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Enhancing Infrastructure Disaster Management Education: A case study on Program Learning Outcome (PLO) attainment and Continuous Quality Improvement (CQI)

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Abstract

In light of increasing disasters, this paper examines the Infrastructure Disaster Management course (FIE708) at UiTM with an emphasis on the adoption of pedagogical methods in line with PLO1, PLO8, and PLO11. This two-semester study (October 2023-August 2024) evaluates student learning outcomes and the effectiveness of CQI in improving problem-solving, leadership, and ethical decision-making. Such success was attributed to blended learning, case studies, and feedback. Results emphasise the potential of CQI in enhancing teaching methodologies and providing lessons learned for the advancement of disaster management education.

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1.0 Introduction

Disasters, be they natural or human-made, are a real peril to the infrastructure worldwide and have severe ramifications for public safety and financial stability in addition to societal function. Effective management of disasters requires a multifaceted risk-reversing approach, as evidenced by the need for a special partnership between stakeholders for an appropriate disaster response (Fu & Zhang, 2024; Opabola & Galasso, 2024; Sandoval et al., 2023; Shakman et al., 2020). Therefore, comprehending risks, devising strategies for preparedness operations, and carrying out a response during disasters is the theoretical comprehension provided by this course.

Investment in infrastructure is crucial to our functioning as a society, and its failure during disasters can have devastating impacts on human life, public health and safety, and economic stability (Fu & Zhang, 2024; Opabola & Galasso, 2024; Shakman et al., 2020). Engineers have a key role in the creation and post-event existence of disaster-resilient infrastructure yet are not trained as

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comprehensively in disaster management measures (Syed Zakaria et al., 2020). Climate change, urbanisation, and technological dependencies are making disaster risks more complex than ever, touching all four corners of interdisciplinary engineering, environmental science, public health, and information technology (Education, 2013; Kitagawa, 2021; Wen et al., 2023).

This study investigates educational outcomes of the Infrastructure Disaster Management (FIE708) course, which are the Program Learning Outcomes (PLOs) and Continuous Quality Improvement (CQI) process. This study evaluates how the course reflects an infrastructure solution and relates to disaster risk management on the ground. This paper addresses the following areas of concern::
a) An in-depth look at how the FIE708 course is structured, its syllabus content, goals, and how it is taught.
b) An evaluation of PLO accomplishments over two semesters, highlighting advancements and identifying areas for further development.
c) An evaluation of PLO accomplishments over two semesters, highlighting advancements and identifying areas for further development.
d) A review of the CQI approach to identify areas for course enhancement that have influenced student learning results and the curricular framework.

Nomenclature

FIE708	Infrastructure Disaster Management
PLOs	Program Learning Outcomes
CQI	Continuous Quality Improvement

1.1 The Significance of Disaster Management Education

With natural catastrophes on the rise, coupled with potential man-made risks such as industrial accidents, a model of teaching is needed that would adequately prepare upcoming engineers to act well in assessing and planning for these emergencies (Exadaktylos, 2021; Karanci et al., 2024). It is not just about reactive measures but also proactive risk assessments, and disaster preparedness until long-term recovery strategies. Consequently, disaster management education should include adequate case studies and simulations that conform to the existing baseline of scenarios (Education, 2013; Karanci et al., 2024).

Action on disaster mitigation and recovery starts from the point where engineers stand. They design and redesign for disaster resilience, forecast and respond to early warning signals of impending crisis, and manage post-disaster relief and recovery efforts, making the field an example of responsibility for sustainable development (Kwabena et al., 2021). Each engineer also needs to have the tools and resources to deal with human, economic, and ethical challenges during disaster recovery projects (Exadaktylos, 2021). The emphasis is further underlined by the FIE708 course, which aims to build students' technical, leadership, and ethical decision-making capabilities.

1.2 Educational Methodologies

This multi-modal pedagogical approach is evident in the Infrastructure Disaster Management course, which integrates traditional theoretical lectures with several e-learning modules and interactive case studies as exemplars (Khorram-Manesh et al., 2015). This enables students to interact with the content in various flexible and vibrant ways that result in a better opportunity for absorbing and applying disaster management concepts (David Gullette, 2013; Selby & Kagawa, 2012).

The hybrid disaster management course incorporates online resources, enabling students to explore the subjects at their own speed (Khorram-Manesh et al., 2015). Interactive scenarios and simulations, including quizzes or activities, may be created in e-learning courses to enable students to practice decision-making without incurring risks. This includes exposure to real-life disaster scenarios covering infrastructure failures (related to earthquakes, floods, and technological accidents). Case studies give students the chance to practice their theoretical understanding in complicated contexts, thus enhancing problem-solving skills and critical thinking.

The course incorporates Continuous Quality Improvement (CQI) as a core mechanism for evaluating and refining instructional materials and delivery approaches, building on the Outcome-Based Education (OBE) framework that has long been embedded in the Faculty of Civil Engineering at UiTM (Ismail et al., 2010). Prior UiTM studies have demonstrated that structured CO-PO mapping and analytic rubrics provide reliable evidence for monitoring Programme Outcomes and informing data-driven CQI actions (Ahmad Zakwan et al., 2022; Derahman et al., 2024). The course design is exceptional, guaranteeing ongoing enhancement of material and delivery techniques through intelligible data, with CQI serving as a fundamental element of the educational framework in FIE708 (Education, 2013; Sivahop, 2021). The CQI approach utilises PLO attainment data to identify areas for improvement, formulate action plans, and execute improvements. The CQI Framework are as follows:
a) Data Collection: The PLOs attainment data collection included periodic assessments, surveys, focus groups and instructor observations. At minimum, this data illustrates student competencies in disaster management strategies, leadership and ethical decision-making.
b) Data analysis: A detailed analysis of data focused on trends as well as student strengths and weaknesses. To test whether changes in PLO achievement were significant, we employed inferential statistical procedures (t-test, ANOVA).
c) Action Plan Developed: The analysis led to an action plan for curriculum revision, enhancement of e-learning modules, and introduction of leadership development workshops.
d) Implementation and Evaluation: In a later semester, the changes were incorporated to evaluate the impact of these interventions on the attainment of PLOs. This cycle of iteration allows for improvements in both student outcomes and the structure of the course itself.

2.0 Research Methodology

The quantitative data gathered from assessments, such as assignments, projects, and tests, were analysed using both descriptive and inferential statistical approaches to measure PLO achievement. This quantitative strategy parallels earlier UiTM work in which rubric-based continuous assessments and PO matrices were used to quantify programme outcome attainment in solid mechanics and surveying courses (Ahmad Zakwan et al., 2022; Derahman et al., 2024). This methodological approach was selected to ensure a systematic and evidence-based evaluation of learning outcomes across semesters. The analysis focused on three PLOs aligned with the course objectives: PLO1 (evaluating complex situations), PLO8 (leadership and interpersonal abilities), and PLO11 (ethical decision-making). The subsequent statistical methods were utilised:

a) Descriptive Statistics: Descriptive statistics, comprising means, standard deviations, and percentages, were computed to encapsulate student performance across three principal Program Learning Outcomes: PLO1 (Evaluate difficult situations), PLO8 (Leadership and interpersonal abilities), and PLO11 (Ethical decision-making). This data presents a summary of student performance across two semesters (October 2023-February 2024 and March-August 2024).

b) Inferential Statistics:

-Independent sample t-tests were performed for PLO1, PLO8, and PLO11 to ascertain if a statistically significant difference in student performance existed between the two semesters. This analysis evaluated the statistical significance of the mean differences in PLO accomplishment between Semester 1 and Semester 2 at a significance threshold of $p < 0.05$. Paired-sample t-tests were employed for intra-group comparisons to evaluate alterations in the same students' performance on PLOs prior to and following specific interventions (e.g., leadership workshops and case-based ethical reasoning exercises).

- An ANOVA (Analysis of Variance) was conducted to assess the total variance in student performance across various Program Learning Outcomes (PLOs) within the same semester. This facilitated the identification of notable disparities in achievement across PLO1, PLO8, and PLO11, especially concerning educational interventions. Where ANOVA indicated significant differences, Tukey's HSD post hoc tests were utilised to identify the specific PLOs that differed.

c) Magnitude of Effect: Effect sizes for t-tests and ANOVA results were computed to evaluate the practical significance of the findings. Cohen's d was employed for t-tests to measure the effect size of differences across semesters, while Eta-squared (η^2) was computed for ANOVA to assess the proportion of variance attributed to the differences in PLO attainment.

3.0 Results and Discussions

This section delineates and analyses the findings of the achievement of Program Learning Outcomes (PLO1, PLO8, and PLO11) across two semesters (October 2023-February 2024 and March-August 2024). Statistical studies were used to evaluate the significance of alterations in student performance and the efficacy of the Continuous Quality Improvement (CQI) interventions.

3.1 PLO1: Evaluating Complex Problems

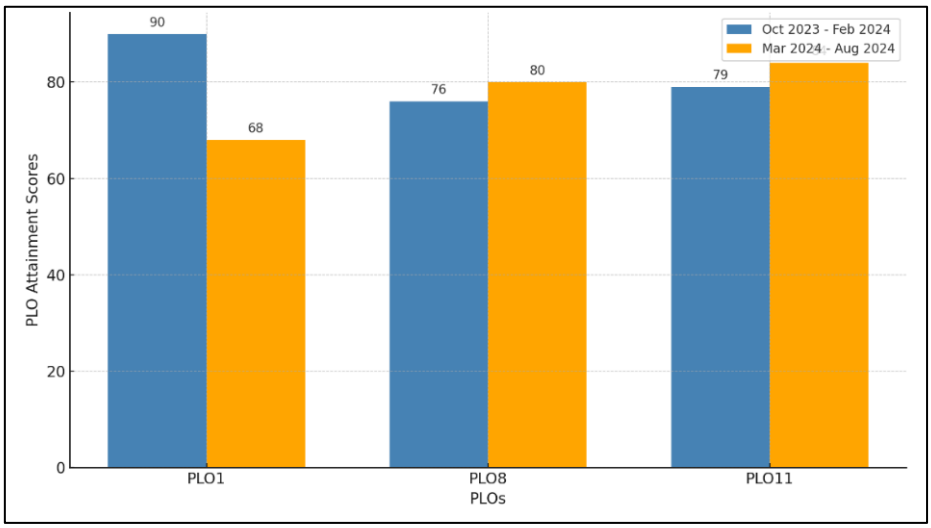

Fig. 1: Bar chart comparing PLO attainment scores for Semester October 2023-February 2024 and Semester March-August 2024

During Semester 1 (October 2023-February 2024), students excelled in PLO1, with an average accomplishment score of 90%. In Semester 2 (March-August 2024), the average score decreased markedly to 68%. The drop was statistically significant, as seen by an independent sample t-test, $t(58) = 5.12$, $p < 0.001$, suggesting that the complexity of the case studies presented in the second semester significantly hindered students' problem-solving capabilities. Fig. 1 clearly depicts a significant reduction in the PLO1 scores between the two semesters. The significant decrease underscores the necessity for enhanced scaffolding to assist students in transitioning from basic to more intricate crisis management situations. The noted decrease indicates that although students originally showed a robust capacity to assess intricate challenges, they encountered difficulties when confronted with more sophisticated crisis management

situations. The findings underscore the necessity for improved instructional scaffolding to connect theoretical knowledge with practical application in progressively intricate circumstances. Supplementary problem-solving workshops and iterative feedback systems may be needed to adequately equip students for managing increasingly complex crises.

3.2 PLO8: Leadership and Interpersonal Skills

Student performance in PLO8 demonstrated significant enhancement between the two semesters. In Semester 1, the mean score for PLO8 was 76%; however, in Semester 2, it rose to 80%. An independent sample t-test indicated a statistically significant increase, $t(58) = 2.21$, $p = 0.03$, implying that the leadership development workshops implemented in Semester 2 positively influenced students' collaborative and leadership skills in crisis management contexts. Fig. 1 illustrates a moderate yet statistically significant rise in PLO8 ratings from Semester 1 to Semester 2, highlighting the efficacy of focused treatments like leadership training. The findings demonstrate that the incorporation of peer-review evaluations and leadership workshops afforded students significant opportunities to cultivate leadership and team management competencies in disaster response contexts. The enhancement in PLO8 corresponds with the course's aim to cultivate future leaders capable of proficiently managing infrastructure-related calamities. Nonetheless, there exists potential for development, especially in improving assertiveness and decision-making under pressure, which may be tackled through more focused leadership simulations.

3.3 PLO11: Ethical Decision-Making

The accomplishment score for PLO11 increased from 79% in Semester 1 to 84% in Semester 2. A paired-sample t-test indicated that the improvement was statistically significant, $t(58) = 3.15$, $p = 0.002$, confirming the efficacy of the ethical case studies and class discussions integrated into the curriculum. These interventions prompted students to critically examine ethical challenges in catastrophe management, such as reconciling economic recovery with environmental sustainability. The favourable trend in PLO11 is illustrated in Fig. 1, which clearly represents the rise in ethical decision-making scores across the two semesters. This enhancement indicates that students become more proficient in addressing the intricate moral and ethical dilemmas associated with catastrophe management. Utilising real-world case studies, which compelled students to evaluate trade-offs and long-term social consequences, showed efficacy in improving ethical reasoning abilities. To enhance this PLO, supplementary case studies featuring more complex ethical issues should be incorporated, along with reflective exercises to enrich students' comprehension of ethical decision-making processes.

3.4 Comparative Analysis of PLO Attainment

Fig. 1 illustrates the comparison of PLO achievement between the two semesters, presenting a visual depiction of the average scores for each PLO. The data present mixed outcomes, with PLO8 (leadership) and PLO11 (ethical decision-making) demonstrating statistically significant enhancements, whilst PLO1 (problem-solving) displayed a marked deterioration. The ANOVA test performed on the three PLOs in Semester 2 indicated significant differences, $F(2, 57) = 6.47$, $p = 0.003$, demonstrating that student performance in leadership and ethical decision-making increased more markedly than in evaluating complex situations. This discrepancy underscores the disparate levels of difficulty encountered by students across the various PLOs. The results indicate that leadership and ethical reasoning can be improved by focused interventions; however, problem-solving in intricate crises necessitates prolonged instructional assistance. The decline in PLO1 achievement highlights the necessity for a more incremental advancement in the intricacy of case studies, bolstered by continuous formative evaluations and tailored input.

3.5 Summary of Discussion

The statistical analysis results indicate that CQI interventions effectively enhance leadership (PLO8) and ethical decision-making (PLO11) while highlighting a substantial challenge in sustaining high performance in problem-solving (PLO1) as disaster scenario complexity escalates. The findings highlight the significance of adaptive teaching practices that respond to students' changing demands as they proceed from basic to complex problem-solving activities. The observed pattern-strong attainment in leadership and ethical decision-making, with greater difficulty sustaining performance in complex problem-solving-echoes findings from other UiTM civil engineering courses, where rubric-based assessments showed that generic skills and teamwork-related POs responded more rapidly to targeted pedagogical reforms than higher-order analytical outcomes (Ahmad Zakwan et al., 2022; Derahman et al., 2024). These parallels reinforce the need for more intensive scaffolding and staged task design when courses emphasise complex engineering problem capabilities within the OBE framework (Ismail et al., 2010).

4.0 Conclusions and Recommendations

4.1 Conclusions

This study sought to assess the efficacy of pedagogical changes in the FIE708 course by examining student performance in three principal PLOs over two semesters. We employed statistical analyses to evaluate the influence of CQI initiatives on the achievement of PLO1 (Evaluating Complex Problems), PLO8 (Leadership and Interpersonal Skills), and PLO11 (Ethical Decision-Making). The results indicated varied outcomes:

a) PLO1 (Evaluating Complex Problems) showed a notable decrease from 90% to 68% between Semester 1 and Semester 2 ($p < 0.001$). This outcome signifies that those students faced difficulties in applying their theoretical knowledge to progressively intricate crisis management scenarios. The statistical significance of this reduction highlights the necessity for enhanced scaffolding in problem-solving

teaching, especially as the complexity of case studies increases. Subsequent iterations of the course should integrate more incremental advancements in task complexity and offer ongoing formative feedback to assist students in acquiring the skills required for managing advanced crisis situations.

b) PLO8 (Leadership and Interpersonal Skills) exhibited a notable enhancement, rising from 76% to 80% ($p < 0.05$). This enhancement signifies the efficacy of leadership development workshops and peer-review evaluations, which facilitated the augmentation of students' collaboration and leadership skills. Nevertheless, enhancing leadership simulations to emphasise decision-making under duress and authentic crisis management situations could yield significant benefits.

c) PLO11 (Ethical Decision-Making) showed a notable enhancement, increasing from 79% to 84% ($p < 0.01$). The implementation of case-based learning and reflective discourse on ethical challenges facilitated this development. Enhancing the intricacy of these ethical dilemmas, especially those that involve conflicting social and environmental interests, would augment students' ability to address real-world challenges in disaster management.

The findings of this study demonstrate that CQI-driven educational interventions effectively enhanced leadership and ethical decision-making skills, while underscoring the necessity for more systematic support in cultivating problem-solving abilities in intricate scenarios. The statistical analysis offers empirical data that endorses the continuance and growth of specific interventions, especially those centred on leadership and ethical reasoning. The FIE708 experience therefore extends previous UiTM evidence on OBE implementation and PO assessment by demonstrating how blended delivery, leadership workshops and ethics-focused case studies can be integrated within a disaster-management context while remaining anchored to the same CO-PO-CQI architecture (Ahmad Zakwan et al., 2022; Derahman et al., 2024; Ismail et al., 2010).

4.2 Recommendations

Following the evaluation of PLO achievement and the efficacy of CQI measures, various recommendations can be proposed to augment the FIE708 course and enhance student performance:

a) Enhancing Problem-Solving Competencies (PLO1): The notable decrease in PLO1, from 90% in Semester 1 to 68% in Semester 2, underscores the necessity for enhanced instructional support as students navigate increasingly intricate crisis management scenarios.

The subsequent strategies are advised to address this issue:

- Incremental Augmentation of Case Study Complexity: Introduce foundational, scaffolded case studies at the outset of the course, progressively escalating the complexity as students enhance their proficiency in advanced problem-solving activities. This will prevent pupils from being inundated with intricate scenarios prematurely.
- Conduct regular formative evaluations, including quizzes and problem-solving exercises, to furnish pupils with prompt feedback regarding their progress. These evaluations will facilitate the early identification of problematic areas and enable teachers to provide focused assistance as needed.
- Workshops for Collaborative Problem-Solving: Conduct workshops that enable students to collaborate in teams to address intricate disaster management challenges. These sessions will promote peer learning and collaborative investigation of sophisticated problem-solving techniques.

b) Enhancing Leadership Development (PLO8): Although there was a notable enhancement in PLO8 (Leadership and Interpersonal Skills), increasing from 76% to 80%, additional efforts are needed to better augment these skills:

- Leadership Simulations: Create and integrate more sophisticated leadership simulations that immerse students in high-stakes crisis management scenarios. These simulations must accurately replicate real-world disaster scenarios, necessitating students to exhibit proficient decision-making, conflict resolution, and team management skills.
- Leadership Training Tailored to Specific Roles: Deliver leadership training customised for distinct positions within a disaster management team (e.g., emergency response coordinator, logistics manager). This methodology will guarantee that students are equipped to assume diverse leadership roles in practical situations.
- Collaborative Interdisciplinarity: Designate initiatives necessitating interdisciplinary collaboration among students, such as in public health, environmental science, and engineering. This collaborative interdisciplinary approach will equip students for leadership positions in catastrophe management, where cross-functional cooperation is essential.

c) Improving Ethical Decision-Making (PLO11): The enhancement in PLO11 (Ethical Decision-Making), from 79% to 84%, indicates that the incorporation of ethical case studies was effective. To enhance pupils' ethical reasoning, the following actions are advised:

- Augmenting the Complexity of Ethical Dilemmas: Incorporating intricate and confusing ethical concerns into catastrophe management case studies. These should encompass scenarios that entail complex trade-offs among economic recovery, environmental sustainability, and societal welfare, prompting students to contemplate the long-term ramifications.
- Invited Lectures and Practical Perspectives: Engage experts from the disaster management sector to present guest lectures on ethical decision-making in practical disaster scenarios. This experience will furnish students with pragmatic insights into the moral and ethical intricacies they may encounter in their professions.
- Ethics Reflection Papers: Prompt students to compose reflection papers addressing ethical dilemmas faced during simulations or case studies. This contemplative exercise will foster profound contemplation of ethical principles and improve decision-making processes.

d) To augment both technical and interpersonal competencies, the training should integrate advanced technological instruments:

- Disaster Simulation Software: Employ sophisticated disaster simulation software, including Geographic Information Systems (GIS), to generate simulated disaster scenarios. These simulations will provide students with practical experience in risk assessment, crisis management, and decision-making devoid of real-world risks.

- Augmented Blended Learning: Broaden the use of blended learning modalities by incorporating additional interactive digital resources, including video simulations, quizzes, and scenario-driven e-learning tasks. This will offer students greater flexibility while promoting enhanced engagement with the course content.
e) To help students feel more confident and prepared when tackling advanced case studies, it's helpful to offer optional preparation materials or short refresher modules, especially for those who may need a bit more support. For instance, brief online lessons on core concepts like disaster risk assessment can give students the foundation they need before diving into complex scenarios. In addition, lecturers may provide casual drop-in sessions that emphasise practical problem-solving and provide help specific to students' inquiries.
f) Use a variety of assessment methods to meet the needs of all students and keep them interested. Use formative assessments as low-stakes ways to help students learn, along with self-assessment and reflective assignments that let them track their progress on PLOs. These methods give students more freedom, encourage them to get more involved, and make disaster management education more personalised by connecting what they learn in the classroom to real-life situations.

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Paper Contribution to Related Field of Study
This paper attempts to contribute to the area of disaster education to assess PLOs and CQI in the postgraduate engineering program from a data-driven perspective. It develops a model that can be replicated that combines blended learning, leadership development, and ethical reasoning to improve student competence in infrastructure disaster management. Our results demonstrate - through statistical evidence - the success of focused pedagogical interventions in the development of PLO8 and PLO11 and a demand for more adequate support in PLO1. Seeking to integrate course format with the complexities of real-world disasters and the United Nations' (UN's) sustainable development goals (SDGs), the study contributes to a growing body of curriculum strategies that seek to prepare future engineers to address issues of an interdisciplinary nature in disaster resilience. .

References

Ahmad Zakwan, F. A., Ismail, R., & Endut, M. (2022). Assessment Programme Outcomes (POs) of the solid mechanics course for an engineering diploma programme. *International Journal of Practices in Teaching and Learning (IJPTL)*, *2*(2).

Derahman, A., Yusof, M., & Hamzah, N. (2024). Analytic rubrics for the practical assessment of students' performances in engineering survey course. *Journal of Sustainable Civil Engineering & Technology (JSCET)*, *3*(2), 1–10.

Education, R. K. B. D. (2013). Management: A Joyride for Students. *Teachers and Disaster Managers Springer Science & Business Media*.

Exadaktylos, A. (2021). The Importance of Education and Training in Disaster Management: An Overview. In E. Pikoulis & J. Doucet (Eds.), *Emergency Medicine, Trauma and Disaster Management: From Prehospital to Hospital Care and Beyond* (pp. 591–597). Springer International Publishing. https://doi.org/10.1007/978-3-030-34116-9_46

Fu, Q., & Zhang, X. (2024). Promoting community resilience through disaster education: Review of community-based interventions with a focus on teacher resilience and well-being. *PLoS One*, *19*(1), e0296393.

Ismail, A. M., Ismail, R., Zakwan, F. A. A., & Ismail, B. N. (2010). Implementation and assessment of outcome based education (OBE) in the Faculty of Civil Engineering at Universiti Teknologi MARA (UiTM). *2010 2nd International Congress on Engineering Education*, 211–214.

Karanci, A. N., Ikizer, G., & Doğulu, C. (2024). Community Education and Preparedness for Disaster Risk Reduction. In A. Yildiz & R. Shaw (Eds.), *Disaster and Climate Risk Education: Insights from Knowledge to Action* (pp. 149–168). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-5987-3_9

Khorram-Manesh, A., Ashkenazi, M., Djalali, A., Ingrassia, P. L., Friedl, T., Von Armin, G., Lupesco, O., Kaptan, K., Arculeo, C., & Hreckovski, B. (2015). Education in disaster management and emergencies: Defining a new European course. *Disaster Medicine and Public Health Preparedness*, *9*(3), 245–255.

Kitagawa, K. (2021). Conceptualising 'disaster education.' *Education Sciences*, *11*(5), 233.

Kwabena, D. F., Kevin, M., Enokenwa, O.-B., Tantoh, H. B., Eromose, E., Hadisu, A., Sibusisiwe, M., Philip, M., Christopher, M., & Arianne, L. (2021). Mainstreaming Education Into Disaster Management to Facilitate Disaster Resilience. In S. Eslamian & F. Eslamian (Eds.), *Handbook of Disaster Risk Reduction for Resilience: New Frameworks for Building Resilience to Disasters* (pp. 223–238). Springer International Publishing. https://doi.org/10.1007/978-3-030-61278-8_10

Opabola, E. A., & Galasso, C. (2024). Informing disaster-risk management policies for education infrastructure using scenario-based recovery analyses. *Nature Communications*, *15*(1), 325.

Sandoval, V., Voss, M., Flörchinger, V., Lorenz, S., & Jafari, P. (2023). Integrated Disaster Risk Management (IDRM): Elements to Advance Its Study and Assessment. *International Journal of Disaster Risk Science*, *14*(3), 343–356. https://doi.org/10.1007/s13753-023-00490-1

Selby, D., & Kagawa, F. (2012). *Disaster risk reduction in school curricula: case studies from thirty countries*. United Nations Children Fund.

Shakman, K., Wogan, D., Rodriguez, S., Boyce, J., & Shaver, D. (2020). Continuous Improvement in Education: A Toolkit for Schools and Districts. REL 2021-014. *Regional Educational Laboratory Northeast & Islands*.

Sivahop, J. (2021). Continuous Quality Improvement: A Holistic Approach to Course Evaluation and Program Self-Assessment. *The Journal of Physician Assistant Education*, *32*(3), 192–194.

Syed Zakaria, S. A., A. Majid, T., Lau, T. L., & Azimi, M. A. (2020). Exploration of Training and Education for Attaining Disaster Resilience from Sustainability Perspective Among Civil Engineering Students. *Proceedings of AICCE'19: Transforming the Nation for a Sustainable Tomorrow 4*, 361–376.

David Gullette. (2013). *Disaster risk reduction in education: good practices and new approaches*. United Nations Childrens Fund (UNICEF).

Wen, J., Wan, C., Ye, Q., Yan, J., & Li, W. (2023). Disaster Risk Reduction, Climate Change Adaptation and Their Linkages with Sustainable Development over the Past 30 Years: A Review. *International Journal of Disaster Risk Science*, *14*(1), 1–13. https://doi.org/10.1007/s13753-023-00472-3