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Integration of Vocational Education and Multistakeholder Collaboration in West Java Province's Disaster Mitigation

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Abstract

West Java Province has a high risk of disasters due to complex geological conditions, population density, and rapid urbanisation. These conditions require a paradigm shift from reactive mitigation strategies to proactive and integrated ones. This study aims to analyse the integration between vocational education in disaster management and multi-stakeholder collaboration as a strategic effort to strengthen the disaster mitigation system in West Java. Using a qualitative-descriptive method through literature review and Focus Group Discussion (FGD) with relevant stakeholders, this study examines the roles and synergies within the Pentahelix model framework. Research findings indicate that vocational education in disaster management, with a practice-based learning approach (learning by doing), plays a strategic role in producing technically competent and adaptive human resources. On the other hand, the Pentahelix collaboration model, which involves the government, academics, the business world, communities, and the media, creates a comprehensive and inclusive mitigation ecosystem. The integration of these two aspects facilitates the transfer of field knowledge, scientific-policy collaboration, and increased collective awareness. This synergy produces an adaptive resilience ecosystem that bridges academic science, field practice, and community empowerment. This study concludes that strengthening cross-sector coordination, expanding the implementation of applied research, directing CSR towards mitigation activities, and optimising the media as an educational channel are key to realising a sustainable and collaborative disaster mitigation model in West Java.

Keyword: vocational education, multistakeholder collaboration, disaster mitigation, West Java.

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INTRODUCTION

Indonesia is the country with the highest risk of natural disasters in the Asia-Pacific region because it lies at the meeting point of three major tectonic plates: Indo-Australian, Eurasian, and Pacific. West Java, as one of the provinces with the largest population, has a high level of vulnerability to natural disasters due to its complex geology and extreme topography (BNPB, 2021). The West Java region has complex geographical and geological conditions, such as mountains and highlands, large rivers, landslide-prone areas, and active fault lines. The presence of Mount Tangkuban Parahu, Mount Papandayan, and the potential seismic activity of the Lembang Fault further increase the risk of geological disasters (Afnimar et al, 2015). In addition, rapid urbanisation in metropolitan areas such as Greater Bandung and Bogor has increased vulnerability to hydrometeorological disasters such as flooding and landslides due to environmental degradation (F. R. Harahap, 2013). In this situation, disaster mitigation can no longer be reactive, but must be proactive and integrated with development policies and resilience-based education systems (Salindo & Salindo, 2024).

Disaster mitigation must be an integral part of regional development policy, including in spatial planning, disaster education, and institutional capacity building (Yuliyanti et al., 2023). In the context of education, vocational education in disaster management plays a strategic role in developing human resources who are technically competent and adaptable to the dynamics of disaster risk. In the context of increasing frequency of disasters due to climate change and urbanisation, this education prepares professionals who are able to apply the principles of mitigation, preparedness, and rehabilitation based on community resilience (Partini & Hidayaht, 2024).

On the other hand, disaster mitigation does not only depend on individual capacity, but also on the active involvement of various parties, because disasters are a shared concern that requires cross-sector collaboration. The government, academics, the business world, the media and the community need to work together in an integrated risk management system to strengthen national resilience to disaster threats (Albris et al, 2020). The Pentahelix collaboration model has emerged as a relevant and necessary strategic approach. This model emphasises the importance of synergy between five key elements, namely: government, academia, business, community, and media. Collaboration between these parties not only enables a more proportional division of roles, but also encourages the creation of a more inclusive mitigation system based on knowledge and local needs (Pujiono Center, 2022).

This study aims to examine how vocational education on disasters can be synergised with multi-stakeholder collaboration to strengthen the disaster mitigation system in West Java

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Province. This integration is expected to become a model of collaborative learning involving universities, local governments, technical institutions, the private sector, and the community in a joint effort to build regional resilience and resistance to disaster risks.

LITERATURE REVIEW

Vocational Education

Vocational education is an educational approach that focuses on preparing skilled, ready-to-work personnel through practice-based learning. This system integrates campus learning with direct field experience, such as industrial internships and real-world job simulations, to equip students with specific technical skills (hard skills) that are directly applicable in the workplace (Fuller, 2015). Disaster vocational education emphasises practical, competency-based learning through a learning-by-doing approach that integrates field experience and real-life simulations. This approach has proven effective in improving preparedness, technical skills and decision-making abilities Fatmaryanti, et al, 2021).

Disaster Education

The concept of disaster education emphasises a learning process that aims to shape the knowledge, attitudes and skills of communities in dealing with disaster risks independently and sustainably. This education does not only focus on the transfer of theoretical knowledge, but also on strengthening risk awareness, preparedness and mitigation capabilities based on experiential learning and community participation (Harahap, 2024). By integrating an interdisciplinary and contextual approach, disaster education plays an important role in building disaster literacy and strengthening community resilience to disasters (Asih et al, 2023).

Multistakeholder Collaboration (Pentahelix Model)

The Pentahelix approach offers a comprehensive collaborative framework for addressing the complexities of disaster risk reduction. This model synergistically integrates the capacities and roles of five key actors, namely the government as regulator, academia as producer of innovation and knowledge, the business sector as provider of resources and technology, the community as empowered subject, and the media as amplifier of information and public education (Setyawati, 2024). The advantage of this collaborative model lies in its ability to form a robust network that encompasses both social and technical aspects. By combining the strengths of all stakeholders, Pentahelix has proven to be effective in improving disaster mitigation capacity, from the most local community level to a wider regional coverage (Kurniadi

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et al., 2023).

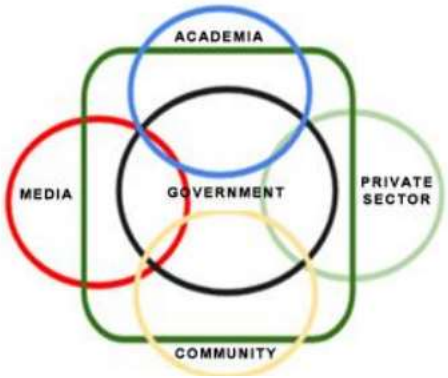


Figure 1. Pentahelix Model at Diasater Management (Source : Pujiono Centre, 2022)

Community Based Disaster Mitigation

Community based disaster mitigation places communities at the forefront of risk management by utilising local resources, traditional knowledge, and existing social mechanisms. This approach emphasises active participation, independence, and community empowerment to assess and reduce risks in a sustainable manner, rather than simply being recipients of external assistance. This model is considered more effective and sustainable than a top-down approach because it builds local capacity and strengthens social resilience to disasters. Strengthening local capacity through training, education, and policy support can accelerate the internalisation of a disaster-aware culture in the community (Paripurno et al, 2022).

METHOD

This article was compiled using a qualitative-descriptive method through a literature study, which is a research approach that systematically collects, analyses and presents data from written sources (such as books, journals, documents or reports) to describe a phenomenon, concept or issue in depth (Agustini, et al,2023). Data was collected through Focus Group Discussions (FGD) involving participants from the West Java Provincial Disaster Management Agency (BPBD), the Center for Volcanology and Geological Hazard Mitigation (PVMBG), and lecturers and students from the Disaster Management Study Programme at the Indonesian Defence University, held on 25–26 June 2025 in Bandung, West Java. The discussion focused on the role of vocational education in strengthening disaster mitigation, the effectiveness of multi-stakeholder collaboration, and the challenges of implementation in the field. The analysis was

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conducted using the Pentahelix model framework, which analyses the roles and interactions of the five main actors in the disaster mitigation system: government, academia, business, community, and media (Pujiono Center, 2022).

RESULTS AND DISCUSSION

Disaster Risks and Mitigation Challenges in West Java

Geologically, West Java is located on the Circum-Pacific and Mediterranean fault lines with seven active volcanoes and five major faults such as the Lembang and Cimandiri faults, making it a high-risk area for earthquakes and landslides. Its topography consists of lowlands in the north, hills in the centre, and steep mountains in the south, which increase the risk of flooding and landslides. Based on the results of a disaster risk assessment by the National Disaster Management Agency (BNPB), landslides are the most dominant disaster with a high hazard category in almost all districts, especially Garut, Tasikmalaya, and Cianjur (BNPB, 2021). According to data from the West Java Regional Disaster Management Agency (BPBD) on the BARATA website for the period 1 January – 30 September 2025, the most frequent type of disaster is earthquakes in the Bandung, Cianjur, and Sukabumi areas, which are prone to seismic activity due to the presence of active faults. The second most frequent disaster is landslides in the highlands of Garut, Tasikmalaya, and Sumedang, which often experience landslides, especially during the rainy season. Third are floods that occur almost every year in lowland areas such as Karawang, Bekasi, and parts of Bandung Raya (Barata, 2025).

This vulnerability in West Java is exacerbated by high population density, weak spatial planning regulations, and a lack of public awareness of disaster risks. Therefore, mitigation cannot be carried out partially, but must involve all parties in an integrated manner. As stated by Andreastuti et al., 2017, disaster mitigation in Indonesia still faces obstacles in terms of inter-sectoral coordination, budget constraints, and low public participation. Therefore, mitigation strategies must combine a top-down approach (regulation and policy) with a bottom-up approach (education and community empowerment).

Disaster Vocational Education as a Mitigation Instrument

The results of the FGD revealed that vocational education in disaster management plays a strategic role in bridging the gap between academic theory and practical needs in the field. Through a practice-based learning system (learning by doing), students are trained to analyse risks, map hazards, and design community-based mitigation programmes. In this context, students from the Defence University conducted a study visit focused on Focus Group

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Discussions with disaster management actors in West Java. This activity enabled students to understand the disaster command and coordination system, conduct field observations of institutional structures, and design empirical-based mitigation policy recommendations.

This discussion of the results is in line with the findings of Muchabaiwa & Chiweshe (2024), which show that technical and vocational education (TVE) can increase community capacity in disaster mitigation and risk reduction. The TVE programme in Zimbabwe has successfully equipped individuals and communities with the knowledge, skills, and motivation needed to prepare for, respond to, and recover from disasters. This confirms that vocational education is a key instrument in disaster risk reduction (DRR) strategies..

Disaster vocational education must adapt its curriculum to local needs and regional challenges so that learning outcomes can be directly implemented in regional mitigation systems. In this way, vocational education functions as a knowledge hub that connects academic research, public policy, and field practice (Kadir & Nurdin, 2022).

Kolaborasi Multipihak (Model Pentahelix) dalam Mitigasi

The Pentahelix model was developed as a systemic approach to synergise the roles of five sectors in disaster risk reduction. This is in line with the research by Fadlan et al., (2025) that the application of the Pentahelix model is a strategic approach in strengthening the disaster mitigation system through synergy between the government, community, business world, academia, and the media. This approach emphasises the importance of cross-sectoral coordination to ensure that disaster risk reduction (DRR) efforts are effective, adaptive, and sustainable. The roles of each party are as follows:

Government

The results of the Focus Group Discussion (FGD) show that the integration of vocational education in disaster management and multi-stakeholder collaboration creates functional synergy between academic actors and disaster management practitioners. The West Java Regional Disaster Management Agency (BPBD) acts as a policy facilitator and provider of practical training for students through the Community Service Programme (KKN) and study visits, which serve as a means of applying technical knowledge in risk mapping, early warning systems, and the preparation of data-based mitigation recommendations. This collaboration is strengthened by the role of the Geological Agency (PVMBG) as a scientific authority and provider of geological data, which forms the basis for more targeted risk analysis and mitigation planning. The synergy between BPBD, PVMBG, and vocational students creates a comprehensive

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mitigation ecosystem, connecting the dimensions of policy, science, and field practice. These results are in line with research by Sasaki et al., (2025), which confirms that the role of universities in providing mitigation policy recommendations increases when the three pillars of higher education, education research, and community service are implemented in an integrated and collaborative manner with local government agencies. This indicates that community service programmes and study visits not only serve as vocational learning opportunities, but also as a tangible form of academic contribution to evidence based policy making. However, these collaborative efforts still face a major challenge, namely limited human resources and funding for the implementation of local policies (Månsson, 2018).

Community

The role of local communities is also an important component in disaster vocational education practices. These local wisdom practices can be further studied by vocational students as part of community-based research to strengthen local wisdom-based mitigation. These local wisdom practices can be further studied by vocational students as part of community-based research to strengthen local wisdom-based mitigation. Through this approach, students not only acquire technical competencies, but also understand the social and cultural dynamics of disaster risk management (Musthofa & Indartono, 2020).

Private Sector

The role of the private sector through Corporate Social Responsibility (CSR) programmes is an important component in supporting vocational education in disaster management and strengthening mitigation capacity at the local level. In West Java, companies such as PLN and Pertamina contribute by providing shelters, emergency logistics, and evacuation simulation training, which not only increases community preparedness but also serves as a practical learning platform for vocational students in disaster management. This collaboration strengthens the link between academic theory and field practice, making the business world a strategic partner in building a contextual and sustainable disaster education ecosystem. The role of CSR in disaster risk reduction in Indonesia can be more effective if it is integrated into the disaster education and training system, rather than merely being a form of philanthropy. This study is in line with the findings of Kaur & Singh, (2024), which confirm that private sector involvement in disaster risk management can strengthen community capacity and improve local resilience when carried out in a structured and collaborative manner. Thus, partnerships

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between vocational institutions and the business world have the potential to create practice-based learning models that support disaster mitigation objectives in a tangible way.

Academics

The results of the study indicate that academics have a strategic role in developing a vocational education curriculum for disaster management that is oriented towards practical needs and regional policies. Universities such as the Bandung Institute of Technology (ITB), Padjadjaran University (Unpad), and the Defence University (Unhan) are actively conducting risk mapping and active fault analysis research, as well as collaborating with the West Java Regional Disaster Management Agency (BPBD) through study visits and Focus Group Discussions (FGDs). This synergy strengthens the field-based learning model, enhances students' competencies in risk analysis, and expands the role of campuses as centres for research and drivers of science-based disaster mitigation. These findings are in line with the research by Madlazim et al., (2023), which emphasises that the role of higher education in disaster mitigation must prioritise a multidisciplinary approach and synergy between institutions. Cross-disciplinary collaboration and partnerships between academics and technical disaster management agencies have been proven to strengthen applied research capabilities and produce mitigation innovations that are relevant to regional needs.

Media

The media plays a strategic role as a catalyst for public education and a bridge between vocational research results and the community. Through digital channels and social media, the dissemination of disaster information has become faster, more interactive, and based on scientific data. The integration of media with vocational education not only accelerates crisis communication but also strengthens disaster literacy through the dissemination of research results and good practices of students in the field. This collaboration promotes contextual learning and expands knowledge networks across actors, from campuses to communities. Research by Pranaja et al., (2024) found that the agile communication model in online platforms accelerates coordination and decision-making during emergency responses. Globally, Seneviratne et al., (2024) also highlighted that social media plays a major role in disaster management when integrated with formal education systems and continuous mitigation training.

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The Pentahelix model is an effective framework for disaster vocational education as a comprehensive mitigation instrument. Synergy between actors makes the learning process more applicable and collaborative, producing competent human resources who are responsive to the social conditions of communities in disaster-prone areas. Therefore, disaster vocational education needs to be continuously developed as a bridge between academic knowledge, field practice, and community resilience strengthening.

Vocational Education Integration and MultiStakeholder Collaboration

Based on the results of the FGD, there were three main achievements from this integration. First, field knowledge transfer, where students were directly involved in risk mapping and empirical data collection activities with BPBD and PVMBG. This experience strengthened the students' analytical skills in assessing regional hazards and vulnerabilities. Second, policy and scientific collaboration, where the results of student research were used as input for local governments in disaster mitigation-based spatial planning. Third, increased collective awareness, through vocational activities and public outreach that strengthen a culture of preparedness, mutual assistance, and disaster literacy in the community.

These findings are in line with research conducted by Hiram et al., (2024), which confirms that disaster communication in vocational schools plays an important role in the success of mitigation programmes. The study found that involving vocational students in simulations, emergency response training, and disaster awareness campaigns improves understanding and preparedness both individually and institutionally. This shows that practice-based and collaborative vocational education has a direct impact on strengthening mitigation capacity at the local level.

Furthermore, Novyanti et al., (2021) stress the value of fostering Higher Order Thinking Skills (HOTS) in vocational education in order to promote critical thinking and creative catastrophe mitigation skills. According to the study's findings, vocational students who had the chance to create instructional materials and mitigation-based learning models demonstrated a considerable improvement in their capacity for critical thought and problem-solving. These results are consistent with the FGD's findings, which emphasized the value of combining fieldwork, research, and multi-stakeholder engagement to create vocational workers that are adaptable and solution-focused..

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CONCLUSION

In West Java, disaster mitigation calls for a systematic strategy that incorporates multi-stakeholder engagement and catastrophe related vocational education. While multistakeholder collaboration increase impact through policy, technology, and community empowerment synergies, vocational education contributes to the production of skilled specialists. When the two are combined, an ecosystem of knowledge-based resilience that is flexible and focused on sustainable development is created. Businesses must focus corporate social responsibility (CSR) on mitigation efforts, academia must increase the use of practical research, the government must improve cross-sector coordination, and the media must establish itself as a reliable source of disaster education. West Java can therefore serve as a national paradigm for the implementation of sustainable multi-stakeholder-based vocational education on disasters..

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