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Challenges in Implementing Gender-based Disaster Safe Education Unit in Muhammadiyah Schools

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Abstract: Potential disaster threats that endanger students' safety require an inclusive, gender-responsive, and protective approach to disaster education for all members of the educational community. This study aims to identify the challenges of implementing the gender-based Safe School Disaster Unit (*Satuan Pendidikan Aman Bencana*/SPAB) program in Muhammadiyah schools located in disaster-prone areas in Sukoharjo Regency. The focus of the study was directed at female students' perceptions of school readiness and responsiveness in implementing gender-inclusive SPAB principles. A total of 238 female students became respondents in this study. The method used was a quantitative approach with Relative Importance Index (RII) analysis to determine the priority of the challenges faced. The results showed that the main challenges in both schools included infrastructure aspects such as safe building design, availability of emergency facilities, and lack of routine renovations. These findings emphasize the importance of integrating a gender approach in developing SPAB policies and practices to create a safe, resilient, and inclusive learning environment for all groups, especially female students.

Keywords: disaster; gender; Muhammadiyah; SPAB; Sukoharjo

Abstrak: Ancaman potensi bencana yang membahayakan keselamatan siswa menuntut pengelolaan pendidikan bencana yang inklusif, responsif terhadap gender, dan melindungi bagi seluruh anggota unit pendidikan. Penelitian ini bertujuan untuk mengidentifikasi tantangan pelaksanaan program Satuan Pendidikan Aman Bencana (SPAB) berbasis gender di sekolah-sekolah Muhammadiyah yang terletak di daerah rawan bencana di Kabupaten Sukoharjo. Fokus penelitian diarahkan pada persepsi siswi tentang kesiapan dan responsivitas sekolah dalam melaksanakan prinsip-prinsip SPAB yang inklusif berbasis gender. Sebanyak 238 siswi menjadi responden dalam penelitian ini. Metode yang digunakan adalah pendekatan kuantitatif dengan analisis *Relative Importance Index* (RII) untuk menentukan prioritas tantangan yang dihadapi. Hasil penelitian menunjukkan bahwa tantangan utama di kedua sekolah tersebut meliputi aspek infrastruktur seperti desain bangunan yang aman, ketersediaan fasilitas darurat, dan kurangnya renovasi rutin. Temuan ini menekankan pentingnya mengintegrasikan pendekatan gender dalam mengembangkan kebijakan dan praktik SPAB untuk menciptakan lingkungan belajar yang aman, tangguh, dan inklusif bagi semua kelompok, terutama siswi.

Kata Kunci: bencana; gender; Muhammadiyah; SPAB; Sukoharjo

A. Introduction

Indonesia is recognized as one of the most disaster-prone countries in the world due to its unique geological, geographical, and climatological characteristics. Situated along the Pacific Ring of Fire, the country is exposed to a wide range of natural hazards, including earthquakes, volcanic eruptions, tsunamis, floods, landslides, droughts, and hydrometeorological disasters that continue to increase in frequency and intensity as a result of climate change.[1] These recurring disasters have caused substantial human casualties, economic losses, infrastructure damage, and disruptions to essential public services. Beyond their immediate physical impacts, disasters also create long-term social consequences by interrupting community livelihoods, weakening social resilience, and reducing access to basic services such as education and healthcare. Consequently, strengthening disaster resilience has become a national priority in Indonesia, particularly within sectors that serve vulnerable populations.

Sukoharjo Regency, located in the southern part of Central Java Province, is included in an area with quite high disaster potential,[2] especially floods, earthquakes and landslides. Based on data from the 2024 Indonesian Disaster Risk Index (IRBI), the disaster risk index in Sukoharjo Regency is 64.18.[3] The impact of the disaster not only disrupts the socio-economic life of the community but also threatens the continuity of the education process,

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[1] Jumadi Jumadi et al., "Tsunami Risk Mapping and Sustainable Mitigation Strategies for Megathrust Earthquake Scenario in Pacitan Coastal Areas, Indonesia," *Sustainability* 17, no. 6 (2025): 2564, https://doi.org/10.3390/su17062564; Lusi Nuryanti et al., "The Cultural-based Model of Community Disaster Resilience in Merapi Communities in Indonesia," in *Post-Disaster Governance in Southeast Asia* (Singapore: Springer, 2022), 225–40, https://doi.org/10.1007/978-981-16-7401-3_10; Utama Alan Deta et al., "Earthquake Scientific Literacy Profile of Indonesian First Year Pre-Service Physics Teacher," *Journal of Education and Learning (EduLearn)* 19, no. 2 (2025): 890–99, https://doi.org/10.11591/edulearn.v19i2.21624.

[2] Budi Siswanto et al., "Pemetaan Daerah Rawan Tanah Longsor di Daerah Desa Sanggang, Kecamatan Bulu, Kabupaten Sukoharjo," *Dedikasi: Community Service Reports* 6, no. 2 (2024): 88–95, https://doi.org/10.20961/dedikasi.v6i2.80301; Eko Setiawan and Denis Martein Reiska, "Formulation of Natural Disaster Mitigation Strategies for Sukoharjo Regency, Indonesia by Applying Disaster Risk Assessment Approach," *IOP Conference Series: Earth and Environmental Science* 1479, no. 1 (2025): 012060, https://doi.org/10.1088/1755-1315/1479/1/012060; Adityo Wicaksono and Yunus Aris Wibowo, "Google Earth Engine (GEE) Technology for Determining Priorities for Disaster Safe Education Units (SPAB) in Sukoharjo, Indonesia," in *IOP Conference Series: Earth and Environmental Science*, 2025, 1462, https://doi.org/10.1088/1755-1315/1462/1/012058.

[3] Ridwan Yunus, ed., *Indeks Risiko Bencana Indonesia Tahun 2024*, vol. 3 (Jakarta: Badan Nasional Penanggulangan Bencana, 2025), https://bnpb.go.id/storage/app/media/Buku BNPB/BUKU IRBI 2024_BNPB_lowres.pdf.

especially for schools located in disaster-prone areas.[4] In this context, educational institutions must have a strong capacity for disaster mitigation and preparedness so that the learning process can continue even amid an emergency.[5] Therefore, it is important to maintain educational institutions, especially student resilience, in dealing with disasters.

The education sector is one of the sectors frequently impacted by disasters. According to the Badan Nasional Penanggulangan Bencana (BNPB) natural disasters in Indonesia have affected 423 educational units.[6] This data indicates that schools are vulnerable to disasters. On the other hand, schools are also places where children spend most of their time. Disaster risks and their impacts have major implications for the well-being of children in schools. Therefore, it is important for schools to promote a culture of safety and create a safe, comfortable, and welcoming environment for children, especially when disasters occur.[7]

Safe school management is crucial because, in many cases, students are highly vulnerable to disasters. This vulnerability is caused by physical, mental, and emotional factors, as well as students' dependence on the adults around them. Natural disasters not only cause physical disruption but also trauma for students. Many developed countries, such as Japan and the United States, use education to prepare children for natural disasters.[8] Education plays a crucial

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[4] Puspita I. Wardhani et al., "Evaluation of Disaster Safe Education Unit Programme Implementation in Mt. Merapi Using the Pressure State Response Approach," *Jàmbá: Journal of Disaster Risk Studies* 16, no. 1 (2024): 2, https://doi.org/10.4102/JAMBA.v16i1.1769.

[5] Colleen Halupa, "Disaster Preparedness and Response in Higher Education," in *Rebuilding Higher Education Systems Impacted by Crises: Navigating Traumatic Events, Disasters, and More* (Syria: IGI Global, 2024), 19–41, https://doi.org/10.4018/979-8-3693-1926-0.ch002; Marnelle B. Tero and Maedel Joy V. Escote, "Building Back Better: Exploring the Resilience of Schools in Disaster Recovery," *International Journal for Multidisciplinary Research* 6, no. 4 (2024): 3–5, https://doi.org/10.36948/ijfmr.2024.v06i04.25483.

[6] Yunus, *Indeks Risiko Bencana Indonesia Tahun 2024*.

[7] The World Bank, *Global Guidance for Supporting and Sustaining Safe Schools* (Washington DC.: The World Bank, 2023), https://documents1.worldbank.org/curated/en/099855212072236771/pdf/P176794-ce84f96e-6ba4-4fbc-bb86-20896cd727b0.pdf.

[8] Elisa Gavari-Starkie, María-Francisca Casado-Claro, and Inmaculada Navarro-González, "The Japanese Educational System as an International Model for Urban Resilience," *International Journal of Environmental Research and Public Health* 18, no. 11 (2021): 5794, https://doi.org/10.3390/ijerph18115794; Aiko Sakurai, "School Safety Management: International Framework and Japanese Practice," in *Risk Management in East Asia* (Singapore: Springer Singapore, 2021), 167–95, https://doi.org/10.1007/978-981-33-4586-7_8.

role in preparing for and managing disaster situations. Schools can play a vital role in educating children and building collaboration between them, both before, during, and after a disaster occurs. Similarly, National Secretariat of Disaster-Safe Schools explains that schools must be able to instill a culture of disaster preparedness by integrating it into the educational curriculum.[9] Education is key to increasing disaster resilience by encouraging flexible thinking, reflection, and more positive changes in perception. Disaster education must be dynamic, interactive, experiential, and participatory.

The Indonesian government, through the Ministry of Education and Culture, has initiated the Disaster Safe Education Unit (in Indonesia: Satuan Pendidikan Aman Bencana/SPAB) program as a form of disaster mitigation and preparedness efforts based on education.[10] This program aligns with the Comprehensive School Safety Framework program initiated by the Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector (GADDRESS). This program aims to build a disaster awareness culture in the school environment through three main pillars, namely safe school facilities, disaster management in schools, and disaster risk reduction education.[11] Although, the SPAB program has been implemented in several schools, its implementation still faces various challenges, [12] especially related to mainstreaming gender issues.

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[9] Avianto Amri et al., "National Evaluation of the Disaster-Safe School Programme" (Jakarta: National Secretariat of Disaster-safe School; UNICEF, 2020).

[10] Avianto Amri et al., "Pathways to Disaster Risk Reduction Education Integration in Schools: Insights from SPAB Evaluation in Indonesia," *International Journal of Disaster Risk Reduction* 73 (2022): 102860, https://doi.org/10.1016/j.ijdrr.2022.102860.

[11] Yusra Tebe et al., *Modul Pilar 1: Fasilitas Belajar Yang Lebih Aman Satuan Pendidikan Aman Bencana* (Jakarta: Sekretariat Nasional SPAB, 2023), 10; Yusra Tebe et al., *Modul Pilar 2: Manajemen Penanggulangan Bencana dan Kesinambungan Pendidikan Satuan Pendidikan Aman Bencana* (Jakarta: Sekretariat Nasional SPAB, 2023), 9; Yusra Tebe et al., *Modul Pilar 3: Pendidikan Pengurangan Risiko dan Resiliensi Satuan Pendidikan Aman Bencana* (Jakarta: Sekretariat Nasional SPAB, 2023), 10; GADRRRES, *Comprehensive School Safety Framework 2022-2030 for Child Rights and Resilience in the Education Sector* (Paris: Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector (GADRRRES), 2022), 4, https://gadrrres.net/files/cssf_2022-2030_en.pdf.

[12] Amri et al., "Pathways to Disaster Risk Reduction Education Integration in Schools: Insights from SPAB Evaluation in Indonesia"; Wardhani et al., "Evaluation of Disaster Safe Education Unit Programme Implementation in Mt. Merapi Using the Pressure State Response Approach"; R Zehra Zaidi and Maureen Fordham, "The Missing Half of the Sendai Framework: Gender and Women in the Implementation of Global Disaster Risk Reduction Policy," *Progress in Disaster Science* 10 (2021): 100170, https://doi.org/https://doi.org/10.1016/j.pdisas.2021.100170.

Disasters do not affect all individuals equally. Women, men, girls, boys, and individuals with diverse social identities often experience different levels of vulnerability, exposure, access to resources, decision-making opportunities, and recovery capacity. Gender inequalities that already exist in everyday life frequently become more pronounced during disaster situations, influencing evacuation processes, access to information, sanitation facilities, psychosocial support, and educational participation. Within schools, these disparities may influence students' safety, participation in preparedness activities, and access to post-disaster educational services.

One of the global frameworks currently used in disasters is the Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR), which emphasizes the integration of women in disasters.[13] This integration is carried out because several studies show that men and women have different levels of vulnerability, needs, and coping strategies in dealing with disasters.[14] These differences are related to physical aspects and social roles, access to information, and levels of vulnerability influenced by social norms and structures. Therefore, integrating gender perspectives into the SPAB is crucial to ensure that all learners, both men and women, receive equal protection and support in dealing with disaster risks.

In disaster cases, female students often face greater obstacles in accessing disaster information, safe spaces, and active roles in disaster risk reduction.[15] It shows the importance of the SPAB approach, which focuses on physical and technical aspects and pays attention to gender sensitivity as an integral part of an inclusive disaster risk reduction strategy. However, the implementation of gender-based SPAB has not received much attention in practice in the field, especially in religious-based schools such as Muhammadiyah, which have their own institutional and cultural characteristics.

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[13] Zaidi and Fordham, "The Missing Half of the Sendai Framework: Gender and Women in the Implementation of Global Disaster Risk Reduction Policy."

[14] Siti Hadiyati Nur Hafida et al., "Data Survey of Students Behavioral and Psychological Adaptations in Disaster-prone Areas of Mount Merapi in Indonesia," *Data in Brief* 42 (2022): 108229, https://doi.org/10.1016/j.dib.2022.108229; Siti Hadiyati Nur Hafida, Nor Kalsum Mohd Isa, and Mohd Hairy Ibrahim, "The Role of Psychological Adaptations in the Forming of Students Behavioral Adaptations in Dealing with Volcano Eruptions in Disaster-Prone Areas of Mount Merapi," *Disaster Advances* 15, no. 7 (2022): 19.

[15] Dewi Susilongtyas et al., "The Role of Decision Making for Family Activities by Industrial Labour of Women Migrant Based on Their Migration Characteristics," *Forum Geografi* 34, no. 1 (2020): 77–85, https://doi.org/10.23917/forgeo.v34i1.8525.

Muhammadiyah schools, as part of the Islamic education network that is widespread in Indonesia, have a strategic role in the success of the SPAB program, especially in disaster-prone areas. According to official data from Muhammadiyah, this organization has a total of 5,354 schools, including madrasa;[16] this is certainly a concern so that Muhammadiyah schools can later provide safe education services for their students. However, until now, there have not been many studies specifically highlighting the challenges Muhammadiyah schools face in implementing gender-based SPAB, especially in areas with high disaster potential, such as Sukoharjo.

Although disaster preparedness in schools has received increasing scholarly attention, existing studies have predominantly focused on measuring school preparedness levels, evaluating the implementation of the SPAB, or assessing the effectiveness of disaster education programs in improving students' knowledge and preparedness. Comparatively fewer studies have examined how gender perspectives are operationalized within school disaster risk reduction systems, particularly beyond policy discourse and into institutional practice. Research on gender and disasters has largely concentrated on community resilience, post-disaster recovery, or the vulnerability of women and marginalized groups, with limited attention to educational institutions as gender-responsive disaster governance settings. Furthermore, empirical evidence from faith-based schools remains scarce despite their substantial contribution to Indonesia's education system and disaster-prone regions. The unique organizational culture, governance structure, and religious values of Muhammadiyah schools may shape both opportunities and challenges in implementing gender-responsive disaster preparedness, yet these dimensions remain largely unexplored. Addressing this gap is crucial for deepening the understanding of women's experiences and perspectives regarding disaster risk reduction in school settings, particularly in identifying challenges, needs, and practices related to gender considerations. The findings of this study are expected to provide preliminary evidence to support the development of more inclusive disaster education policies, while also serving as a foundation for future research that more comprehensively incorporates diverse gender perspectives.

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[16] A. Aanardianto, "Sekolah Muhammadiyah Menjadi Institusi Pendidikan Swasta Terbanyak Menampung Guru dan Murid di Indonesia," *Muhammadiyah.or.id*, December 7, 2024, https://muhammadiyah.or.id/2024/12/sekolah-muhammadiyah-menjadi-institusi-pendidikan-swasta-terbanyak-menampung-guru-dan-murid-di-indonesia/.

This study aims to identify the challenges of implementing gender-based SPAB in two Muhammadiyah schools in disaster-prone areas in Sukoharjo. This study is expected to provide a real picture of school readiness in responding to female students' needs in disaster risk reduction. The results of this study are also expected to be the basis for making more inclusive and gender-responsive policies in implementing the SPAB programs in religious education environments.

B. Methods

This study uses a descriptive quantitative approach to identify and map the challenges of implementing the gender-based SPAB program in Muhammadiyah schools. The main focus of the study is directed at understanding the experiences, obstacles, and needs of female students in the context of disaster preparedness in schools. The study was conducted in two Muhammadiyah schools located in disaster-prone areas in Sukoharjo Regency, namely SMA Muhammadiyah 5 Gatak and SMA Muhammadiyah 1 Sukoharjo. The two schools were selected purposively because their locations have a high potential for flooding and earthquakes. The locations can be seen in Figure 1. The number of respondents in this study was 238 female students. Respondents were selected based on their involvement and direct experience in the implementation of the SPAB in Muhammadiyah schools. This study does not aim to compare the experiences of men and women. In this study, gender serves as an analytical lens to examine roles, participation, vulnerability, and institutional practices regarding the SPAB implementation.

Data were collected using a structured questionnaire developed based on the principal components of the SPAB framework. The questionnaire was designed by adapting the key indicators stipulated in the national SPAB guidelines and relevant literature on school disaster risk reduction and gender-responsive disaster management. The instrument consisted of three main dimensions representing the core pillars of SPAB implementation: a) Safe Learning Facilities, which examines challenges related to the availability, accessibility, and safety of school infrastructure, emergency facilities, evacuation routes, sanitation facilities, and disaster-supporting infrastructure that accommodate gender-specific needs. b) School Disaster Management, which assesses institutional preparedness,

disaster governance, emergency planning, school policies, stakeholder coordination, resource allocation, and decision-making processes supporting gender-responsive disaster management. c) Disaster Risk Reduction Education, which measures challenges related to curriculum integration, disaster education, simulation activities, teacher competence, student participation, and the incorporation of gender perspectives into disaster preparedness learning.

Each indicator was assessed using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), where higher scores indicate greater perceived challenges in implementing gender-based SPAB.

Prior to the main survey, the questionnaire underwent a comprehensive validation process to ensure its content accurately represented the constructs being measured. Content validity was established through expert judgment involving specialists in disaster risk reduction, disaster education, educational management, and gender studies. The experts evaluated each questionnaire item based on its relevance, clarity, representativeness, and suitability for measuring the implementation challenges of gender-responsive SPAB. Feedback obtained during this process was incorporated into the revision of several questionnaire items to improve clarity and content appropriateness.

Figure 1
Research Location



Source: Data Analysis Results

Following the content validation process, a pilot study was conducted involving respondents with characteristics similar to those of the target population. The pilot data were subsequently analyzed to evaluate the reliability of the instrument using Cronbach's Alpha coefficient, which measures the internal consistency among questionnaire items. According to commonly accepted standards, a Cronbach's Alpha value of 0.70 or higher indicates satisfactory reliability, demonstrating that the instrument consistently measures the intended constructs. The results of both the validity and reliability assessments confirmed that the questionnaire was suitable for use in the main data collection.

The data obtained were analyzed using the Relative Importance Index (RII). RII is a method commonly used in research to measure the level of importance of various factors based on respondent perceptions.[17] This technique measures the relative importance of each indicator of challenges female students face in implementing the SPAB. The RII value ranges from 0 to 1. After calculating the RII value for each indicator, all indicators were ranked from the highest to the lowest RII score. Indicators with higher RII values were interpreted as representing the most critical challenges in implementing Gender-Based Disaster Safe Education Units within Muhammadiyah schools. The ranking generated through the RII analysis enabled the identification of priority issues across the three SPAB dimensions: safe learning facilities, school disaster management, and disaster risk reduction education. These findings provide evidence-based recommendations for policymakers, school administrators, and disaster management practitioners in designing more inclusive and gender-responsive disaster preparedness strategies within educational institutions.

C. Result and Discussion

This analysis identifies the main challenges in implementing gender-based SPAB programs in two Muhammadiyah schools in disaster-prone Sukoharjo Regency areas. Through the RII approach, the perceptions of 238 female

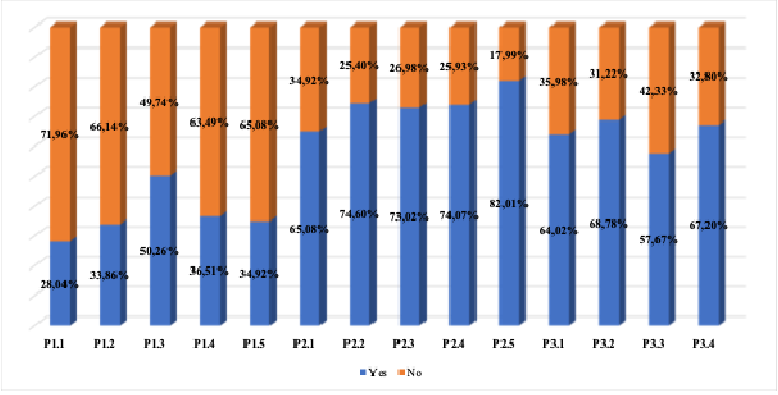
[17] S. Senthamizh Sankar et al., "Examining the Relative Importance and Association between Safety Leadership Styles and Factors Affecting Organizational Safety Climate," *Buildings* 13, no. 8 (2023): 2062, https://doi.org/10.3390/buildings13082062; Febrianti Silviana Dewi, Yusuf Latief, and Bernadette Detty Kussumardianadewi, "The Most Influential Factors on The Risk Cost Estimation Process of Implementing Bim 5d in Quantity Take-off for Green Retrofitting of High-Rise Buildings," *CSID Journal of Infrastructure Development* 7, no. 2 (2024): 262–77, https://doi.org/10.7454/jid.v7.i2.1141.

students were analyzed to determine the indicators that most influence the success or obstacles to implementing gender-responsive SPAB. These results reflect the factual conditions of the school's physical and non-physical readiness and show the extent to which the special needs of female students have been accommodated in the SPAB program being implemented.

Implementation of the SPAB at SMA Muhammadiyah 1 Sukoharjo

To provide a clearer understanding of the findings regarding the implementation of SPAB program at SMA Muhammadiyah 1 Sukoharjo, Figure 2 presents the analysis results based on the measured indicators.

Figure 2
Implementation of the SPAB at SMA Muhammadiyah 1 Sukoharjo



Source: Data Analysis Results

Based on Figure 2, these results indicate that a key challenge lies in the availability and suitability of school infrastructure to support the effective implementation of the SPAB. Regarding female students, specific needs during emergencies include access to safe and separate sanitation facilities, privacy, facilities for menstrual hygiene management, and evacuation or temporary shelter spaces that ensure protection and a sense of security. Meeting these needs becomes more difficult when school infrastructure is damaged, limited, or not designed with the specific requirements of females in disaster situations in mind. Therefore, the SPAB infrastructure must take these needs into account to ensure that disaster preparedness and response within the school

environment are more inclusive. Rohani and Rahmawati show that the infrastructure aspect is often a major challenge that occurs in schools to increase school resilience in dealing with disasters.[18]

Table 1.
Relative Importance Index in SMA Muhammadiyah 1 Sukoharjo

SPAB Pillar	Indicator	RII	Rank
Pillar 1	Design of safe school buildings or facilities (P1.1)	0.860	1
	Security inside school buildings (P1.2)	0.831	2
	Easy and accessible evacuation routes (P1.3)	0.749	5
	Routine renovations (P1.4)	0.817	4
	Special facilities or rooms for disaster emergencies (P1.5)	0.825	3
Pillar 2	Clarity of disaster emergency procedures or protocols (P2.1)	0.675	8
	Schools contacted during disasters (P2.2)	0.627	13
	Training to deal with disasters (P2.3)	0.635	11
	Learning process during disaster situations (P2.4)	0.630	12
	Emergency communication systems during disasters (P2.5)	0.590	14
Pillar 3	DRR-based curriculum (P3.1)	0.680	7
	Disaster training or workshops (P3.2)	0.656	10
	Integration of disaster education by teachers (P3.3)	0.712	6
	DRR programs or activities in schools (P3.4)	0.664	9

Source: Data Analysis Results

The indicator regarding the design of safe school buildings or facilities received the highest RII score (0.860), indicating that female respondents view the aspect of physical school safety as a primary challenge in the implementation of the SPAB. Infrastructure that fails to meet safety standards, such as buildings lacking earthquake resistance, limited evacuation routes, and inadequate emergency facilities, can heighten safety risks for the entire school community. However, from a female perspective, these conditions also present specific gender-based challenges, particularly regarding ease of mobility and

[18] R. Rohani and Tina Rahmawati, "Disaster Mitigation and Emergency Response in the School Environment," *Jurnal Penelitian Pendidikan IPA* 11, no. 1 (2025): 425–31, https://doi.org/10.29303/jppipa.v11i1.9753.

access during evacuation, the need for sanitation facilities and spaces that ensure privacy, and protection against potential harassment or violence during evacuation and emergency sheltering. Consequently, school infrastructure design within the SPAB framework must not only meet physical safety standards but also address needs related to security, accessibility, and privacy to foster a more inclusive school environment in the face of disasters. It is in accordance with Septikasari et al., with good building conditions, the impact of disasters can be minimized so that preparedness at the school level can be encouraged.[19]

Furthermore, security in school buildings is also a major concern (RII = 0.831). In this context, security includes the stability of the building structure and the guarantee of comfort and protection for female students during learning activities. Narrow spaces without multiple exits, slippery stairs, or the lack of emergency assembly points can create a sense of insecurity among students, especially girls. A safe school building can encourage a higher level of safety for students within the school.[20]

The indicator of special facilities or spaces for disaster emergencies is in third place (RII = 0.825). This finding shows that most female students feel that no space can be used for temporary evacuation, emergency medical treatment, or a separate and private safe place when a disaster occurs. The existence of this space is very important to support women's comfort and special needs, such as privacy, access to sanitation, and psychological support. Li et al. stated that optimizing public spaces can increase disaster resilience by emphasizing the creation of multi-purpose functions, ensuring effective transit areas for daily use and disaster emergencies, and building shelters.[21]

The fourth indicator, routine renovation (RII = 0.817), shows that schools have not regularly updated or maintained building structures. The periodic renovation process is important to adjust infrastructure to disaster-safe

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[19] Zela Septikasari et al., "Needs Assessment: Strategy of Integration Disaster Education at Elementary Schools in Disaster Prone Areas," *Journal of Education and Learning (EduLearn)* 18, no. 1 (2024): 244–52, https://doi.org/10.11591/edulearn.v18i1.20921.

[20] Jitendra Agarwal et al., "Safer and Resilient Schools in Seismic Regions: A Systems Perspective," *Civil Engineering and Environmental Systems* 40, no. 3 (2023): 129–49, https://doi.org/10.1080/10286608.2023.2289568.

[21] Qin Li et al., "Resilience Evaluation and Renovation Strategies of Public Spaces in Old Communities from a Disaster-Adaptive Perspective," *Sustainability* 16, no. 16 (2024): 6823, https://doi.org/10.3390/su16166823.

building standards and minimize potential hazards from building damage early on. Buildings that are easily damaged and rarely renovated can increase schools' vulnerability in the face of disasters.[22]

Finally, the indicator of easy and accessible evacuation routes (RII = 0.749) also shows significant challenges. Despite being ranked fifth, this RII score still shows that many female students struggle to access evacuation routes during simulations and in emergencies. Unclear routes, physical barriers, or those not friendly to students with special needs can hinder the evacuation process and increase vulnerability.[23] Shelters located in highly visible areas will facilitate faster evacuation and can reduce the time it takes for people to reach a safe place.

These results confirm that the main challenges in implementing gender-based SPAB at SMA Muhammadiyah 1 Sukoharjo are physical facilities and school environmental security. These five indicators show that protection for female students has not been fully integrated into disaster mitigation planning at school. Therefore, a comprehensive evaluation of infrastructure and disaster risk management at school is needed, taking into account gender needs and perspectives. In addition, these findings provide a strong signal that the implementation of gender-based SPAB is not just limited to education and simulations but must touch on technical policies and school physical planning that are responsive to the differences in needs between male and female students. This step is important to encourage the realization of educational units that are truly safe, inclusive, and resilient to disasters.

Implementation of the SPAB at SMA Muhammadiyah 5 Gatak

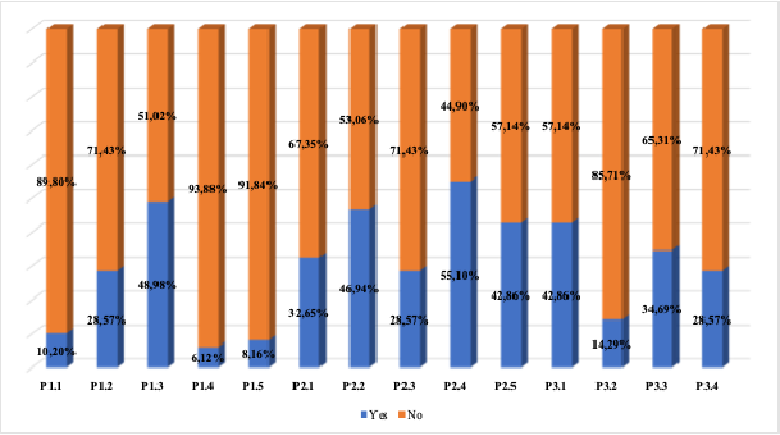
To provide a clearer understanding of the findings regarding the implementation of the SPAB program at SMA Muhammadiyah 5 Gatak, Figure 3 presents the analysis results based on the measured indicators.

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[22] Hercules Pungky Naga Dewa et al., "Vulnerability Analysis of School Buildings to Tsunami in the Cilacap Coastal Area," *Forum Geografi* 37, no. 2 (2023): 117–33, https://doi.org/10.23917/forgeo.v37i2.23269.

[23] Meng-ting Tsai and Hung-Wen Chang, "Contribution of Accessibility to Urban Resilience and Evacuation Planning Using Spatial Analysis," *International Journal of Environmental Research and Public Health* 20, no. 4 (2023): 2, https://doi.org/10.3390/ijerph20042913.

Figure 3
Implementation of the SPAB at SMA Muhammadiyah 5 Gatak



Source: Data Analysis Results

Table 2
Relative Importance Index in SMA Muhammadiyah 5 Gatak

SPAB Pillar	Indicator	RII	Rank
Pillar 1	Design of safe school buildings or facilities (P1.1)	0,949	3
	Security inside school buildings (P1.2)	0,857	5
	Easy and accessible evacuation routes (P1.3)	0,755	13
	Routine renovations (P1.4)	0,969	1
	Special facilities or rooms for disaster emergencies (P1.5)	0,959	2
Pillar 2	Clarity of disaster emergency procedures or protocols (P2.1)	0,837	8
	Schools contacted during disasters (P2.2)	0,765	12
	Training to deal with disasters (P2.3)	0,857	6
	Learning process during disaster situations (P2.4)	0,724	14
	Emergency communication systems during disasters (P2.5)	0,786	10
Pillar 3	DRR-based curriculum (P3.1)	0,786	11
	Disaster training or workshops (P3.2)	0,929	4
	Integration of disaster education by teachers (P3.3)	0,827	9
	DRR programs or activities in schools (P3.4)	0,857	7

Source: Data Analysis Results

These results indicate that the challenges of implementing the SPAB relate not only to the physical and structural readiness of schools but also to human resource capacity, particularly regarding disaster training. From the perspective of female respondents, training is crucial as it enhances knowledge, confidence, and the ability to make decisions and take appropriate actions during evacuations and emergencies. Training that is responsive to women's needs can also address aspects often overlooked in general preparedness, such as menstrual health and hygiene requirements, privacy and safety at evacuation sites, and an understanding of the risks of harassment or violence during emergencies. Thus, disaster training serves not only to build the technical capacity of students and teachers but also to ensure that the needs and experiences of women are taken into account in the planning and implementation of the SPAB. It is also in accordance with Tero and Escote, who state that teachers or school leaders have an important role in increasing school resilience in facing disasters.[24] However, if it is not balanced with disaster training, the understanding of teachers or school leaders regarding disasters is not optimal.

The indicator with the highest value is routine renovation (RII = 0.969), indicating that female respondents perceive the maintenance and upgrading of school infrastructure as not yet being carried out optimally or on a regular basis. Routine renovation is crucial for ensuring that school buildings and facilities continue to meet disaster safety standards and for minimizing risks posed by damaged or substandard structures. Safe infrastructure is fundamentally essential for the entire school community, regardless of gender. However, from the perspective of female respondents, facility maintenance must also account for needs that arise during emergencies, such as the availability of adequate, separate sanitation facilities; privacy for menstrual hygiene management; easily accessible evacuation routes; and evacuation spaces that offer protection against potential harassment or violence. Thus, routine renovation concerns not only the structural safety of buildings but also the effort to maintain school facilities that are safe, accessible, and capable of accommodating diverse needs during disaster situations. Conato, Frighi, and Sacchetti stated that renovation is important to achieve more resilient

[24] Tero and Escote, "Building Back Better: Exploring the Resilience of Schools in Disaster Recovery."

conditions by focusing on flexible and proactive design to create resilience and sustainability in the face of disasters.[25]

Furthermore, the indicator of special facilities or spaces for disaster emergencies (RII = 0.959) is second. It shows that the availability of evacuation spaces, safe gathering places, or temporary spaces for vulnerable groups such as female students has not been a priority concern. This space is important not only as a refuge during a disaster but also as a form of inclusive treatment of women's specific needs, such as access to private space, sanitation, and psychological assistance. In a disaster emergency, a safe shelter is important for people who cannot be evacuated.[26]

The third indicator is safe school building or facility design (RII = 0.949), which further reinforces the finding that physical school design still faces challenges in supporting disaster resilience. From the perspective of female respondents, a gender-responsive building design goes beyond structural integrity and the availability of evacuation routes; it also encompasses safe and easily accessible evacuation paths, adequate and separate sanitation facilities, facilities for menstrual hygiene management, spaces that ensure privacy, and lighting and spatial layouts that minimize the risk of harassment or violence during emergencies. Thus, these results highlight the need for school facility designs that are not only structurally safe but also incorporate accessibility, privacy, sanitation, and protection into disaster preparedness planning. School buildings must align with disaster management plans at national or local levels to minimize the impact of disasters, especially deaths and injuries to children during disaster situations.[27]

Interestingly, the fourth indicator on the list of challenges is disaster training or workshops (RII = 0.929), which suggests that the capacity-building aspect of the SPAB program is also considered suboptimal. Disaster training and simulations play a crucial role in building student preparedness, including the ability to anticipate obstacles that female students might face during

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[25] Fabio Conato, Valentina Frighi, and Laura Sacchetti, "Proposal of a Multiscalar Assessment Framework to Guide Renovation Actions toward a More Resilient Built Environment," in *Mediterranean Architecture and the Green-Digital Transition.* (Cham: Springer, 2023), 167–77, https://doi.org/10.1007/978-3-031-33148-0_14.

[26] Tom Caldwell and Mike Riccitiello, "Emergency Safe Havens," *International Journal of Protective Structures* 16, no. 1 (2025): 240–51, https://doi.org/10.1177/20414196241284415.

[27] Sakurai, "School Safety Management: International Framework and Japanese Practice."

evacuation. From the perspective of female respondents, such obstacles may include congested or inaccessible evacuation routes, limited information regarding evacuation procedures, the need to access sanitation and hygiene facilities, and concerns about privacy and safety at evacuation sites. Inadequate training can leave students lacking the knowledge and practical experience needed to respond to these conditions, such as identifying safe evacuation routes, utilizing evacuation spaces correctly, and understanding protection procedures during emergencies. Therefore, SPAB training needs to be designed not only to enhance technical disaster-response skills but also to accommodate the diverse needs and situations that arise during the evacuation process. Septikasari et al. stated that school disaster training is still very limited, even in disaster-prone areas, which ultimately encourages low disaster preparedness.[28]

The final indicator among the five key challenges is safety within the school environment (RII = 0.857). Although it does not rank the highest, this finding indicates that safety remains a significant concern from the perspective of female respondents. In a gender context, safety refers not only to physical protection against injury or chaos during emergencies but also encompasses adequate lighting; safe, private, and sanitary restroom facilities; sufficient supervision in school areas and evacuation sites; and an environment that fosters psychological safety and the freedom to express gender-specific needs without stigma or discrimination. Furthermore, spatial arrangements and supervision mechanisms during evacuations must account for protection against potential harassment, exploitation, and gender-based violence that may arise or escalate during emergencies. Thus, safety in the implementation of SPAB must be understood in a multidimensional sense, encompassing physical safety, privacy, psychological security, and protection against gender-based violence. According to Tebe et al., safety in school buildings is very important for disaster resilience.[29] However, schools must be able to establish health, safety, and education measures, including establishing regulations and laws, allocating sufficient budget, and educating teachers, students, and families.

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[28] Septikasari et al., "Needs Assessment: Strategy of Integration Disaster Education at Elementary Schools in Disaster Prone Areas."

[29] Tebe et al., *Modul Pilar 1: Fasilitas Belajar yang Lebih Aman Satuan Pendidikan Aman Bencana*.

These findings indicate that the challenges of implementing SPAB from the perspective of female respondents at SMA Muhammadiyah 5 Gatak are multidimensional, encompassing infrastructure readiness as well as capacity building through disaster education and training. The implications underscore that a gender-responsive approach to SPAB cannot be achieved solely through the provision of safe physical facilities; it also requires ensuring that women have equal access, participation, information, and protection across all stages of disaster management, from mitigation and preparedness to response and recovery. It entails involving women in planning and decision-making, providing equal access to disaster training and information, addressing needs regarding privacy, sanitation, and menstrual health, ensuring protection against gender-based violence during emergencies, and facilitating participation in post-disaster recovery processes. Thus, a more gender-responsive implementation of SPAB must integrate physical resilience, capacity building, participation, and protection to ensure that women's needs and experiences are not overlooked throughout the disaster management cycle.

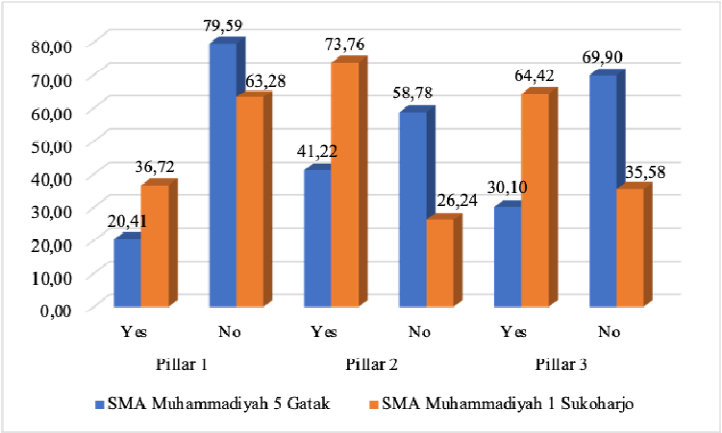
Implementation of the SPAB in flood-prone areas

In general, the implementation of the SPAB in the two schools can be seen in the following figure 4. Based on the research results presented in the figure 4, the readiness of SMA Muhammadiyah 5 Gatak and SMA Muhammadiyah 1 Sukoharjo in implementing gender-based SPAB differs significantly across three main pillars. Pillar 1 (Safer Learning Facilities) shows that SMA Muhammadiyah 1 Sukoharjo is more prepared, with 36.72% of respondents stating that their school meets the indicators for disaster-safe facilities, compared to SMA Muhammadiyah 5 Gatak, which only achieved 20.41%. Meanwhile, the majority of respondents at both schools still stated that their facilities do not meet the SPAB standards, with a higher percentage in Gatak (79.59%) than in Sukoharjo (63.28%). This indicates that school infrastructure at both schools still needs to be improved to support disaster preparedness.

In Pillar 2 (School Disaster Management and Educational Continuity), SMA Muhammadiyah 1 Sukoharjo again demonstrated better preparedness, with 41.22% of respondents stating that their school had an adequate disaster management system, compared to SMA Muhammadiyah 5 Gatak, which only achieved 26.24%. Meanwhile, more than half of respondents in Gatak (73.76%) stated that the disaster management system was not functioning properly,

while in Sukoharjo the percentage was lower (58.78%). This indicates that the implementation of disaster policies in Sukoharjo is stronger, although challenges remain in ensuring educational continuity during disasters.

Figure 4
Implementation of the SPAB in flood-prone areas



Source: Data Analysis Results

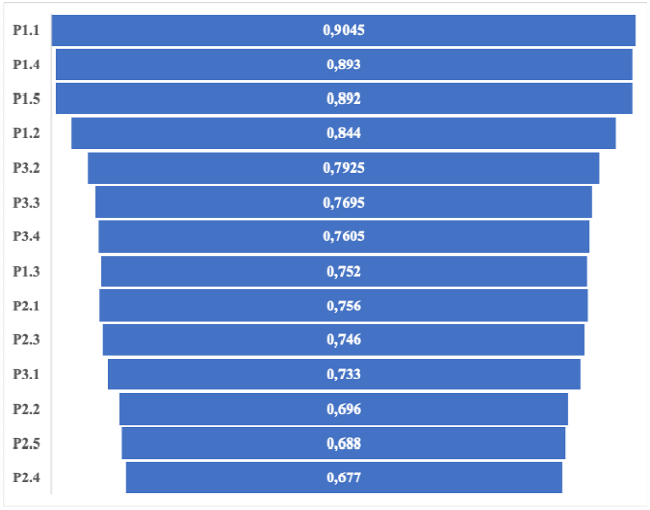
In Pillar 3 (Disaster Risk Reduction Education and School Resilience), SMA Muhammadiyah 5 Gatak had a greater advantage, with 64.42% of respondents stating that their school had implemented disaster education effectively, compared to SMA Muhammadiyah 1 Sukoharjo, which only achieved 30.10%. It indicates that despite Gatak's limited facilities and disaster management systems, the school is more active in educating students about disaster risk reduction and increasing resilience. Conversely, at SMA Muhammadiyah 1 Sukoharjo, 69.90% of respondents stated that disaster education was suboptimal, compared to 35.58% in Gatak.

Overall, this study shows that SMA Muhammadiyah 1 Sukoharjo is superior in terms of facilities and disaster management, but SMA Muhammadiyah 5 Gatak is more active in providing disaster education to students. To improve educational institutions' preparedness for disasters, improvements to school infrastructure and facilities, strengthening disaster management policies, and more comprehensive integration of disaster education across both schools are needed. Furthermore, a gender-based

approach needs to be ensured in the implementation of the SPAB (Disaster Preparedness and Disaster Management) so that all students, including vulnerable groups, receive equal protection in the face of potential disas.

Figure 5 presents the Relative Importance Index (RII) values for the challenges encountered in implementing gender based SPAB in Muhammadiyah schools. The RII values range from 0.677 to 0.9045, indicating that all investigated indicators are perceived as important challenges by the respondents. The higher the RII value, the greater the priority that should be given to addressing the corresponding issue. Overall, the findings demonstrate that the implementation of gender-responsive SPAB is influenced by multiple interconnected challenges spanning safe learning facilities, school disaster management, and disaster risk reduction education.

Figure 5
Total Relative Importance Index for gender-based SPAB in Muhammadiyah schools



Source: Data Analysis Results

Challenges in Implementing Gender-based

The analysis reveals that the three highest-ranked challenges are concentrated within the safe learning facilities dimension. The most significant

challenge is the design of safe school buildings or facilities (RII = 0.9045), followed by routine renovation of school facilities (RII = 0.893) and the availability of special facilities or rooms for disaster emergencies (RII = 0.892). These findings suggest that respondents perceive physical infrastructure as the most critical prerequisite for implementing gender-responsive disaster-safe schools. It is in accordance with research which states that infrastructure is an important variable in increasing student preparedness in facing disasters, especially for schools in disaster-prone areas.[30]

The highest-ranked indicator, the design of safe school buildings or facilities, indicates that many schools still lack infrastructure that adequately supports disaster preparedness while simultaneously accommodating the different needs of male and female students. Gender-responsive school infrastructure extends beyond structural safety; it also includes equitable accessibility, secure evacuation routes, gender-sensitive sanitation facilities, adequate lighting, accessible emergency exits, and learning environments that protect vulnerable groups during disasters. Inadequate infrastructure may disproportionately affect female students and other vulnerable groups during emergency situations, thereby reducing the effectiveness of school disaster preparedness.

The second-ranked challenge, routine renovation of school facilities, emphasizes the importance of maintaining school infrastructure to ensure that disaster mitigation measures remain functional and effective. Regular maintenance is essential for preserving the structural integrity of buildings, ensuring that evacuation routes remain unobstructed, maintaining emergency equipment, and adapting facilities to evolving disaster risks. Without continuous renovation and maintenance, even schools that have previously met disaster safety standards may gradually become more vulnerable. This finding indicates that disaster preparedness should not be viewed as a one-time infrastructure investment but rather as a continuous process requiring sustainable financial and institutional commitment.

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[30] Naof F. Al-Ansary, Mahmoud F. El-Sharkawy, and Sana A. Alsulaiman, "Safety Preparedness in Arab Public Schools," *Heliyon* 9, no. 9 (2023): e19635, https://doi.org/10.1016/j.heliyon.2023.e19635; Olena Kaidanovska and Petro Dumnych, "Current Problems of Arranging Shelters in Educational Institutions in Ukraine," *Architectural Studies* 9, no. 2 (2023): 81–95, https://doi.org/10.56318/as/2.2023.81.

Similarly, the third-ranked challenge, the availability of special facilities or rooms for disaster emergencies, highlights the limited provision of dedicated spaces that can support emergency response activities. Such facilities may include temporary shelters, emergency operation rooms, first-aid rooms, psychosocial support rooms, or safe spaces that provide privacy and protection for female students and other vulnerable groups during disaster situations. The absence of these facilities may reduce schools' capacity to respond effectively to emergencies while simultaneously ensuring the protection and well-being of all students.

Beyond infrastructure-related challenges, several indicators associated with disaster risk reduction education also received relatively high RII values. Indicators P3.2 (0.7925), P3.3 (0.7695), P3.4 (0.7605), and P3.1 (0.733) demonstrate that educational aspects remain an important concern in implementing gender-based SPAB. These findings suggest that integrating gender perspectives into disaster education, simulation exercises, teacher capacity development, and student participation has not yet been fully optimized. Although disaster education programs have been implemented in many schools, gender-responsive approaches appear to remain insufficiently integrated into learning activities and preparedness training.

Challenges were also identified within the school disaster management dimension, although the corresponding RII values were generally lower than those of the infrastructure dimension. Indicators P2.1 (0.756) and P2.3 (0.746) indicate that institutional governance, coordination mechanisms, and disaster management planning still require improvement. Meanwhile, P2.2 (0.696), P2.5 (0.688), and P2.4 (0.677) occupy the lowest positions in the ranking. Although these indicators represent comparatively lower priorities, their RII values remain well above 0.60, suggesting that school management systems still encounter considerable challenges in institutionalizing gender-responsive disaster preparedness.

When the three SPAB dimensions are compared, a clear pattern emerges. Challenges related to safe learning facilities dominate the highest rankings, while challenges concerning disaster risk reduction education occupy the middle positions, and school disaster management indicators appear predominantly in the lower rankings. This distribution indicates that respondents consider the availability of gender-responsive infrastructure to be the fundamental prerequisite for successful the SPAB implementation. Without

adequate physical facilities, improvements in disaster management systems and educational programs may not fully achieve their intended outcomes.

Overall, the RII analysis demonstrates that the primary challenges in implementing Gender-Based Disaster Safe Education Units are concentrated in the provision and maintenance of disaster-resilient, gender-responsive school infrastructure. Specifically, the three most critical challenges are (1) the design of safe school buildings or facilities (RII = 0.9045), (2) routine renovation of school facilities (RII = 0.893), and (3) the availability of special facilities or rooms for disaster emergencies (RII = 0.892). These findings indicate that strengthening physical infrastructure should become the priority in enhancing gender-responsive school disaster preparedness. Agarwal et al. state that limitations in infrastructure planning will affect security and response to various needs in schools.[31] Once appropriate infrastructure has been established, complementary efforts should focus on strengthening institutional disaster management and integrating gender perspectives more comprehensively into disaster risk reduction education. Such an integrated approach will enable schools to provide safer, more inclusive, and more resilient learning environments capable of protecting all students before, during, and after disasters.

D. Conclusion

The challenges in implementing the gender based SPAB in two Muhammadiyah senior high schools located in disaster-prone areas of Sukoharjo Regency. The findings indicate that the implementation of gender-responsive SPAB has not yet been fully optimized, as schools continue to face substantial challenges across the three core dimensions of the SPAB framework, namely safe learning facilities, school disaster management, and disaster risk reduction education. Among these dimensions, challenges related to safe learning facilities emerged as the most critical, suggesting that infrastructure remains the fundamental prerequisite for establishing disaster-resilient and gender-inclusive schools.

RII analysis identified three priority challenges that require immediate attention: the design of safe school buildings or facilities (RII = 0.9045), routine renovation of school infrastructure (RII = 0.893), and the availability of special

[31] Agarwal et al., "Safer and Resilient Schools in Seismic Regions: A Systems Perspective."

facilities or rooms for disaster emergencies (RII = 0.892). These findings demonstrate that disaster preparedness cannot rely solely on institutional policies or disaster education but must also be supported by infrastructure that is structurally resilient and responsive to the different needs of male and female students. In addition, the two schools exhibited context-specific challenges, with SMA Muhammadiyah 5 Gatak facing greater concerns regarding evacuation routes and building safety. At the same time, SMA Muhammadiyah 1 Sukoharjo showed greater limitations in conducting disaster education and simulation activities that actively involve female students.

Gender perspectives have not yet been comprehensively integrated into the implementation of the SPAB. Although schools recognize the importance of disaster preparedness, gender-responsive considerations such as equitable access to evacuation facilities, safe spaces that protect privacy, and meaningful participation of female students in disaster preparedness activities remain limited. These findings suggest that the implementation of the SPAB continues to emphasize general disaster preparedness, while the specific vulnerabilities, capacities, and protection needs associated with gender have yet to become an integral component of school disaster management and educational practices.

Overall, this study highlights the need for a more comprehensive and inclusive approach to strengthening the SPAB implementation in Muhammadiyah schools. Efforts should prioritize the development of gender-responsive school infrastructure, regular maintenance and upgrading of disaster preparedness facilities, institutional capacity building through inclusive disaster education and simulation programs, and stronger school policies that integrate gender considerations into disaster risk reduction. By addressing these priorities, schools will be better positioned to create learning environments that are not only resilient to disasters but also safe, inclusive, and equitable for all students. Furthermore, future studies involving a larger number of schools and employing mixed-methods approaches are recommended to provide a broader understanding of the institutional and sociocultural factors influencing the implementation of gender-responsive SPAB.[s]

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