Multidisciplinary Collaboration and Industry Partnership: Keys for the Development of the Masters of Geomatics in Disaster Risk Reduction Curriculum

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Abstract

Despite the high susceptibility of the Philippines to natural disasters, there is a significant lack of human resources focused on disaster risk reduction (DRR). To address this, the University of the Cordilleras, in collaboration with the ERASMUS CBHE Plus Program: Geomatics in Disaster Risk Reduction of the European Union, has developed a curriculum for a GeoDRR program. This program is designed to produce professionals with expertise in disaster risk reduction, geomatics, and remote sensing. The curriculum development employed a mixed-methods approach using the ADDIE (Analyze, Design, Develop, Implement, Evaluate) Framework and the DACUM (Developing a Curriculum) method. The ADDIE Framework guided the structured development process, while the DACUM method identified the necessary competencies for students. The resulting UC MGeoDRR curriculum comprises 15 units of Core Courses, 15 units of Professional Courses, 9 units of Electives, and a 6-unit Capstone project. The curriculum is designed to be localized and contextually relevant, integrating DRR into research, innovation, and extension activities. The pilot program is recommended for graduates of related undergraduate programs and DRR professionals and practitioners.

1. Introduction

1.1. Background of the Study

Disasters cause disruptions, economic losses, and even death. Over the years, the world has experienced devastating impacts caused by both manmade catastrophes and natural calamities, ranging from tsunamis, earthquakes, pandemics, and accidents. These events not only leave destruction but also reveal challenges faced by different countries.

In the United States, disasters affect animal care services (Rowitt and Brown, 2022) and in Japan, mothers of young children with allergies are likely to worry about the effects of evacuation on their children (Yamazaki & Nakai, 2023). Meanwhile, in China, natural disasters have significantly worsened the incomes of impoverished households (Wang & Zhao, 2023).

In the Philippines, due to its geographic location in the Pacific Ring of Fire, it has experienced earthquakes and volcanic eruptions. In recent years, the country has experienced 18 destructive earthquakes (PHIVOLCS, 2018) among others, ranking third among 171 countries in 2016-2018 on the World Risk Index (Gabriel et al., 2021). However, given this fact, the Philippines has failed to spend government funds for disaster preparedness, mitigation, and response (Ranada, 2023). Furthermore, a shortage of human resources in disaster risk reduction management is a challenge to the Local Government Units (LGUs).

In response, various initiatives have been undertaken to strengthen the capacity of Local Government Units in disaster risk reduction and management. For instance, the DOST has requested that the LGU of Eastern Visayas adopt technical advancements, such as rainwater collection systems, emergency food stores, and flood early warning systems, to increase the region's resilience (Meniano, 2023).

To contribute to these growing initiatives, the University of the Cordilleras in the Philippines, being a collaborator in ERASMUS CBHE plus program: Geomatics in Disaster Risk Reduction of the European Union construct and recommend the pilot testing of an MGeoDRR Curriculum to improve human resource capacity to prepare for and manage disasters in the Philippines. The University of the Cordilleras is a member of the consortium with the lead Silesian University of Technology of Poland, University of Alicante of Spain, University of West Attica of Greece, Xavier University of the Philippines, Universiti Sains Malaysia, University Uttara Malaysia of Malaysia, and Svay Rieng University and University of Battambang of Cambodia. The proposed MGeoDRR program is assured to be at par with international standards and quality assured.

Creating and developing a curriculum on this is a breakthrough because research on how school curricula deal with DRR education and how teachers are trained to teach them is still limited (Kitagawa, 2023). Some countries with DRR content integrated into their education are Japan, Malaysia, and England. In Malaysia, its geography education curriculum for secondary schools has included natural disasters like tsunamis, floods, earthquakes, landslides, hurricanes, droughts, and volcanoes (Hawa et al., 2023). On the other hand, Kitagawa (2023) observed that England, or the English, has placed greater emphasis on the development of geographical abilities, whereas Japan has made more references to natural hazards, disaster prevention, and cultivating attitudes toward developing a local community.

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For the Philippines, the proposed MGeoDRR curriculum promises to increase the number of human resources with the essential knowledge and abilities in DRRM to respond to the needs of LGUs. Graduates of this program will be equipped to reduce the risk of disaster. This includes efforts like reducing disaster risks and looking into the root causes of the problem and vulnerability (Gabriel et al., 2021). Hence, it is said that education reduces disaster risk (Partini & Hidayaht, 2024).

Despite the high susceptibility of the Philippines to natural disasters, there is a notable scarcity of human resources specialized in disaster risk reduction (DRR). Existing educational programs inadequately prepare professionals with the necessary skills in geomatics, remote sensing, and disaster management. This gap in specialized training leaves local government units (LGUs) and communities vulnerable and underprepared for disaster response and mitigation. The proposed MGeoDRR curriculum seeks to close this crucial knowledge gap by creating a thorough, competency-based educational program that gives graduates the skills needed to manage and lower the risks of disasters, improving community preparedness and resilience in the Philippines.

The primary objective of the proposed MGeoDRR curriculum is to develop a comprehensive curriculum that equips students with the knowledge, skills, and attitude necessary to lead in disaster risk reduction and management (DRRM). Utilizing a mixed-methods research approach, the program's development follows the DACUM (Developing a Curriculum) in developing the MGeoDRR curriculum and the ADDIE (Analyze, Design, Develop, Implement, and Evaluate) framework to craft the individual courseware.

The MGeoDRR curriculum aims to significantly enhance the Philippines' human resource capacity in disaster risk reduction, ultimately contributing to more effective and sustainable disaster management practices nationwide.

1.2. Geomatics in Disaster Risk Reduction

Gomarasca (2010) has presented the basics of geomatics and its definition:

> Geomatics is defined as a systematic, multidisciplinary, integrated approach to selecting the instruments and the appropriate techniques for collecting, storing, integrating, modeling, analyzing, retrieving at will, transforming, displaying, and distributing spatially referenced data from different sources with well-defined accuracy characteristics and continuity in digital format. (p. 137)

Geomatics enhances disaster risk reduction by providing essential tools and techniques in disaster risk reduction efforts. Integration of spatial data and advanced analytical methods enables better approaches to planning and management of disasters and ultimately contributes to safer and more resilient communities.

A recent report from the UN Office for Disaster Risk Reduction (UNDRR) underscored the critical role of geomatics in mitigating disaster risks. It highlighted how technologies such as GIS and remote sensing can identify hazard-prone areas, assess vulnerable communities, and monitor the long-term effects of disasters. This allows policymakers to create effective disaster management plans and build stronger communities that can better withstand disasters (UNDRR, 2022). Chisty et al. (2022) further noted that the global framework for disaster risk reduction reinforced this point, highlighting the role of geomatics in empowering communities and mitigating disaster risks.

Recent studies emphasize the pivotal role of geomatics in reducing disaster risks. Munawar, Hammad, and Waller (2022) provided a comprehensive review of remote sensing for flood prediction, a key component of early warning systems and disaster preparedness. Similarly, Cui et al. (2022) emphasized the importance of geospatial technologies in addressing scientific challenges related to disaster risk reduction, particularly in evaluating and mitigating geological threats. By analyzing spatial data, authorities can identify areas prone to natural disasters such as floods, earthquakes, and landslides. This information is critical for developing early warning systems and planning mitigation strategies (Press, 2010).

Utilization of remote sensing and unmanned aerial vehicles for real-time environmental monitoring is critical in the development of early warning systems. These technologies provide timely data that can be used to alert communities and coordinate evacuations effectively (Rajabifard et al., 2020). Not only for monitoring but technologies of geomatics can also support disaster response operations by providing updated spatial data to assist in relief and rescue operations, damage assessments, and recovery planning of a locality.

As such, Uddin and Matin (2021) explored the benefits of geomatics in disaster risk reduction. Their research demonstrates how geospatial technology can be used to map hazard zones and assess the suitability of shelters. This approach provides valuable insights for mitigating disaster risks and improving preparedness. Moreover, Geomatics technologies are pivotal in conducting comprehensive risk assessments (Khadka et al, 2021). Peng and Zhang (2022) further demonstrated the practical applications of geomatics by showcasing how GIS combined with game theory can assess urban flood risks. Additionally, Lu et al. (2022) used geomatics to evaluate the spatial and temporal development of resilience in metropolitan clusters. Their study highlights the advantage of geomatics in assessing and strengthening urban resilience, a critical factor in disaster risk reduction.

Continuous monitoring of environmental changes through geomatics helps detect early signs of potential disasters, allowing for preemptive actions to be taken (Huang et al., 2023). Integrating geomatics into urban planning ensures the development of resilient infrastructure and the minimization of urban vulnerabilities to disasters (Ahmed, 2021).

Facts show the ever-present natural disasters, and that geomatics has been developed as a strong weapon against these natural disasters. Developing a complete tool case for risk estimation, disaster forecast, and management allows communities and policymakers to develop resistance and reduce the impact of disasters. Undertakings all point to geomatics as a game-changer in disaster risk reduction. Geomatics presents a complete approach to protecting communities and infrastructure. Moving forward, investing and advancing geomatic technologies hold the key to a safer future.

1.3. Integration of Disaster Risk Reduction in Education

Gokmenoglu, Yavuz, and Sensin (2023) provide a critical analysis of the incorporation of disaster risk reduction (DRR) education into Turkiye's curriculum, emphasizing its importance in cultivating a culture of safety and resilience among students in disaster-prone areas. Through content analysis of compulsory course textbooks, the research identifies a crucial need to enhance DRR-related content in early education, emphasizing the importance of viewing disasters as preventable through informed preparedness. Gokmenoglu, Yavuz, and Sensin (2023) further identified curriculum development in disasters as an essential research area. Furthermore, Scolobig and Balsiger (2024) identified learning opportunities and teaching capacities in higher education in DRR as key prerequisites for resilient communities.

In the context of Southeast Asian countries, the integration of DRR education into the curriculum is of paramount importance given the region's vulnerability to natural disasters such as typhoons, earthquakes, and floods. Although some countries, like Indonesia and Japan, have made strides in embedding DRR education into their school systems, there remains a need for broader implementation across the region. For instance, while the Philippines frequently faces natural calamities, the incorporation of DRR education into its curriculum has been limited, highlighting a critical area for development.

The integration of disaster education into nursing curricula is increasingly recognized as essential given the critical role nurses play in disaster response. Eid-Heberle and Burt (2022) emphasize that comprehensive disaster knowledge is vital for nurses across all disciplines, necessitating the inclusion of standalone disaster courses within nursing programs. These courses should integrate innovative teaching methods to ensure that nurses are fully equipped for all stages of disaster management: mitigation, preparedness, response, and recovery. Historical roots trace back to influential figures like Florence Nightingale and Clara Barton, underscoring the longstanding need for disaster preparedness in nursing practice.

Complementing this perspective, Ranse et al. (2022) highlight the paucity of standardized disaster-related content in undergraduate nursing curricula. Utilizing a Delphi study, their research identified key priority areas such as "disaster knowledge," "assessment and triage," "critical thinking," "technical skills," "mental wellbeing," and "teamwork in stressful situations." The findings advocate for embedding these topics either within existing units or as standalone courses, tailored to local contexts through various educational methods, including didactic approaches and simulation exercises.

While disaster risk reduction (DRR) education has been emphasized primarily within the nursing discipline, its benefits extend beyond healthcare and can be effectively implemented in other programs. Integrating DRR education into fields such as engineering, urban planning, public health, and environmental science can enhance the overall preparedness and resilience of communities. Educating professionals in these disciplines on disaster preparedness and response strategies equip them with the knowledge to mitigate risks, design resilient infrastructures, and implement effective disaster management plans. This interdisciplinary approach not only strengthens individual sectors but also fosters a more coordinated and comprehensive response to disasters, ultimately safeguarding lives and reducing the economic and social impacts of disasters.

1.4. Conceptual Framework

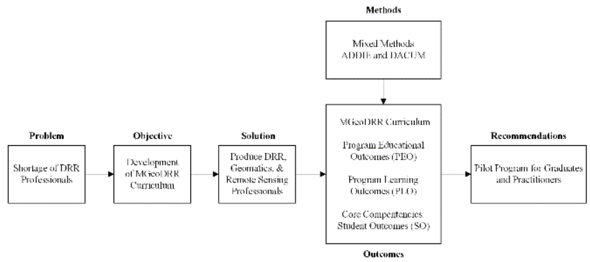

Figure 1. Conceptual Framework

The conceptual framework outlines the process for addressing the shortage of Disaster Risk Reduction (DRR) professionals through developing an MGeoDRR curriculum at the University of the Cordilleras. The framework recommends implementing a pilot program to test and refine the curriculum, involving both graduates and practitioners, ensuring that the curriculum meets the needs of the industry and effectively prepares students for professional roles.

2. Methodology

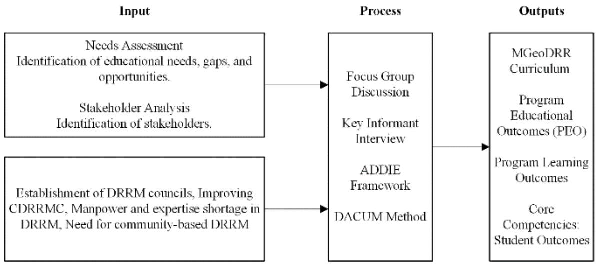

Figure 2. IPO Framework

To develop the MGeoDRR curriculum, a mixed-methods approach was employed, integrating both qualitative and quantitative data collection techniques. The methodology utilized the ADDIE (Analyze, Design, Develop, Implement, and Evaluate) Framework and the DACUM (Developing a Curriculum) method. Key Informant Interviews (KII) with experts in disaster risk reduction, geomatics, and remote sensing provided in-depth insights into the necessary competencies and industry requirements. Additionally, Focus Group Discussions (FGD) with stakeholders, including educators, practitioners, and potential students, were conducted at the University of the Cordilleras and with ERASMUS to gather diverse perspectives and ensure the curriculum was comprehensive and contextually relevant. This approach, which was through meetings and workshops, ensured a well-rounded and robust curriculum design that met both academic standards and practical needs.

Furthermore, the University of the Cordilleras conducted an online survey for Deliveries Market Survey Report from May 20 to June 15, 2021, which was conducted through Google Forms and disseminated using the university network and social media to four university sectors involving academic staff and faculty, administrative staff, potential students and technical staff and key findings of the GeoDRR survey for stakeholders.

2.1. DACUM Method for Curriculum Development

The development of the Masters of Geomatics in Disaster Risk Reduction (MGeoDRR) curriculum was guided by the DACUM (Developing A Curriculum) method. This method was used to identify the competencies required for the specific job or role as graduates of MGeoDRR. The following processes were undertaken using the DACUM method:

2.1.1. Formation of the Key Informant Committee: A committee consisting of experts from various disciplines relevant to disaster risk reduction and geomatics was formed. This included industry practitioners, representatives from government and non-governmental organizations (NGOs), and academicians.

2.1.2. Conducting the Key Informant Workshop: A series of workshops were organized where the committee members collaborated to identify the key competencies and skills required for graduates of the MGeoDRR program. These workshops were facilitated by Research Services Office (RSO) staff who guided the participants through a structured process of brainstorming and consensus-building.

2.1.3. Development of the Competency Profile: The output of the workshops was a comprehensive competency profile. This profile detailed the knowledge, skills, and attitudes needed for practitioners in geomatics and disaster risk reduction. Each competency was broken down into tasks, and the associated skills and knowledge were clearly defined.

2.1.4. Validation of the Competency Profile: The draft competency profile was then subjected to validation by a broader group of stakeholders, including additional industry partners, alumni, and other experts in the field. Feedback was collected and incorporated to ensure that the profile accurately reflected the needs of the industry and the demands of the profession.

2.1.5. Curriculum Mapping: Based on the validated competency profile, the curriculum was mapped out. This involved identifying the courses and modules included in the GeoDRR program and ensuring that each competency was adequately integrated. The mapping process also involved sequencing the courses to facilitate a logical progression of learning.

2.2. ADDIE Framework for Courseware Design

The ADDIE framework was employed to design the courseware of the MGeoDRR curriculum. The ADDIE model is a systematic instructional design framework that encompasses five phases namely Analysis, Design, Development, Implementation, and Evaluation. The following processes were undertaken:

2.2.1. Analysis

Needs Assessment: A needs assessment was conducted to determine the specific learning needs of the students and the gaps in existing courseware. This involved reviewing current educational materials, analyzing industry requirements, and gathering input from stakeholders. In this phase, the competency profile derived from the DACUM process was integrated.

Learner Analysis: The characteristics of the target learners, including their educational background, experience levels, and learning preferences, were analyzed to tailor the courseware to their needs.

2.2.2. Design

Learning Outcomes: Clear and measurable learning outcomes were defined for each course and module. These outcomes were aligned with the competencies identified in the DACUM process.

Instructional Strategies: Appropriate instructional strategies were selected to achieve the learning outcomes. This included decisions on the use of lectures, practical exercises, case studies, simulations, and other pedagogical approaches.

2.2.3. Assessment Methods: Various assessment methods were designed to evaluate the student's attainment of the learning outcomes. This included formative assessments, such as quizzes and assignments, as well as summative assessments like exams and project evaluations.

2.2.4. Development

Course Materials: Detailed course materials were developed, including lecture notes, presentation slides, reading materials, and practical exercise guides. Industry partners contributed real-world case studies and data sets to enhance the relevance of the course content.

LMS Content: Learning Management System modules and online resources were created to supplement the face-to-face instruction. This included interactive multimedia content, online quizzes, and discussion forums.

2.2.5. Implementation

Pilot Testing: The courseware shall be pilot tested with a small group of students to gather feedback and identify any issues. Adjustments will be made based on the feedback received.

Full-scale Implementation: The courseware shall then be rolled out to the entire cohort of GeoDRR students. Instructors will be trained in the new materials and instructional strategies.

2.2.6. Evaluation

Formative Evaluation: Continuous evaluation must be conducted throughout the implementation phase to monitor the courseware's effectiveness and make ongoing improvements.

Summative Evaluation: At the end of the course, a comprehensive evaluation shall be conducted to assess the courseware's overall success in achieving the learning outcomes. This involved collecting feedback from students, instructors, and industry partners and analyzing student performance data.

By employing the DACUM method for curriculum development and the ADDIE framework for courseware design, the GeoDRR program will be able to create a robust and industry-relevant curriculum that meets the needs of both students and employers.

3. Results and Discussion

3.1. Phases of the MGeoDRR Program Development

Based on the methodology, the five Phases of the Masters of Geomatics in Disaster Risk Reduction (MGeoDRR) Program Development are as follows:

3.1.1. Competency Profiling: The cornerstone of an MGeoDRR program. A process of defining the professional competencies of a GeoDRR graduate. It provides the framework based on the identified performance outcomes by industry experts and is evaluated by educators for Curriculum Development.

3.1.2. Curriculum Design: The competency profile in this phase guides the academic partners in designing a curriculum or program content. It details instructional goals and methods for developing desired competencies. Elements of this phase include syllabus design, learning objectives, sequencing of instructions, and delivery structures.

3.1.3. Instructional Materials Development: This is where every part of the instructional material is focused more on the learner's capacity to build the desired competencies and less on concepts and theories. This phase includes the production of lesson plans, instructional media, and other related documents.

3.1.4. Program Conduct: This is the actual delivery of instructional materials and the application of methods designed to ensure the acquisition of desired competencies. This is best delivered in an authentic environment where practical and actual applications of learned competencies can be displayed and evaluated.

3.1.5. Program evaluation: This phase measures the effectiveness and efficiency of the whole PSM course. Comprised of Formative and Summative Evaluation. This phase aims to evaluate educators' development of instructional materials and measure the level of desired professional competencies acquired by students.

3.2. MGeoDRR Curriculum

The online survey for the Deliveries Market Survey Report conducted by the University of the Cordilleras highlighted the need, respondent's willingness to engage, and importance of the GeoDRR program. It was distributed to students, administrative staff, faculty members, technical staff, and stakeholders of four university sectors for their responses.

The survey showed that many students are interested in a master's degree in GeoDRR if offered by the University of the Cordilleras. Administrative staff also expressed interest in administrative roles within a department offering an MSc in GeoDRR, citing opportunities for skill development and program management to mitigate disaster effects. All respondents agreed that the University of the Cordilleras to offer the MGeoDRR Curriculum.

The faculty members suggested that they need specialized training in DRR (e.g. Advanced GIS, CIM, BIM), development of geomatic courses, and geoscience training for teaching in MSc in geoDRR. For the Technical Staff, they suggested development/training programs that they need to be able to work efficiently as technical staff in MGeoDRR including theories behind the DRR processing and modular training for the post processing of primary datasets, advanced training on GIS & Remote Sensing, and trainings on Disaster Risk Reduction and Climate Change & Adaptation.

Stakeholders recommended developing training programs to enhance DRR implementation, support research, and planning activities, strengthen LGU's GIS-based DRRM responses, and ensure the presence of GeoDRR professionals and equipped staff for disaster response.

Given this fact, the result of this research is the development of a GeoDRR Program at the University of the Cordilleras. This program will be supervised by the University of the Cordilleras College of Engineering and Architecture (CEA). This is one of the results of the FGD because the master's in science in Civil Engineering (MSCE) has been used to enhance the design and implement the MGeoDRR curriculum. Overall, the MGeoDRR Curriculum has 15 units of Core Courses, 15 units of Professional Courses, 9 units of Electives, and 6 units of Capstone with a total of 45 units. The University of the Cordilleras has been able to contribute GDRR 510 Research Methodology, GDRR 513 Environmental Planning and Sustainable Development, GDRR 515 Data Science Applications in DRR and CCA, GDRR 523 Land Use Planning and Management, GDRR 531 Special Topics in Geomatics in Disaster Risk Reduction, GDRR 533 Immersion, CAPSTONE 1, and CAPSTONE 2, to the curriculum based on FGDs and KII.

Aside from the survey, key informant interviews were conducted with industry practitioners and employers. The key informants strongly agreed on the necessity for MGeoDRR. Adequate knowledge and skills in GIS and remote sensing are needed along with modeling disaster risks. However, it was discovered that values like volunteerism, and community oriented-ness need to be possessed by future GeoDRR professionals. Moreover, the key informants required that these future professionals must also be resourceful, alert, attentive, multi-skilled, good at communication, and fast learners. The input of the key informants helped craft the program and subject objectives. Scolobig and Balsiger (2024) highlighted the co-learning between stakeholders from public and private sectors to bridge the gap between theory and practice.

The 45-unit course requirement is compliant with the CMO 15 series of 2019 and the European Credit Transfer and Accumulation System (ECTS) equivalency of MGeoDRR. This enhances international recognition, commitment to quality assurance, and global competitiveness for a rich educational experience, as well as to contribute to research and extension for the public good. Its aims are to a) integrate disaster risk reduction and climate change adaptation into research and teaching processes, b) strengthen the capacity for GIS, environmental planning, remote sensing, and DRR, and c) promote community resiliency.

DRR requires a multidisciplinary or interdisciplinary approach (Scolobig and Balsiger, 2024). Thus, this means

Core Courses (15 units)		
Code	**Course Title**	**Units**
GDRR 510	Research Methodology	3
GDRR 511	Introduction to GIS, Web GIS & Geodatabase Management Applications	3
GDRR 512	Introduction to Natural Hazards and Risk	3
GDRR 521	Remote Sensing	3
GDRR 522	Disaster Risk Reduction	3

Table 1. Core Course Titles and Code

The MGeoDRR curriculum consists of 15 core units and covers research techniques, Geographic Information Systems, web GIS, geodatabase management, natural hazards, risk assessment, remote sensing technologies, and disaster risk reduction strategies. These are included because according to Song et al. (2023), before students delve into Disaster Risk Reduction (DRR) using hazard maps, it is essential for them to first grasp the fundamentals of maps, Geographic Information Systems (GIS), and the natural environment.

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Professional Courses (15 units)		
Code	**Course Title**	**Units**
GDRR 513	Environmental Planning and Sustainable Development	3
GDRR 514	Extraction and Analysis of Geospatial Data	3
GDRR 515	Data Science Applications in DRR and CCA	3
GDRR 520	Natural Hazards, Exposure, and Risk Mapping	3
GDRR 523	Land Use Planning and Management	3
GDRR 524	Geo-Information Science Applications	3
GDRR 530	Natural Hazards, Exposure, and Risk Mapping	3
GDRR 531	Special Topics in Geomatics in Disaster Risk Reduction	3

Table 2. Professional Course Titles and Code

The Master's in Geomatics in Disaster Risk Reduction Management program includes professional courses totaling 15 units and covers environmental planning, geospatial data analysis, data science for disaster risk reduction, mapping techniques for natural hazards, and advanced applications of geo-information science. It also addresses emerging topics in geomatics and DRR. In a study by Koen et al. (2024), participants indicated that Disaster Risk Reduction (DRR) was being integrated into modules related to sustainable development, environmental planning, spatial planning and resilience, flood planning, urban design and infrastructure, metropolitan planning, planning law, housing and development policy, and city security and safety. This demonstrates the incorporation of DRR into existing planning modules.

Elective Courses (9 units)		
Code	**Course Title**	**Units**
GDRR 516	Geo-Spatial Analysis of Multi-Hazard Risk	3
GDRR 525	Geo-Information Imagery for Disaster Relief & Recovery	3
GDRR 526	Geo-Information for Risk & Vulnerability Assessment	3
GDRR 532	Building Resilient Communities based on GeoInformation: Case Study	3
GDRR 533	Immersion	3

Table 3. Elective Course Titles and Code

The Master's in Geomatics in Disaster Risk Reduction Management program includes elective courses totaling 9 units and covers multiple hazards analysis using geospatial techniques, geo-information imagery in disaster relief and recovery efforts, risk and vulnerability assessment, building resilient communities with geo-information through case studies, and hands-on experience in disaster risk reduction using geo-information. These are all included in the course because according to Cui et al. (2022) geospatial technologies are important for addressing scientific challenges related to disaster risk reduction. This is especially true for evaluating and mitigating geological threats. Also, there are crucial in conducting comprehensive risk assessments (Khadka et al, 2021)

Capstone (6 units)		
Code	**Course Title**	**Units**
	Comprehensive Exams	
CAPSTONE 1	Capstone 1	3
CAPSTONE 2	Capstone 2	3

Table 4. Capstones and Code

The Master's in Geomatics in Disaster Risk Reduction Management program includes a capstone component totaling 6 units. This component covers comprehensive exams to assess students' overall knowledge and understanding, as well as an applied project or research addressing a real-world issue in disaster risk reduction using geomatics.

The target audience of this Curriculum are those that have a) a Bachelor's Degree in Geomatics and DRR and allied courses, b) six months of work experience in the field of geomatics and with work involving emergency services and risk mitigation programs implementation and planning, and c) and workers from LGUs with merits as land use planning coordinator, health officer, infrastructure manager, agricultural officer, and disaster risk reduction management officers. This aims to enhance the expertise and competencies of human resources in disaster risk reduction management.

In an in-depth analysis, Scolobig and Balsiger (2024) identified topics which include science-society interface to address new challenges in contemporary DRR. This supports the inclusion of integration planning subjects in landuse and environmental planning.

3.3. Program Educational Outcomes (PEO)

The Program Educational Outcomes (PEO) outlines the specific achievements that graduates of the MGeoDRR program are expected to attain. These outcomes demonstrate the program's dedication to providing students with the essential skills and expertise needed to succeed in disaster risk reduction and management. Through comprehensive training and education, graduates will be well-prepared to address complex disaster phenomena and contribute effectively to community resilience.

Graduates of the MGeoDRR program will be able to:

PEO 1. Identify disaster phenomenon and its different contextual aspects.

PEO 2. Execute hazard, exposure vulnerability, and risk assessments.

PEO 3. Model hazards and prepare hazard, exposure, and vulnerability maps and analysis.

PEO 4. Design a GeoDRRM project for an identified community.

3.4. Program Learning Outcome

The Program Learning Outcomes (PLO) define the key competencies that students will develop during their time in the MGeoDRR program. These outcomes emphasize leadership, technical proficiency, and a commitment to community well-being. Students will be trained to become leaders in the disaster risk reduction and management industry, adept at using data analytics and innovative technologies, and committed to lifelong learning and community service.

1. Leaders in the Disaster Risk Reduction and Management (DRRM) industry with proficiency in planning and program development, risk analysis management, and situational awareness. (Leadership in the Field)

2. Competent and efficient in applying data analytics, geomatics, and innovative technologies in providing solutions to Disaster Risk Reduction and Management (DRRM) problems. (Technical Competency)

3. Confident in communicating, collaborating, teamwork, lifelong learning, and conducting research and innovations in Disaster Risk Reduction and Management (DRRM) for the betterment of communities and the nation. (Malasakit for the Community)

3.5. Core Competencies: Student Outcomes (SO)

The Core Competencies, delineated through specific Student Outcomes (SO), provide a detailed framework of the knowledge, skills, attitudes, values, and tools that students are expected to acquire. These outcomes ensure that graduates are well-rounded professionals capable of addressing various aspects of disaster risk reduction and management.

3.5.1. Knowledge

SO 1: Ability to apply knowledge of DRRM and disasters in the development of plans, reports, research, and scholarly works.

SO 2: Ability to relate DRRM knowledge to local structures, mandates, processes, protocols, policies, and manpower of DRRM councils.

3.5.2. Skills

SO 3: Develop DRRM plans, Local Climate Change Adaptation Plans, and Comprehensive Land Use Plans

SO 4: Design, articulate, develop, and manage programs, projects, policies, activities, and budgets from DRRM plans.

SO 5: Analyze multi-sectoral data and geospatial data for the analytical component of DRRM plans.

SO 6: Apply scientific research, innovation, data analytics, geospatial, and modeling techniques in solving DRRM problems.

SO 7: Ability to communicate effectively and mainstream risks, plans, and reports for the understanding of stakeholders as well as develop inter-agency collaboration and sustained partnership.

3.5.3. Attitude

SO 8: Willingness to function in multidisciplinary teams towards collating multiple perspectives in DRRM.

SO 9: Alertness and proactive attitude towards disaster preparedness and response.

3.5.4. Values

SO 10: Understanding of professional, ethical responsibility, cultural and gender sensitivity, and lifelong learning.

SO 11: Take action on the community needs, and national issues on DRRM.

3.5.5. Tools

SO 12: Ability to use technology to solve DRRM problems and to transfer these technologies to stakeholders.

4. Conclusion

The Philippines requires a well-trained workforce to effectively manage and respond to disaster risk reduction and management (DRRM) challenges. Through the MGeoDRR Program, graduates will be experts in addressing disaster risks, strengthening community resilience, and planning and preparing risk reduction plans to help the population, especially the vulnerable. This also supports the local legislation on disaster risk reduction and management enacted in 2010 as it covers a) Disaster Prevention and Mitigation, b) Disaster Preparedness, c) Disaster Response, and d) Disaster Rehabilitation and Recovery as its thematic areas.

Scolobig and Balsiger (2024) recognized the increasing trend of post graduate training in disaster management. It is expected that graduates of the program will have career opportunities in service areas in Local Government Units that focus on disaster risk reduction and management, and emergency responses. Moreover, they can be GIS experts, DRRM officers, Planning Officers, Academics, Faculty, and Researchers. This highlights the practicality and relevance of the program to the country as it addresses challenges and problems caused by the disadvantages caused by the geographic location of the Philippines.

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