preventive health practices	Health promotion integration	Promotes healthy lifestyle for disaster resilience	Health activities, campaigns, reflection
Risk awareness and preparedness	Scenario-based integration	Analyzes how lifestyle influences disaster response	Scenario analysis, problem-solving, discussions
Community health resilience	Community-based integration	Connects personal health with community preparedness	Collaborative learning, group research, projects
Physiological response to stress	Inquiry-based integration	Investigates effects of lifestyle on body systems	Laboratory activities, hands-on inquiry
Personal responsibility	Reflective integration	Encourages evaluation of lifestyle choices and preparedness	Reflection activities, experiential learning

Table 2. DRRR Integration in Lifestyle and Body Systems

Analysis of interviews, focus group discussions (FGDs), and documents revealed a lifestyle-based DRRR integration in competency S9LT-1c-27, where teachers link lifestyle behaviors to health risks and disaster vulnerability. Teachers emphasized that unhealthy habits weaken respiratory and circulatory systems, increasing susceptibility during disasters (Inocian et al., 2025). One participant explained that *“when teaching the respiratory and circulatory systems, I discuss how smoking or lack of exercise can make people more vulnerable during disasters”* (P1), while another added that *“poor lifestyle choices make it harder for the body to cope with hazards like smoke inhalation”* (P2). This is supported by FGD findings noting that *“unhealthy habits like smoking weaken the lungs, making students more at risk during disasters”* (FGD1).

Environmental and scenario-based integration further contextualize learning by linking hazards such as pollution, ashfall, and fire smoke with health conditions. (Strategic intervention materials-based instruction on disaster literacy for technology students using the ADDIE model, 2025). One teacher shared, *“I use examples like volcanic ash or wildfire smoke to show how hazards affect breathing and circulation”* (P5), while another noted, *“I give scenarios like evacuations and ask how people with weak lungs may struggle”* (P9). FGD participants affirmed that *“students understand that environmental conditions affect people differently depending on their health status”* (FGD3) and that scenario-based tasks deepen reflection on vulnerability (FGD5).

Health promotion, inquiry-based, and collaborative strategies reinforce resilience by encouraging healthy lifestyles and active learning (Jr., 2025). Teachers emphasized that *“healthy lungs and heart can help individuals cope better during disasters”* (P13), while students engage in investigations, as *“students conduct activities on how lifestyle habits affect respiratory and circulatory health”* (P17). FGD responses support this, highlighting that *“hands-on activities help students understand how the body responds to stress during disasters”* (FGD9).

Document analysis of Daily Lesson Logs (DLLs) further supports these findings, showing the use of active learning strategies such as K-W-H-L charts, games, and hands-on models that promote health awareness (Caliston, 2025). However, DRRR integration is often implicit, indicating a gap between classroom practices and explicit documentation (Olores et al., 2023). Overall, findings confirm that lifestyle-focused DRRR integration enhances students’ understanding of the link between personal health, environmental hazards, and disaster resilience (Bernal & Apdohan, 2021).

DRRR Integration in Heredity

DRRR Concept	Integration Approach	Key Integration Focus	Strategies Used
Biological vulnerability (genetic conditions)	Health vulnerability integration	Links inherited traits with health risks during disasters (e.g., asthma, UV sensitivity)	Contextualized discussion, questioning, real-life examples, reflection
Inclusive preparedness planning	Preparedness planning integration	Designs disaster plans considering individuals with genetic conditions	Group tasks, project-based learning, collaborative activities
Adaptation and resilience	Ecological and adaptation integration	Explains genetic variation and organism adaptation to environmental hazards	Case studies, inquiry-based learning, group analysis
Risk assessment	Scenario-based integration	Analyzes how health conditions affect disaster response and preparedness	Scenario analysis, role-play, simulations
Public health considerations	Public health integration	Connects genetics with community health and disaster response	Discussions, multimedia, case studies, infographics
Genetic variation and vulnerability	Inquiry-based integration	Investigates how genetics influences risk and resilience	Research tasks, collaborative inquiry
Individual differences	Contextualized integration	Relates genetics to real-life disaster situations and lived experiences	Local examples, reflection, experiential learning

Table 3. DRRR Integration in Heredity: Inheritance and Variations

Analysis of interviews, focus group discussions (FGDs), and documents revealed a genetics-based DRRR integration in competency S9LT-Id-28, where teachers link gene location concepts to health vulnerability, preparedness, and adaptation (Gong et al., 2021). Teachers emphasized that inherited traits influence disaster response, as one noted, *“I connect inherited traits with disaster situations so students realize that some conditions like asthma can make people more vulnerable”* (P1), while another added that *“conditions like albinism can increase sensitivity during evacuation”* (P2). This is supported by FGD findings stating that *“students realize that some health conditions can make individuals more at risk during disasters”* (FGD1).

Preparedness and scenario-based integration further enhance application, with teachers guiding students to design inclusive plans and analyze disaster situations. One participant shared that *“students identify inherited traits and relate these to safety during disasters”* (P3), while another explained that *“analyzing disaster scenarios helps students apply genetics concepts to real-life decision-making”* (FGD6). Ecological and adaptation as supported by the study of Kivi et al., highlighted resilience, as teachers explain that *“understanding genetic variation allows organisms to adapt to environmental changes”* (P9), supported by FGD insights that *“students better understand adaptation and survival through genetics”* (FGD5).

Public health, inquiry-based, and collaborative strategies deepen understanding by emphasizing inclusive healthcare and active learning. Teachers noted that *“genetic predispositions may influence health risks during disasters”* (P17), while students engage in group discussions and investigations, supported by FGD responses that *“collaborative tasks encourage deeper analysis of genetics and disaster risks”* (FGD8). Contextualized integration further promotes awareness of individual differences, with participants noting that *“students understand that people have different capacities and needs during emergencies”* (FGD10).

However, document analysis of Daily Lesson Logs (DLLs) revealed limited inclusion of DRRR decision-making tasks, simulations, and risk-based activities, indicating that integration remains largely theoretical. While interview and FGD data show strong and consistent application of DRRR strategies, the lack of explicit documentation highlights a gap between intended practices and instructional planning. (Magnayea, 2025).

DRRR Integration in Biodiversity and Evolution

DRRR Concept	Integration Approach	Key Integration Focus	Strategies Used
Environmental hazards and biodiversity loss	Hazard–ecosystem integration	Links disasters (e.g., eruptions, floods, climate change) to species extinction	Case studies, contextualized examples, discussions
Ecosystem resilience and adaptation	Adaptation integration	Explains how genetic variation enables survival or leads to extinction	Inquiry-based learning, group analysis, discussions
Ecosystem imbalance and disaster risk	Environmental risk awareness integration	Highlights how biodiversity loss increases vulnerability to hazards	Multimedia, ecological diagrams, discussions
Human-induced environmental risks	Human–environment interaction integration	Connects deforestation, pollution, and climate change with disaster risks	Local case studies, community examples, reflection
Species survival in disasters	Scenario-based integration	Analyzes how species respond to environmental changes	Scenario analysis, simulations, role-play
Conservation for risk reduction	Sustainability integration	Promotes biodiversity conservation to reduce disaster risks	Project-based learning, campaigns, conservation planning
Community environmental awareness	Community-based integration	Links ecosystem protection with community resilience	Group research, community projects, presentations

Table 4. Biodiversity and Evolution

Analysis of interviews, focus group discussions (FGDs), and documents revealed an ecology-based DRRR integration in competency S9LT-Ie-f 30, where teachers connect biodiversity and evolution with hazards, adaptation, and environmental risks. Teachers emphasized that understanding species extinction helps students recognize how abrupt environmental changes increase disaster vulnerability, as one noted, *“I connect species extinction to real disasters like volcanic eruptions or floods so students understand how environmental changes affect survival”* (P1), supported by FGD findings that *“students become more aware that disasters can lead to extinction if organisms cannot adapt”* (FGD2).

Hazard–ecosystem, adaptation, and environmental risk awareness integration highlight how ecosystem disruption and failure to adapt increase disaster risks. One teacher explained that *“I integrate in our class discussion about the concept of extinction and teach them that it happens when organisms cannot cope with sudden environmental changes like deforestation or pollution”* (P4), while another added that *“I highlighted it conceptually that genetic variation allows species to adapt, but rapid changes can lead to population loss”* (P5). FGD participants affirmed that *“losing species can weaken ecosystems and increase disaster risks embedding these concepts in their class activities or in the discussion”* (FGD5) and that *“healthy ecosystems serve as protection against hazards”* (FGD6).

Human–environment and scenario-based integration further contextualize learning, as teachers use local examples and disaster scenarios to analyze ecosystem impacts. One participant shared, *“I use local examples of deforestation and flooding so students can see how human actions increase disaster risks like kaingin”* (P8), while another noted, *“I give scenarios like forest fires and ask which species might survive or go extinct”* (P9). FGD responses support this, stating that *“scenario-based activities help students apply ecological concepts to real-life situations”* (FGD10).

Furthermore, sustainability, inquiry-based, and community-based approaches reinforce environmental stewardship and resilience. Teachers emphasized that *“during class discussion I highlighted that protecting biodiversity can reduce disaster risks”* (P13), while students engage in investigations and community projects, supported by FGD findings that *“students participate in activities that promote environmental protection and disaster awareness in our school like tree planting and clean up drive,”* (FGD15).

Document analysis of Daily Lesson Logs (DLLs) further supports these findings, showing integration of ecosystem conservation and biodiversity concepts (BCSP, 2021) However, while integration is evident, it is often implicit, indicating a gap between instructional practices and explicit DRRR planning. (Abregana, 2025) Overall, triangulated data confirm that biodiversity education strengthens disaster resilience by highlighting the protective role of healthy ecosystems. (Philippines, 2021) (Philippines, 2021)

DRRR Integration in Ecosystem Processes

DRRR Concept	Integration Approach	Key Integration Focus	Strategies Used
Environmental hazards and ecosystem processes	Hazard–ecosystem integration	Explains how disasters (e.g., droughts, floods, eruptions) disrupt photosynthesis and respiration	Contextualized discussion, questioning, multimedia
Food security and ecosystem stability	Food system integration	Links photosynthesis to food production and survival during disasters	Case studies, food chain diagrams, discussions
Environmental degradation and climate change	Human–environment interaction integration	Connects human activities with disruption of ecosystem balance	Local examples, climate discussions, infographics
Ecosystem disruption during disasters	Scenario-based integration	Analyzes effects of hazards on photosynthesis, respiration, and survival	Scenario analysis, problem-solving, case studies
Conservation for disaster risk reduction	Sustainability integration	Highlights role of plants in climate regulation and risk reduction	Campaigns, project-based learning, conservation planning
Community environmental awareness	Community-based integration	Links ecosystem protection with disaster-resilient communities	Group research, community activities, presentations
Environmental factors affecting processes	Inquiry-based integration	Investigates how environmental changes influence photosynthesis and respiration	Experiments, plant investigations, collaborative inquiry

Table 5. Ecosystem: Life Energy

Analysis of interviews, focus group discussions (FGDs), and documents revealed an ecosystem-process DRRR integration in the competency **S9LT-Ig-j-31** on Ecosystem: Life Energy highlighting photosynthesis and respiration, where teachers connect biological processes with environmental hazards, climate change, and sustainability (Disaster Risk Reduction in School Curricula: Case Studies from Thirty Countries, 2024). Teachers emphasized that understanding these processes helps students recognize their role in oxygen supply, food production, and ecosystem stability during disasters (Mendoza, 2025). One participant noted, *“I connect photosynthesis and respiration to disasters like droughts and floods because these affect plant growth and food production in our lesson”* (P1), while another added that *“when disasters damage crops or forests, photosynthesis decreases and affects the entire ecosystem”* (P2). This is supported by FGD findings stating that *“students realize that when plants are damaged, oxygen production and food supply are also affected”* (FGD2).

Hazard–ecosystem, food security, and human–environment integration highlight how environmental degradation disrupts ecosystem processes and increases disaster risks (Bernal & Apdohan, 2022). One teacher explained, *“I let my students analyze how drought reduces photosynthesis and affects crop yields”* (P5), while another shared, *“I use local examples of deforestation and pollution so students see how these affects plant processes”* (P8). FGD participants affirmed that *“photosynthesis is directly connected to food security during disasters and I let my students process this idea by asking high ordered questions”* (FGD4) and that *“human activities disrupt ecosystems and increase disaster risks”* (FGD5).

Scenario-based and sustainability integration further contextualize learning and promote resilience (Abregana, 2025). Teachers use disaster scenarios, as one noted, *“I present situations like volcanic eruptions or forest fires and ask how these affect plant life and oxygen production”* (P9), while also emphasizing conservation, with another stating that *“protecting forests helps reduce disasters and I let my students to do simple eco-rehabilitation plan”* (P13). FGD responses support this, noting that *“students apply their understanding of photosynthesis to real-life disaster situations”* (FGD8) and that *“protecting ecosystems reduces disaster risks”* (FGD9).

Furthermore, inquiry-based, experiential, and community-based approaches deepen engagement through investigations and real-world applications (Villarojo & Floro, 2024). One participant shared that *“I let my students conduct investigations on how environmental factors affect photosynthesis”* (P17), supported by FGD findings that *“experiments and group work help students understand how plants respond to environmental stress”* (FGD13).

Document analysis of Daily Lesson Logs (DLLs) further supports these findings, showing strong emphasis on environmental risk, biodiversity, and ecosystem protection. However, integration is often implicit, indicating a gap between instructional practice and explicit DRRR planning (Abregana, 2025). Overall, triangulated data confirm that understanding ecosystem processes strengthens disaster resilience by highlighting the protective role of healthy and sustainable environments. (Cabilao-Valencia et al., 2019.)

Synthesis of Findings

The findings revealed that DRRR concepts are effectively integrated across Grade 9 Life Science competencies through health, lifestyle, genetics, biodiversity, and ecosystem perspectives, highlighting themes such as health vulnerability, environmental hazards, adaptation, sustainability, and community resilience. Teachers employ diverse pedagogical approaches—including health-hazard, environmental, scenario-based, inquiry-based, community-based, and reflective strategies—to connect scientific concepts with real-life disaster contexts. These approaches enhance students’ understanding of how biological processes, lifestyle choices, and ecosystem changes influence disaster risks and survival. Across all competencies, inquiry-based and contextualized learning strategies promote critical thinking, awareness, and application of disaster preparedness. However, document analysis consistently reveals that DRRR integration remains largely implicit in Daily Lesson Logs, indicating a gap between classroom practices and explicit instructional planning.

CONCLUSION

The study concludes that Disaster Readiness and Risk Reduction (DRRR) concepts are consistently integrated across Grade 9 Life Science competencies, including respiratory and circulatory systems, lifestyle and health, heredity, biodiversity and evolution, and ecosystem processes. These integrations highlight key concepts such as health vulnerability, environmental hazards, ecosystem resilience, food security, sustainability, and community preparedness, helping students understand how biological processes and environmental changes influence disaster risks and survival. Teachers employ diverse, student-centered pedagogical approaches—such as health-hazard, environmental, scenario-based, inquiry-based, community-based, and reflective strategies—using contextualized discussions, real-life examples, simulations, experiments, and community projects to enhance learning. These approaches foster critical thinking, problem-solving, and disaster awareness while strengthening students’ understanding of resilience. However, integration remains largely implicit in instructional planning. Developing structured teaching guides can enhance explicit integration and improve students’ preparedness, resilience, and decision-making skills in disaster situations.

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