



Development of Disaster Readiness and Risk Reduction Lessons: The Lens of the Bicol Region

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Abstract: The Bicol Region in the Philippines is highly vulnerable to various natural hazards, including typhoons, volcanic eruptions, and earthquakes. To mitigate these risks, it is essential to integrate disaster risk reduction and management (DRRM) into various aspects of life, including education and other key areas of concern. This study aimed to develop and validate lessons for Disaster Readiness and Risk Reduction (DRRR) for Senior High School Science, Technology, Engineering, and Mathematics (SHS-STEM) students in the Bicol region. Lessons were designed to address the unique hazards and vulnerabilities of the area, focusing on community-based DRRM and policies related to RA-10121. The study employed a developmental design and a mixed-methods approach, combining both qualitative and quantitative methods to gather insights from key stakeholders and validate the developed lesson. The results of the validation process showed that the lessons were well-received and effective in promoting disaster readiness and risk reduction among local communities. The lessons were found to be well-suited for the cognitive level and learning needs of senior high school STEM students. They effectively incorporated essential DRRM concepts, emphasizing community involvement and legal frameworks. The study highlights the importance of involving local communities in DRRM efforts, ensuring that DRRM initiatives are culturally sensitive and effective. The developed lessons can contribute to improving disaster preparedness and resilience among students and their communities. It provides a valuable model for enhancing community resilience and reducing disaster risk, which can be scaled up and replicated in other regions. The findings of this study have significant implications for DRRM in the Philippines, emphasizing the need for comprehensive and well-designed DRRR education for students, particularly in the context of STEM education.

Keywords: *disaster preparedness, lesson development, natural hazards*

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Introduction

Integrating STEM education into DRR is crucial for equipping learners with the scientific knowledge, technical skills, and problem-solving abilities needed to understand, prepare for, and respond to disasters. STEM education helps students understand the scientific principles underlying natural hazards, including weather patterns, earthquakes, storm surges, typhoons, volcanic eruptions, and flash floods, which are crucial for developing effective risk assessment and mitigation strategies. With this integration, we can ensure that students are not only aware of risks but also capable of applying scientific reasoning and technological solutions to real-world disaster scenarios. Disaster risk reduction and management (DRRM) is a vital part of ensuring the safety and well-being of communities worldwide. The Bicol Region in the Philippines is especially vulnerable to various natural hazards, including typhoons, volcanic eruptions, lahar flows, floods, landslides, earthquakes, and droughts (Mascariñas et al., 2013). These hazards pose significant threats to the lives and livelihoods of the region's residents, especially those in the agricultural sector, which is often the most vulnerable to natural disasters.

To effectively reduce these risks, it is essential to incorporate disaster risk reduction (DRR) into various aspects of life, including education. The Department of Education Senior High School Teaching Guide highlights the multifaceted nature of DRR, which involves biological, geological, socioeconomic, political, sociocultural, and economic factors. This topic is increasingly important to society because it directly affects people's daily lives in their living environments. The Department of Education encourages teachers to incorporate DRRM concepts into their teaching, especially in science subjects. The government has also implemented measures to strengthen the DRRM system, such as the Philippine DRRM Act of 2010 (Republic Act 10121), which established the National DRRM Plan (DRRM

ACT of 2010). Additionally, the Commission on Higher Education has required the inclusion of DRRM in the curricula for freshmen students enrolled in the Civic Welfare Training Service (CWTS). The specific learning outcomes for CWTS focus on understanding disaster management concepts and principles, identifying hazards and disasters affecting the Philippines, and internalizing the principles and components of disaster preparedness.

Despite personal encounters with disaster and the importance of DRR, the Department of Education Region V has faced challenges in developing lessons that are tailored to the region's specific needs. The Bicol region constantly experiences the direct impact of typhoons, especially along the Pacific Ocean, including Sorsogon, Albay, and Catanduanes, as well as the eastern portions of Camarines Sur and Camarines Norte. Volcanic eruptions are also present due to Mt. Mayon in Albay and Mt. Bulusan in Sorsogon. Additionally, earthquakes occur in Masbate because of active fault lines, while Camarines Sur, Camarines Norte, Albay, Sorsogon, and Catanduanes are susceptible to landslides. To address these challenges, it is crucial to develop and validate lessons on disaster risk readiness and reduction that are explicitly for Grade 12 STEM students at the Bicol University College of Education Integrated Laboratory School (BUCEILS) High School Department, as all six provinces in the Bicol region are well represented in this class. This will enable students to gain a deeper understanding of the region's unique hazards and develop the necessary skills to mitigate these risks. BUCEILS served as the pilot implementation of the lessons and can be extended to other senior high schools in the Bicol region.

DRR in Education

Several studies have highlighted the importance of integrating DRR into school curricula. For instance, Regala (2014) conducted a study on the integration of DRR in school curricula in selected secondary schools in Legazpi City Division and found that this approach can enhance students' knowledge and preparedness for disasters. Another study (Tan, 2019) assessed the disaster preparedness of national high schools and emphasized the need for effective DRR strategies to be integrated into school curricula. A study conducted by Ongtangco et al. (2016) examined the perspectives of University of Santo Tomas NSTP facilitators on disability and their experiences in teaching DRRM. The study revealed that making DRRM disability-inclusive remains a challenge due to various factors.

In another study, Proulx and Abuoud (2019) examined the short-term effects of a preschool-based DRR program in rural Indonesia. The study found that the intervention in DRR yields positive results, including an improvement in the quality of the learning environment in preschool and an increase in reading, writing, and arithmetic skills. This suggests that incorporating DRR principles into early childhood education can have long-term benefits. The literature indicates that DRR education must be taken seriously by stakeholders, both in the academy and in the community. Integrating and embracing DRR education in all aspects of life can lead to a culture of safety in the community. Parents would not be worried about their children during school days if students were well-educated in terms of DRRM.

Local DRR Practices

The Philippines is a disaster-prone country, experiencing frequent occurrences of natural disasters, including typhoons, earthquakes, and volcanic eruptions. The Mamanwa indigenous peoples in Basey, Samar, have a rich local-indigenous knowledge and practices that can be valuable in DRRM. Cuaton and Su (2020) conducted a study that cross-examined the local and indigenous knowledge and practices of the Mamanwa indigenous peoples following the devastation of Super Typhoon Yolanda in the Philippines in 2013. The study found that the elderly Mamanwa were assured to pass their local indigenous knowledge to the next generation in the community, highlighting the importance of preserving and integrating local knowledge into DRR state policies.

In the province of Albay, several climatic and geological hazards are present due to its geographical location. Naz et al. (2019) identified six strategies for achieving effective DRRM, including making DRRM a goal, strictly ordering policies, establishing institutions, allocating sufficient budget, consistently implementing programs and projects, and building harmonious partnerships with stakeholders. These strategies can be applied to other disaster-prone areas. Furthermore, the COVID-19 pandemic has highlighted the importance of biological hazards in DRRM. This local and worldwide experience in biological hazards is a good baseline for developing DRR skills in mitigating biological hazards.

In a different context, Yadav et al. (2021) suggested that transformative social change requires a transformative vision. They emphasized the need to report and address biases and problems in DRR policies and practices to achieve a more inclusive and equitable future. Internationally, there are also initiatives to mainstream disaster risk reduction into agriculture, as seen in a case study from the Bicol Region, which aimed to strengthen capacities for climate risk management and disaster preparedness in selected provinces of the Philippines.

Several studies have been conducted on DRRM, focusing on various aspects, such as gender in DRR in Nepal (Yadav et al., 2021), DRR in NSTP for people with disabilities in the Philippines (Ongtangco et al., 2016), and local-indigenous knowledge in times of disaster (Cuaton & Su, 2020). However, there is a gap in research on DRRM used in the Science, Technology, and Society course. This study aims to bridge this gap by examining the integration of DRRM into the STS subjects in the context of the Bicol Region.

Research Questions

To address the gap, this study focused on the development and validation of lessons for Disaster Readiness and Risk Reduction (DRRR) for senior high school STEM students at the Bicol University College of Education Integrated Laboratory School, identifying specific learning outcomes in DRRR.

- (1) What lessons in DRRR can be developed and validated by experts from different fields?
- (2) What are the localized contexts used in the lessons as observed by experts?

Methodology

Research Design

The study employed pure developmental research on lesson development. Essentially, this research began with an analysis of needs assessments conducted in terms of content, the level of critical content, and local context to be used. It was followed by designing, which involves defining the learning objectives, activities, and assessments to be used. While the development focuses on crafting the lesson in DRRR, validation by experts was conducted immediately. A quantitative rating was provided, while experts' opinions served as a qualitative aspect. After integrating the comments and suggestions of experts, the revised lessons were returned to the pool of experts for their approval.

Data Collection

The study used a three-phase method to develop and validate DRRR lessons for senior high school teachers in the Bicol region.

Phase 1: Consultative Meeting. A focus group discussion was held to identify needs in DRRR with senior high school coordinators and education program supervisors in science from selected schools in the Bicol region. This meeting aimed to gather insights from key stakeholders to pinpoint current challenges and gaps in the DRRR subject. The findings from this meeting served as the basis for developing lessons that would address these gaps and challenges, ultimately improving the effectiveness of the DRRR module.

Phase 2: Development of Lessons. The development of lessons was guided by learning competencies provided by the Department of Education Central Office. The existing modules from DepEd Region V served as the basis for the content. This ensured that the developed lessons aligned with the national educational standards and incorporated relevant local context. Additionally, interviews and focus group discussions were conducted with local officials, residents, senior citizens, and experts to document their personal experiences with specific disasters.

Phase 3: Validation. Two sets of experts validated the developed lessons.

1. *Expert validators.* A pool of specialists from various fields reviewed the lessons, including two volcanologists from PHIVOLCS and the United States Geological Survey, heads of three fire stations (BFP), three municipal and one provincial DRRM coordinators, two biological disease experts, two doctors from DOH, five biologists, two nurses, six community development experts, two officials from the Department of National Defense, three weather forecasters, and two economists. A total of 34 content experts validated the content of the developed modules. This diverse group of experts provided a thorough review of the lessons from different perspectives.
2. *Curriculum writers and experienced teachers.* A second group of validators included 10 DepEd teachers who have been teaching DRRR since 2018 and three authors of the DepEd DRRR module. This group provided feedback on the practicality and effectiveness of the lessons from the perspective of educators with experience teaching the subject. All feasible suggestions and recommendations were incorporated into the developed lessons.

Instruments

The main instrument used in conducting this study was the juror's/expert's rating sheet. The first part includes the profile of jurors, requesting their names, evaluator, workstation, and educational attainment to determine their expertise. The second part focuses on evaluating the consistency of objectives, activities, assessments, content accuracy, clarity, and appropriateness. It assesses the alignment of each objective, activity, and evaluation with the specified learning competencies. Each statement is followed by a five-point Likert scale with quantitative and adjectival descriptions ranging from 1 for not evident, 2 for slightly evident, 3 for moderately evident, 4 for evident, and 5 for highly evident. The instrument also includes indicators for cognitive appropriateness, alignment with learning goals, conceptual correctness, data accuracy, comprehensibility, and test length. Experts and jurors provided comments and suggestions for refining the developed lessons. The tool was created by the researcher, drawing on ideas from previous research, adapting certain items, and modifying others. It was validated by a panel of jurors from different state universities in the Bicol region before being used in the study. After validation, this tool was pilot-tested on graduate students from Bicol University pursuing an MA in General Science Education.

Ethical Consideration

All participants provided informed consent before participating in the study. Additionally, the university's ethics committee reviewed the study's conduct. Personal data were anonymized to protect evaluators' identities during analysis and reporting.

Results and Discussion

DRRR Lesson Development and Validation

The development and validation of disaster readiness and risk reduction lessons in the Bicol region were vital steps in strengthening the resilience of local communities to disasters. The lessons, which were tailored to the region's specific context, aimed to equip students and residents with the essential knowledge, skills, and strategies to mitigate the impact of disasters. These lessons were created using a participatory approach that involved local stakeholders and experts in the DRRM process. This ensured that the lessons were relevant, practical, and culturally sensitive to the local population's needs and experiences. Table 1 presents the numerical validation results of experts in the developed lessons for Disaster Readiness and Risk Reduction (DRRR) for senior high school STEM students. The experts evaluated the lessons based on four criteria: consistency among objectives, activities, and assessment (A); content and content accuracy (B); clarity (C); and appropriateness (D).

Table 1: Numerical Validation Result of Experts in the Developed Lessons in DRRR

	Lesson Title	A	B	C	D
1	Basic Concept of Disaster and Disaster Risk	4.50	5.00	4.50	5.00
2	Exposure and Vulnerability	5.00	5.00	5.00	5.00
3	Basic Concept of Hazards	5.00	5.00	4.00	4.50
4	Earthquake Hazards	5.00	5.00	5.00	5.00
5	Volcanic Hazards	5.00	5.00	4.00	5.00
6	Geologic (Landslide) Hazards	5.00	5.00	5.00	5.00
7	Hydrometeorological Hazards	5.00	5.00	4.50	5.00
8	Fire Hazards	5.00	5.00	4.50	4.50
9	Biological Hazards	5.00	5.00	5.00	5.00
10	Community-based DRRM	5.00	5.00	5.00	5.00
11	Policies of DRRM-RA-10121	4.50	4.50	4.50	5.00
		5.00	5.00	4.50	5.00

The results show that experts generally found the lessons to be well-designed and suitable for teaching DRRR concepts. Three criteria received a median score of 5.00 for (A) consistency among objectives, activities, and assessment; (B) content and content accuracy; and (D) appropriateness. Meanwhile, (C) clarity received a median score of 4.50. This indicates that all 11 developed and validated DRRR lessons are considered acceptable by experts in the relevant field and by teachers. Among the 11 lessons, five received a perfect median score of 5.00. These are (L2) Exposure and Vulnerability, (L4) Earthquake Hazards, (L6) Geologic (Landslide) Hazards, (L9) Biological Hazards, and (L10) Community-based DRRM. These lessons earned perfect scores across all four criteria, showing that experts found them to be highly consistent, accurate, clear, and suitable for the target audience. This is reflected in comments from evaluators for L6: "*The use of hazard events will aid teachers to actually incorporate them into their lessons,*" given that the Bicol region is rich in geological processes and hazards. For L9, evaluators noted, "*Subtopics on*

epidemic, pandemic, and endemic are very essential here in the Bicol Region.” At the same time, for L10, they suggested, “Deepen the discussion on initiatives in the four thematic areas, emphasizing prevention and mitigation through drills, capacity-building, and simulation.” Let the students analyze the local DRRM using the BDRRM plans.” Validators aimed to recommend ways to make the lessons more meaningful to students’ learning experiences.

The inclusion of community-based DRRM and policies related to RA-10121 highlights the importance of community participation and the legal framework for disaster management. This knowledge is vital for students to understand their roles and responsibilities in disaster preparedness and response. The province of Albay has consistently received awards for its disaster preparedness and mitigation efforts. Specifically, its early warning system and efficient evacuation plans, known as the “zero casualty” approach, have been recognized as a model for international best practices, as highlighted by the United Cities and Local Governments (UCLG Peer Learning, 2018). In neighboring Indonesia, during a disaster, immediate family members help each other survive by providing shelter and food (Wannewitz & Garschagen, 2024). The high scores for clarity and appropriateness indicate that the lessons are well-suited to the cognitive level and learning needs of senior high school students in STEM. The lessons are presented in a way that is easy for students to understand and engage with, which is crucial for effective learning. The results also suggest that the developed lessons align well among objectives, activities, and assessments, ensuring students grasp the concepts and can apply them effectively. The high scores for content and content accuracy indicate that the lessons are precise and current, which is essential for teaching DRRR concepts.

The validation results presented in Table 1 are related to earlier research on disaster readiness and risk reduction education. Many studies have highlighted the importance of thorough and well-structured DRRR education for students, especially within STEM education. For example, Masocha et al. (2024) emphasize the importance of integrating disaster risk reduction into school curricula, encompassing both theoretical knowledge and practical skills. This matches the comprehensive approach in the developed lessons, which address multiple hazards and stress community-based DRRM and policies. Abenir et al. (2022) underline the value of community-focused DRRM leadership for small communities and the role of education in building disaster resilience. The high scores for lessons 10 and 11, which focus on community-based DRRM and policies related to RA-10121, indicate that the lessons successfully integrate these concepts.

The study of Stewart (2024) emphasizes the effectiveness and importance of clear and concise communication in DRR education, which is reflected in the high scores for clarity and appropriateness in Table 1. Additionally, the high scores for criterion A in Table 1 suggest that the developed lessons are well-designed and effective in teaching DRRR concepts. It also highlights the importance of consistency among objectives, activities, and assessment in DRR education. Incorporating the context of DRR in STEM education is very important to empower students to prepare for and respond to upcoming disasters. Mafimisebi and Thorne (2017) studied lessons from past disasters to strategize DRR principles and make them actionable within organizational contexts to combat natural disasters. Additionally, community-based disaster risk reduction can motivate children to participate in community activities and empower local adults to implement local DRR actions. By equipping young people, we can safeguard the next generation (Sakurai & Ito, 2022).

Localized Context Used in the Lessons as Observed by Experts

Table 2 provides a detailed overview of experts’ observations and practices regarding various aspects of DRRM, with a focus on local context and community-based approaches. The experts observed multiple events of disasters and related risks in the Bicol Region, including the impact of Typhoon Nina in Virac, Catanduanes, in December 2016, and the use of Doppler radars by the PAGASA in Baras, Catanduanes. They also reviewed the situation report of Typhoon Rolly in November 2020 in the areas of Bato, Catanduanes, and Tiwi, Albay, along with damage assessment reports from Guinobatan, Albay, and the municipalities of Pasacao, Bombon, Magarao, and Calabanga in Camarines Sur. Additionally, they observed the status of St. John the Baptist Parish Church in Tabaco City. Collectively, these observations highlight the recurring nature of disasters in the Bicol region.

The experts also observed cases of exposure and vulnerability, such as the aftermath of Typhoon Tisoy, which toppled electric posts and trucks in Guinobatan, Albay, in December 2019. They noted the Guinsaugon Landslide in Southern Leyte in 2006 and the physical condition of St. John the Baptist Parish Church in Tabaco City after Super Typhoon Rolly hit Albay in 2020. After a destructive cyclone in New Zealand, Fijian housing structures were found to be vulnerable due to design and construction weaknesses (Aquino et al., 2019). For safety, communities can be encouraged to raise awareness about cyclone-proofing techniques and available technologies. Similar to the Philippines, which is prone to typhoons, having experienced Typhoon Haiyan in 2013 (Ravina & Shi, 2017), a

transitional shelter prototype was developed using locally available materials and found to be the most socially sustainable transitional shelter in the Philippines.

Table 2: Observations of Experts and Jurors in the Developed Lessons in DRRR

Lesson Title	
Basic Concept of Disaster and Disaster Risk	<ul style="list-style-type: none"> The wrath of Typhoon Nina in Virac, Catanduanes, December 2016 The Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) for instance have utilized doppler radars in Baras, Catanduanes, and other areas of the country. Situation report of Typhoon Rolly in November 2020 within the vicinity of Bato, Catanduanes and Tiwi, Albay. Damage assessment reports in Guinobatan, Albay, and the municipalities of Pasacao, Bombon, Magarao, Calabanga in Camarines Sur. Situation of St. John the Baptiste Parish Church of Tabaco City The aftermath of Typhoon Tisoy. Toppled electric post and a toppled truck in Guinobatan, Albay, on December, 2019.
Exposure and Vulnerability	<ul style="list-style-type: none"> Guinsaugon Landslide (2006) in Southern Leyte Physical structure of St. John the Baptiste Parish Church of Tabaco City after super typhoon Rolly hit Albay last 2020 A young girl from Maynonong Village in Tiwi, Albay laying out salvaged books on the ground hoping they would get dry enough for use.
Basic Concept of Hazards	<ul style="list-style-type: none"> Residents of the town of Camalig in the province of Albay evacuated due to the possible eruption of Mayon Volcano. Fire incident at Brgy. Homapon, Legazpi City, Albay involving many stores near the church. Landslide that happen in San Roque, Malilipot Albay due to the super typhoon Rolly causing the road connecting to Calbayog to be ruined. Providing examples of earthquake in Cataingan, Masbate on August 2020. Chronological earthquake events in Masbate City and Masbate Province.
Earthquake Hazards	<ul style="list-style-type: none"> Situation of Batauan, Masbate during earthquake in February 2023. For the international context, hundreds of students died in Mexico City during earthquake on September 2017. Earthquake that happened in Syria-Turkey last 2023. Hyatt Terraces Hotel in Baguio City collapsed during the 16 July 1990 Luzon Earthquake. Albay's Mayon volcano violently spewing incandescent lava on June 2023.
Volcanic Hazards	<ul style="list-style-type: none"> Situation in Juban, Sorsogon as the effects of Sorsogon's Mt. Bulusan's eruption on June 5, 2022. On May 7, 2013 five foreign national were killed and seven are injured because of the instant small phreatic event of Mayon Volcano. Introducing the Volcanic Info Ph to the students. Discussing on how to interpret the volcanic hazard map. Showing the landslide incidents in Tiwi, Albay – Sagñay, Patitinan, Camarines Sur Road and Brgy. Patitinan. Landslides Sto. Domingo Albay, Sitio Sohoton, Calayucay to Salvacion Road.
Geologic (Landslide) Hazards	<ul style="list-style-type: none"> Catanduanes, Barangay Puraran, Baras landslide and Summit, Viga highway landslide that causes traffic. Sorsogon Province landslide to the selected municipalities. Massive landslide at Brgy. San Roque, Malilipot, Albay Mudflow in Guinobatan, Albay Teaching the students on how to interpret the geologic hazard maps. Super Typhoon Rolly (International Name: Goni) hits Bato, Catanduanes in October, 2020. Discussing the Modified Tropical Cyclone Category Introducing the Storm-surged color coded warning system. Introducing the Project NOAH of DOST.
Hydrometeorological Hazards	<ul style="list-style-type: none"> Flood waters near the San Fernando-Milaor Boundary during the 2011 Typhoon Bebang A house in Libon, Albay submerged under 1 meter deep flood waters. Houses along shoreline swept by storm surge during the May 2004 Typhoon Dindo in Sioron, Gigmoto, Catanduanes. Storm surge In Brgy. Bulabog, Sorsogon City during the 2006 Typhoon Milenyo. destroyed and flooded houses after super Typhoon Rolly/Goni hit the town of Malinao, Albay on November 2020. Remembering the super typhoon reming in November 30, 2006 that hits Albay Province. Understanding the hydrometeorologicval situation in Bicol Region specially the Bicol river. Integration of fire incident at Bicol University Tabaco Campus burning one of its Marcos Type Building last August 7, 2021 surroundings observation – classroom, school premise, or home –of areas where potential fire hazards are present. Teaching the students on how to stop the fire using household stuffs.
Fire Hazards	<ul style="list-style-type: none"> Instructions in proper using the fire extinguisher. Fire Incident from an apartment at Tigaon, Camarines Sur in 2023. Fire Incident Brgy. 18 Cabangan West Legazpi City, Albay in December 2023. Basic Response Procedures to Fires. Introducing fire drill Remembering the cause and effects of COVID-19 in the Philippines and Bicol region. Discussing the types of pathogens and how it spreads.
Biological Hazards	<ul style="list-style-type: none"> Providing the differences of Endemic, Epidemic, & Pandemic Graphical representation of COVID-19 cases and daily deaths in the Philippines from February 15, 2020 to November 26, 2023. Scientific and local efforts in combatting COVID-19 in the Philippines and in Bicol Region. Describing the good and bad practices in handling biological hazards. Strengthening the Community-based DRRM as the spirit <i>bayanihan</i>. Discussion of Disaster and Mitigation actions of DOST, DILG, DSWD and NEDA. Providing best practices of South East Asian Nations for the community-based DRRM.
Community-based DRRM	<ul style="list-style-type: none"> Good Practices for DRR in the Bicol Region. Highlighting the emergency preparedness monitoring and example of community preparedness plan. Importance of early warning systems and examples. A must-have emergency kit. Philippines' Disaster Risk Reduction Laws and Policies
Policies of DRRM-RA-10121	<ul style="list-style-type: none"> Global Policy Frameworks in DRR Structure and Functions of the National Disaster Risk Reduction and Management Council The National DRRM Framework (NDRRMF) Providing local examples in the Bicol Region.

Furthermore, the experts identified various hazards, such as earthquakes, volcanic eruptions, geomorphic hazards, hydrometeorological hazards, fire hazards, and biological hazards. For example, they referenced the earthquake in Cataingan, Masbate, in August 2020, and the Mayon Volcano eruption in Albay in June 2023. They also observed landslides in Tiwi, Albay, and a mudflow in Guinobatan, Albay. Additionally, they discussed hydrometeorological hazards, including Super Typhoon Rolly, which struck Bato, Catanduanes, in October 2020, and the flooding near the San Fernando-Milaor Boundary during Typhoon Bebang in 2011. Examining land use after a disaster could reduce hazards in the affected area. As Uy et al. (2017) discuss the landslide disaster at Guinsaugon, Leyte, and its implications for land-use policy, they specifically emphasize the need to revisit land-use policies and the importance of risk-sensitive land-use planning and public participation in such planning after a disaster.

The experts also highlighted the importance of community-based DRRM, emphasizing the spirit of *bayanihan* and the role of various government agencies, such as DOST, DOH, DILG, DSWD, and NEDA, in disaster mitigation and response. They provided best practices from Southeast Asian nations and highlighted the importance of early warning systems and emergency preparedness. *Bayanihan* is essential in the context of disasters, especially during the surge of the COVID-19 pandemic, when several families in the Philippines were hesitant to get vaccinated. Kimhi et al. (2022) find that high family income in Israel is negatively associated with vaccine hesitancy, and public attitudes towards vaccines are influenced by trust in leadership.

Finally, the experts discussed policies related to DRRM, including the Philippines' Disaster Risk Reduction Laws and policies, global policy frameworks, and the structure and functions of the National Disaster Risk Reduction and Management Council. They also provided local examples from the Bicol Region, highlighting the importance of effective policies and frameworks in mitigating and managing disasters. Communities that are highly exposed to disasters tend to have a deeper understanding and perception of DRR (Imperiale & Vanclay, 2021). The government's financial problems consistently increase due to aid provided to people affected by natural disasters (Rautela, 2018). The validation results show that the developed lessons for DRRR are well-designed, comprehensive, and suitable for teaching senior high school students in STEM. The classes cover essential DRR concepts, emphasize community involvement and legal frameworks, and are presented clearly and appropriately. These lessons can help improve disaster preparedness and resilience among students and their communities.

The developed Disaster Readiness and Risk Reduction module appears comprehensive, covering a wide range of aspects related to disaster risk management. However, there are some potential gaps and areas for improvement: The module mainly focuses on individual learners and does not explicitly highlight the importance of community engagement in disaster risk reduction. Adding community-based activities and involving local stakeholders could boost the module's effectiveness. While the module offers some theoretical concepts and definitions, it lacks practical applications and case studies that help learners better understand and relate to the concepts. Including real-life examples and scenarios could make the module more engaging and relevant. The module does not clearly explain how it can be integrated with existing curriculum frameworks and standards. Providing straightforward guidelines on how to incorporate DRRR into current subjects and courses could improve its adoption and implementation. The module also does not explicitly emphasize the development of 21st-century skills such as critical thinking, problem-solving, and collaboration. Adding activities that foster these skills could enhance the module's overall impact (School DRRM Manual). Additionally, the existing modules from DepEd V need to be updated to include recent disasters in the Bicol Region.

Conclusion and Recommendations

The development and validation of disaster readiness and risk reduction lessons in the Bicol region have significant implications for disaster risk management in the Philippines. The assessment was carried out through a series of interviews, focus group discussions, and surveys involving residents, community leaders, experts, and DRRM officials. The validation process results indicated that the lessons were well-received and effective in promoting disaster readiness and risk reduction among local communities. Specifically, the lessons were ready to be implemented. They can lead to improved community awareness and understanding of disaster risks, enhanced preparedness and response capabilities, and greater adoption of disaster-resilient practices.

Furthermore, the validation of the lessons involved a comprehensive assessment of reducing disaster risk and enhancing community resilience. The lessons can be scaled up and replicated in other regions, providing a valuable model for improving community resilience and decreasing disaster risk. It can serve as a best practice for involving local stakeholders in the DRRM process, ensuring that disaster risk reduction efforts are culturally sensitive and effective in addressing the specific needs of local communities. This study is limited to the local context of the Bicol region concerning typhoons and storm surges, earthquakes, landslides, volcanic eruptions, floods, and other related

hazards. What the region experienced might be similar to what other areas of the Philippines face. However, selected disaster examples may be updated to reflect recent situations, making them more relevant to learners and the community.

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Use of AI Declaration

Perplexity AI was used to enhance the writing style of the paper.

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