

Disaster-Safe School Literacy and the Implementation of the Three Pillars in Senior High Schools and Vocational High School within Java Regional Education Office II: Implications for Sustainable Development

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ABSTRACT

Disaster-Safe Education Units (Satuan Pendidikan Aman Bencana/SPAB) play a strategic role in strengthening school resilience and supporting sustainable development. However, empirical evidence integrating disaster literacy and institutional readiness across the three SPAB pillars in Indonesian secondary schools remains limited. This study aimed to examine the level of SPAB literacy and evaluate the implementation of the three SPAB pillars in senior high schools and vocational high schools under Regional Education Office II of Central Java Province. A quantitative descriptive-comparative survey was conducted involving 58 schools selected through voluntary response sampling. Data were collected using the official SPAB assessment instrument based on the Indonesian Ministry of Education and Culture Regulation No. 33 of 2019. Descriptive statistics, Friedman tests, independent-samples t-tests, and one-way ANOVA were employed for data analysis. The findings revealed that SPAB literacy was at a high level ($M = 68.47\%$), whereas overall SPAB implementation was moderate ($M = 54.53\%$). Among the three pillars, Safe Learning Facilities achieved the highest implementation, followed by School Disaster Management, while Disaster Risk Reduction and Resilience Education showed the lowest performance. Significant differences were found among the three SPAB pillars ($p < .001$), whereas no significant differences were identified based on school status or school type ($p > .05$). These findings indicate that strong disaster literacy alone is insufficient to ensure effective SPAB implementation. Strengthening disaster risk reduction education, institutional capacity, and curriculum integration is therefore essential to foster resilient, safe, and sustainable schools.

Keywords: Disaster-Safe Schools, Disaster Literacy, Disaster Risk Education, School Resilience, Sustainable Education

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INTRODUCTION

Climate change and the increasing frequency of natural disasters have emerged as major global challenges that directly threaten the sustainability of education systems. Schools, as institutions responsible for developing human capital, face not only the risk of physical damage to educational infrastructure but also disruptions to teaching and learning activities, threats to the safety of school communities, and declines in students' learning outcomes (Pal et al., 2023; Mburuki et al., 2026). From a sustainable development perspective, education plays a strategic role in strengthening communities' capacity to understand disaster risks, reduce vulnerability, and enhance resilience to environmental hazards (Hoffmann & Blecha, 2020; Milenković & Cvetković, 2025). Consequently, integrating disaster education into the education system has become an essential strategy for developing resilient and sustainable schools.

Indonesia is among the countries most vulnerable to natural disasters due to its complex geographical, geological, and climatological characteristics (Djalante, 2018). Earthquakes, floods, landslides, droughts, extreme weather events, forest and land fires, and coastal flooding frequently disrupt educational activities across the country. These conditions require schools to strengthen their preparedness through institutional capacity building, improved disaster literacy, and the cultivation of a risk-aware school culture (Takahashi et al., 2025). Previous studies have demonstrated that schools with a high level of disaster preparedness are better able to minimise disaster impacts on students while ensuring the continuity of educational services during emergencies (Shah et al., 2020; Manca & Delfino, 2021; Widowati et al., 2023).

To strengthen disaster resilience in the education sector, the Government of Indonesia enacted the Regulation of the Minister of Education and Culture No. 33 of 2019 concerning the Disaster-Safe Education Unit Programme (Fandayati et al., 2024). The programme aims to protect students, teachers, educational personnel, and educational assets through disaster risk reduction measures integrated into school governance and management. Conceptually, SPAB is aligned with the internationally recognised Comprehensive School Safety Framework (CSSF), which is built upon three interconnected pillars: (1) safe learning facilities, (2) school disaster management, and (3) disaster risk reduction and resilience education.

A growing body of literature has demonstrated that Disaster Risk Reduction Education (DRRE) significantly improves disaster-related knowledge, attitudes, and preparedness among school communities. Integrating disaster risk reduction into school curricula enhances risk awareness, promotes adaptive behaviour, and strengthens both individual and community resilience (Paton, 2019; Masocha et al., 2025). However, the effectiveness of disaster education depends largely on the disaster literacy of school stakeholders and the institutional readiness of schools to implement disaster risk reduction policies effectively.

Numerous studies have evaluated school preparedness and the implementation of SPAB. Their findings consistently reveal a gap between policy formulation and practical implementation at the school level, particularly regarding disaster risk management, preparedness documentation, disaster training, and programme monitoring and reporting (Samsiyah et al., 2025; Syam et al., 2025; Setiawan et al., 2026). Other studies have shown that school preparedness is strongly influenced by the disaster risk knowledge of school communities and the institutional capacity to manage disaster risk reduction programmes (Mutch, 2023). Nevertheless, previous research has primarily focused on evaluating SPAB implementation or general school preparedness. Empirical studies that simultaneously examine literacy across the three SPAB pillars and institutional readiness for SPAB implementation in senior secondary education remain scarce (Ramdana et al., 2026; Setiawan et al., 2026).

This situation is also evident among senior high schools and vocational high schools under the Regional Education Office II of Central Java Province. According to the National Disaster Management Agency (BNPB) SPAB dashboard, only a relatively small proportion of schools have reported their SPAB implementation readiness compared with the total number of schools in the region (Prasakti, 2026). This low reporting rate may reflect inadequate disaster literacy, limited understanding of the three SPAB pillars, and insufficient institutional readiness to implement the programme comprehensively. Successful SPAB implementation fundamentally depends on the ability of school communities to understand disaster risk reduction principles and to translate national policies into sustainable school-based programmes (Wardhani et al., 2024; Cabatay & Gonzales, 2024; Putera et al., 2025).

Based on this review, three important research gaps were identified. First, previous studies have generally assessed overall school preparedness without examining literacy across each of the three SPAB pillars. Second, SPAB research has predominantly focused on primary and junior secondary education, while studies involving senior high schools and vocational high schools remain limited. Third, no previous study has comprehensively investigated the relationship between literacy regarding the three SPAB pillars and institutional readiness for SPAB implementation as a basis for developing evidence-informed policy recommendations for secondary education. Accordingly, this study contributes to the literature by integrating the

assessment of literacy across the three SPAB pillars with an evaluation of institutional readiness for SPAB implementation in senior high schools and vocational high schools. This integrated approach provides empirical evidence for identifying policy priorities to strengthen disaster education.

Accordingly, this study aims to: (1) analyse the level of literacy regarding the three pillars of the Disaster-Safe Education Unit Programme (SPAB) among senior high schools and vocational high schools under Regional Education Office II of Central Java Province; and (2) evaluate the readiness of these schools to implement SPAB. The findings are expected to provide evidence-based recommendations for improving SPAB implementation and supporting the development of educational institutions that are safe, resilient, and sustainable.

METHOD

This study employed a quantitative approach using a descriptive-comparative survey design to examine the level of disaster literacy and the readiness for implementing the Disaster-Safe Education Unit Programme (Satuan Pendidikan Aman Bencana, SPAB) in senior high schools and vocational high schools under Regional Education Office II of Central Java Province, Indonesia. The study population comprised all senior high schools and vocational high schools administered by Regional Education Office II of Central Java Province.

Data were collected through a questionnaire-based survey using the official SPAB assessment instrument. The questionnaire was formally distributed by Regional Education Office II of Central Java Province through an official circular addressed to all schools within the study population. A voluntary response sampling strategy was employed, allowing all eligible schools an equal opportunity to participate. Of the total population, 58 schools returned completed questionnaires that met the study's inclusion criteria and were therefore included in the final analysis.

The research instrument was developed based on the Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 33 of 2019 concerning the Implementation of the Disaster-Safe Education Unit Programme (SPAB). The instrument consisted of two major components: the SPAB literacy assessment and the SPAB implementation assessment. Disaster literacy was measured using indicators of disaster hazard awareness, access to disaster-related information, understanding of SPAB regulations, and knowledge of disaster preparedness and emergency response. SPAB implementation was assessed according to the three pillars of the Comprehensive School Safety Framework adopted by the SPAB programme: (1) safe learning facilities, (2) school disaster management, and (3) disaster risk reduction and resilience education.

Data were analysed using both descriptive and inferential statistics. Descriptive statistics, including means, standard deviations, percentages, minimum values, and maximum values, were used to describe the levels of disaster literacy and SPAB implementation. Inferential analyses were subsequently conducted to examine differences in SPAB implementation across the three programme pillars, school types (senior high schools versus vocational high schools), and school status (public versus private). The Friedman test was employed to compare implementation scores across the three SPAB pillars. Independent-samples t-tests were used to examine differences according to school type and school status. In addition, a one-way analysis of variance (ANOVA) was performed to compare SPAB implementation among four school categories: public senior high schools, private senior high schools, public vocational high schools, and private vocational high schools. All statistical analyses were conducted using a significance level of 5% ($\alpha = 0.05$).

RESULT AND DISCUSSION

The data analysis was conducted to address the two objectives of this study: (1) to examine the level of Disaster-Safe Education Unit Programme (Satuan Pendidikan Aman Bencana, SPAB) literacy and (2) to evaluate the readiness for SPAB implementation in senior high schools and vocational high schools under Regional Education Office II of Central Java Province, Indonesia. The findings are presented using descriptive statistical analyses to describe

the profiles of SPAB literacy and implementation, followed by inferential statistical analyses to examine differences in SPAB implementation across the three SPAB pillars, school status (public and private), and school type (senior high schools and vocational high schools).

To provide an overview of SPAB literacy and the implementation of the three SPAB pillars, descriptive statistical analyses were performed for all study variables. The analyses included the mean, standard deviation, minimum value, maximum value, and achievement category for each variable. The descriptive results are presented in Table 1.

Table 1. Summary of Descriptive Statistics of Research Variables

Variables	Mean (%)	SD	Min	Max	Category
Disaster-Safe Education Unit Literacy (SPAB Literacy)	68,47	16,44	28,57	100	High
Safe Educational Facilities	79,66	23,24	0	100	High
School Disaster Management	46,31	44,72	0	100	Moderate
Disaster Risk Reduction and Resilience Education	37,64	39,06	0	100	Low
Overall Disaster-Safe Education Unit (SPAB) Implementation	54,53	30,75	0	100	Moderate

Overall, SPAB literacy was classified as high, whereas the overall level of SPAB implementation was moderate. Among the three SPAB pillars, Safe Learning Facilities achieved the highest mean score, while Disaster Risk Reduction and Resilience Education recorded the lowest level of implementation.

SPAB literacy serves as a fundamental prerequisite for the effective implementation of school-based disaster risk reduction programmes. Therefore, a descriptive analysis was conducted for each literacy indicator to assess schools' understanding of disaster-related information, SPAB regulations, and disaster preparedness and response. The results of this analysis are presented in Table 2.

Table 2. SPAB Literacy Levels

Indicator	Positive Percentage (%)
Get disaster information	87,9
Knowing the potential for school disasters	91,4
Able to distinguish valid information	96,6
Understanding Permendikbud No. 33/2019	67,2
Knowing the steps for handling disasters	82,8
Have sufficient knowledge about disasters	77,6

As shown in Table 2, the overall level of SPAB literacy among senior high schools and vocational high schools under Regional Education Office II of Central Java Province was relatively high. Most respondents were aware of potential disaster hazards in their schools (91.4%), had access to disaster-related information (87.9%), and were able to distinguish valid disaster information from unreliable sources (96.6%). However, respondents demonstrated a comparatively lower level of understanding of the Regulation of the Minister of Education and Culture No. 33 of 2019 concerning the Disaster-Safe Education Unit Programme (67.2%). These findings indicate that although disaster literacy among schools is generally well established, a stronger understanding of the SPAB regulatory framework is still needed to support the effective implementation of the programme.

The implementation of SPAB may vary according to school characteristics, particularly school status and school type. Therefore, comparative analyses were conducted to examine differences in SPAB implementation between public and private schools, as well as between senior high schools and vocational high schools. The comparisons were performed across the three core SPAB pillars to provide a comprehensive understanding of implementation patterns among different categories of educational institutions. The results are presented in Table 3.

Table 3. Comparative Analysis of SPAB Implementation by School Status and School

Disaster-Safe Education Unit (SPAB) Pillars	Public Schools		Private Schools		Senior High Schools		Vocational High Schools	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Safe Educational Facilities	78,10	18,87	80,54	25,60	76,84	24,11	82,75	22,04
School Disaster Management	46,26	44,24	46,33	45,60	43,72	43,65	49,28	45,88
Disaster Risk Reduction and Resilience Education	32,54	38,90	40,54	39,39	35,41	37,24	40,12	40,91
Overall Disaster- Safe Education Unit (SPAB) Implementation	52,30	28,74	55,80	32,04	51,99	29,83	57,38	31,61

As presented in Table 3, the overall level of SPAB implementation was broadly comparable between public and private schools. Private schools recorded slightly higher mean scores than public schools on the Safe Learning Facilities pillar and the Disaster Risk Reduction and Resilience Education pillar. Similarly, vocational high schools demonstrated consistently higher implementation scores than senior high schools across all three SPAB pillars. Although these descriptive differences were observed, the magnitude of the differences between school groups was relatively small, suggesting that SPAB implementation is influenced more by the individual conditions and institutional capacity of each school than by school status or school type.

Inferential statistical analyses were subsequently conducted to examine differences in SPAB implementation across the three core SPAB pillars and according to school characteristics. These analyses were performed to determine whether the descriptive variations observed represented statistically significant differences. A summary of the inferential analysis results is presented in Table 4.

Table 4. Summary of Statistical Test Results

Analysis	Statistics	p-value	Decision
Comparison Across the Three SPAB Pillars	$\chi^2=39,88$	<0,001	Significant Difference
Public vs. Private Schools	t=-0,426	0,672	No Significant Difference
Senior High Schools vs. Vocational High Schools	t=-0,663	0,510	No Significant Difference
Four School Categories	F=0,874	0,459	No Significant Difference

As shown in Table 4, a statistically significant difference was found among the implementation levels of the three SPAB pillars ($p < .001$). This finding indicates that SPAB implementation remains uneven across its core components. The Safe Learning Facilities pillar achieved significantly higher implementation levels than both the School Disaster Management pillar and the Disaster Risk Reduction and Resilience Education pillar. In contrast, no statistically significant differences were found according to school status (public vs. private), school type (senior high schools vs. vocational high schools), or the combination of both characteristics ($p > .05$). These findings suggest that SPAB implementation is more strongly influenced by each school's internal conditions and institutional capacity than by its administrative status or educational level.

Overall, the findings indicate that SPAB literacy among senior high schools and vocational high schools under Regional Education Office II of Central Java Province was at a high level. Most schools demonstrated a good understanding of disaster hazards, disaster-related information, and disaster preparedness and response. However, the overall level of SPAB implementation was moderate and varied across the three programme pillars. The Safe

Learning Facilities pillar recorded the highest implementation level, whereas the Disaster Risk Reduction and Resilience Education pillar showed the lowest level of implementation. Inferential statistical analyses confirmed significant differences among the three SPAB pillars but revealed no statistically significant differences based on school status (public versus private) or school type (senior high schools versus vocational high schools). These findings indicate that although disaster literacy among schools is relatively well established, strengthening SPAB implementation—particularly in the areas of school disaster management and disaster risk reduction and resilience education—should remain a priority across all educational institutions.

The findings indicate that SPAB literacy among senior high schools and vocational high schools under Regional Education Office II of Central Java Province is at a high level. Most respondents demonstrated a sound understanding of potential disaster hazards in their school environments, had access to disaster-related information, and possessed basic knowledge of disaster preparedness and emergency response. These findings suggest that the cognitive dimension of disaster literacy has been well developed across most educational institutions (Gülsoy et al., 2025). From the perspective of environmental education, this reflects schools' growing role in fostering environmental literacy, which refers to individuals' capacity to understand the interrelationships between humans and the environment and to make responsible decisions that support environmental sustainability (Scharlemann et al., 2020; Shutaleva, 2023).

Despite this encouraging level of disaster literacy, the overall implementation of SPAB remained at a moderate level. This finding reveals a gap between schools' knowledge of disaster risk reduction and their institutional capacity to translate that knowledge into effective practice. Such a pattern is consistent with the Knowledge–Action Gap theory, which argues that increased knowledge does not necessarily result in behavioural or organisational change unless it is supported by appropriate institutional systems, organisational culture, and enabling environments (Willis et al., 2016). In other words, although school communities possess adequate knowledge of disaster risks, this knowledge has not yet been fully institutionalised as a sustainable culture of school safety (Hosseini & Izadkhah, 2020).

One of the most notable findings of this study is the significant difference among the three SPAB pillars. The Safe Learning Facilities pillar achieved the highest implementation level, whereas the Disaster Risk Reduction and Resilience Education pillar recorded the lowest. This finding suggests that schools tend to prioritise physical preparedness over educational interventions and human capacity development.

The strong performance of the Safe Learning Facilities pillar indicates that schools have invested considerable effort in improving physical safety through the provision of infrastructure and facilities that support disaster mitigation. Nevertheless, adequate infrastructure alone cannot ensure effective disaster preparedness without corresponding improvements in the capacity of school communities to understand, anticipate, and respond appropriately to disaster risks. Therefore, the success of SPAB should not be evaluated solely by the availability of physical facilities but also by the extent to which schools cultivate a sustainable culture of disaster risk awareness through continuous education, training, and capacity-building initiatives (Wang et al., 2020; Amri et al., 2022).

The relatively low performance of the Disaster Risk Reduction and Resilience Education pillar deserves particular attention. From an environmental education perspective, disaster education constitutes an essential component of Education for Sustainable Development (ESD), which seeks to develop citizens who are capable of critical thinking, evidence-based decision-making, and environmentally responsible action (Glavič, 2020). Consequently, strengthening disaster education should become a strategic priority for improving SPAB implementation and enhancing long-term school resilience (Glavič, 2020; Amri et al., 2022).

The study also found no statistically significant differences in SPAB implementation between public and private schools or between senior high schools and vocational high schools. This finding suggests that the challenges associated with SPAB implementation are systemic and are experienced across different categories of educational institutions. School status and school type therefore appear to play a relatively minor role in determining implementation

success. Instead, institutional capacity, school leadership, resource availability, and collaboration with disaster management stakeholders – such as regional disaster management agencies and other relevant institutions – are likely to be more influential factors in determining implementation quality (Djalante & Thomalla, 2012).

Overall, this study demonstrates that improving disaster literacy alone is insufficient to achieve high levels of SPAB implementation. Strengthening disaster-safe schools therefore requires more than increasing knowledge; it also demands the transformation of teaching and learning towards environmental education and biology education that explicitly promote resilience (Rahma et al., 2022; Rahma et al., 2024). Integrating disaster-related issues into the curriculum (Desilia et al., 2023), implementing environmental project-based learning, conducting regular disaster simulations (Arakawa et al., 2023), expanding extracurricular activities related to disaster preparedness, and strengthening partnerships with disaster management organisations represent important strategies for fostering safe, resilient, and sustainable school communities (von Meding et al., 2016; Rizky et al., 2026). In this way, SPAB functions not only as a disaster risk reduction programme but also as a vehicle for strengthening environmental literacy, scientific literacy, and sustainability competencies, all of which are fundamental goals of environmental and biology education in the era of climate change.

DISCUSSION

The novelty of this study lies in the integration of literacy and the implementation of the School-Based Disaster Preparedness and Response (SPAB) program. This integrated approach provides a comprehensive understanding of knowledge regarding the SPAB program and how schools implement it. Furthermore, this study identifies gaps in SPAB implementation based on school status (public and private) and school type (senior high schools and vocational high schools). In contrast, previous studies have largely focused on disaster preparedness, school safety, or the implementation of individual SPAB components (Amri et al., 2022; Samsiyah et al., 2025; Setiawan et al., 2026).

The findings of this study indicate that literacy regarding SPAB falls into the high category, while SPAB implementation falls into the moderate category. These findings suggest that schools' knowledge of SPAB does not fully contribute to their ability to implement SPAB. Among the three SPAB pillars, Pillar 1 ranks highest, while Pillar 3 ranks lowest. Furthermore, the findings of this study indicate that there are significant differences among the three SPAB pillars, but no significant differences were found between public and private schools or between senior high schools and vocational high schools. These findings suggest that

The findings of this study are generally consistent with previous research. Amri et al., (2022) reported that many schools in Indonesia have a good awareness of disaster risks; however, the implementation of disaster risk reduction through management and learning has not been consistent. Desilia et al., (2023) stated that schools in Indonesia have not yet fully integrated disaster risk reduction into their learning curriculum. Alhadi et al., (2026) Other research findings report that school preparedness does not depend solely on physical infrastructure but must also be supported by planning and stakeholder participation that foster a school culture, as well as sustainable educational practices (Hosseini and Izadkhah, 2020; Mutch, 2023; Rahma et al., 2024). These previous research findings reinforce the results of this study, namely that the weakest components are found in the pillars of preventive education. Wardhani et al., (2024) also confirm that preventive education constitute the weakest pillars. Based on these studies, it is evident that the two SPAB pillars requiring attention are the management pillar and the pillar of prevention education.

The commonality between this study and previous research lies in the challenges related to school management and prevention education. Schools generally possess a high level of knowledge regarding SPAB. However, the transformation of this knowledge into the implementation of SPAB has not yet been fully optimized; this requires strong leadership, policy commitment, teacher capacity, curriculum integration, and continuous monitoring. Optimizing these organizational aspects is often more difficult to achieve than improving a

school's physical infrastructure. This difference may be due to variations in the research context, as the participating schools represent a broader administrative region rather than specific high-risk disaster locations. Additionally, differences in assessment instruments, school characteristics, and institutional support mechanisms may also contribute to variations across studies.

This study contributes to the growing body of knowledge on school disaster resilience. The findings indicate that increased SPAB literacy must be accompanied by the implementation of SPAB. By integrating literacy assessment with the three pillars of SPAB, this study helps address a significant empirical gap in previous SPAB research in Indonesia. Furthermore, the absence of significant differences across school status and school type indicates that strengthening disaster-resilient schools requires institutional improvements. Consequently, this study provides empirical evidence supporting the view that sustainable disaster resilience is primarily determined by organizational readiness, governance quality, and educational integration rather than by administrative characteristics.

These findings have important practical, academic, and policy implications. Practically, strengthening Disaster Risk Reduction and Resilience Education through curriculum integration, teacher professional development, periodic disaster simulations, and collaboration with regional disaster management agencies should be a priority for schools. Academically, these findings support theoretical perspectives on the knowledge-action gap. From a policy perspective, education authorities should complement DRR literacy programs with systematic institutional strengthening, monitoring mechanisms, and evaluations to ensure balanced implementation across all pillars of DRR. Future research is recommended to use a mixed-methods design to investigate the organizational, leadership, school culture, teacher competency, and stakeholder collaboration factors that influence the successful implementation of SPAB. Such an investigation will provide deeper insights into the mechanisms through which disaster literacy can be transformed into sustainable school resilience and contribute to achieving the broader goals of Education for Sustainable Development.

CONCLUSION

This study demonstrates that the level of Disaster-Safe Education Unit Programme (Satuan Pendidikan Aman Bencana, SPAB) literacy among senior high schools and vocational high schools under Regional Education Office II of Central Java Province is high. Most schools have a sound understanding of potential disaster hazards, access to disaster-related information, and basic disaster preparedness and emergency response procedures. Nevertheless, the overall level of SPAB implementation remains moderate and has not yet been uniformly achieved across all programme components.

Among the three core SPAB pillars, Safe Learning Facilities achieved the highest level of implementation, followed by School Disaster Management, while Disaster Risk Reduction and Resilience Education recorded the lowest implementation level. These findings indicate that schools are relatively better prepared in terms of physical infrastructure than in strengthening institutional capacity and disaster education. Inferential analyses revealed significant differences among the three SPAB pillars but found no statistically significant differences according to school status (public versus private) or school type (senior high schools versus vocational high schools).

The findings further demonstrate that a high level of disaster literacy does not automatically translate into effective SPAB implementation. Therefore, future efforts to strengthen SPAB should prioritise Disaster Risk Reduction and Resilience Education through the integration of disaster-related content into the curriculum, enhanced capacity building for teachers and students, and the development of safe and sustainable school cultures. These initiatives are expected to strengthen environmental literacy, disaster literacy, and scientific literacy while supporting the broader goal of building resilient and sustainable educational institutions.

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