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Teaching for preparedness: Indonesian physical education teachers' roles in disaster education

Saryono[1]*, Joko Nurkamto[1], M. Furqon Hidayatullah[1], Komarudin[2]
[1]Universitas Sebelas Maret, Indonesia
[2]Universitas Negeri Yogyakarta, Indonesia
*Corresponding Author: saryonosar@student.uns.ac.id

ABSTRACT

Indonesia's high vulnerability to natural disasters has placed increasing importance on the Disaster Risk Reduction (DRR) education. Much of the existing literature emphasizes disaster education in scientific school subjects, but physical education (PE) remains underexplored yet promising. This qualitative study investigated the perceptions of PE teachers in disaster-prone regions of Central Java, Indonesia, and the implementation of disaster education in their teaching practices. Drawing on semi-structured interviews with 14 junior high school PE teachers, thematic analysis revealed three central themes: 1) the contextual realities shaping teachers' experiences, 2) the perceived value of PE as a vehicle for disaster education, and 3) the creative pedagogical strategies in disaster education. Despite limited curriculum support, teachers integrated disaster education through warming-up routines, simulation games, and fitness activities to develop agility, coordination, and leadership among students. The findings highlight PE's applied and experiential aspects as well as its potential for interdisciplinary collaboration. However, the study also exposes systemic barriers, such as centralized policy constraints and lack of institutional support. To enhance disaster preparedness in schools, the study advocates for policy reforms that integrate disaster education into the PE curriculum and promote localized and context-sensitive practices. These efforts can contribute meaningfully to student safety, community resilience, and holistic educational development.

Keywords: physical education, disaster education, pedagogical practices, emergency preparedness, curriculum integration

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INTRODUCTION

Being the largest archipelago in the world, Indonesia presents a geographical landscape with a number of magnificent volcanoes covered by lush rainforests and inhabited by wildlife. Despite its natural charms, the geographical location of Indonesia contributes to its high risk of natural hazards. Situated along the Pacific Ring of Fire, the country is exposed to numerous active volcanoes, which increase the potential risk of eruptions (Widyangga et al., 2024). Indonesia also sits on the confluence of the Eurasian and Indo-Australian tectonic plates, which makes frequent earthquakes a daily occurrence. This is especially more apparent among densely populated islands lying on the active fault zones, such as Sumatra and Java (Ichsan et al., 2024).

In the global context, disaster losses continued to be extensive, leading to the development of frameworks for Disaster Risk Reduction (DRR) in the last two decades. Living in such high-risk areas of natural disasters, proactive planning and strategies through DRR become central for Indonesia. Scholars have paid attention to disaster risk management in the country. Koopman (2023)'s ethnographic work with a community on Lombok Island revealed that indigenous knowledge and faith-based institutions promoted social capital and disaster preparedness. Additionally, Vivita et al. (2023) focused on place attachment to and "build back better" around

a place of worship in post-disaster communities in Aceh. The researchers demonstrated that a mosque has met the criteria for serving as a tsunami evacuation facility.

Furthermore, one of the central strategic endeavors for DRR includes education. Literature has documented information on the importance of disaster education, comprising its potential to enhance awareness and preparedness among students and the school community (e.g., Gökbulut et al., 2024; Wang et al., 2023), mitigate psychological impacts (e.g., Hu et al., 2023), and address vulnerability in disaster-prone areas (e.g., Tamwifi & Akbar, 2024). Despite a growing volume of empirical information, the implementation of disaster education within the context of Indonesia seemed to be sporadic, even in the most affected areas. This condition is, in part, created by a lack of coherent policy and program, along with limitations of infrastructure and resources. For example, Amri et al. (2022)' study demonstrated that while local governments' initiatives were critical for schools to adopt DRR, these stakeholders hesitated to invest in disaster education. Djalante et al. (2012) have long criticized that there were a lack of systematic learning and a lack of commitment from the local governments to prioritize DRR in broader development agendas.

Despite the absence of systematic approaches to disaster education, such educational provisions have often been independently attempted by local schools for mitigating natural hazards. Several studies have documented typical school-wide programs such as preparedness drills (Amini Hosseini & Izadkhah, 2020; Sakurai et al., 2018) and curriculum development and training programs (de Mendonca & Valois, 2017). After all, teachers are the forefront of these endeavors while schools might not specifically develop and systematically implement disaster education. Jaffar et al. (2024) argued that teachers have apparently done all they can to adapt their teaching methods to integrate disaster education. When professional development programs are available for them, teachers may further carry out their learning in their practices. Gundran et al. (2022) reported that teachers who participated in a workshop about integrating didactic and simulation learning approaches were able to develop their knowledge about the concept of communication, collaboration, and application of command systems during disaster response. However, this is not always the case. Scholars have argued that teachers' knowledge and skills do not always lead to behavioral changes in students. This motivated Nakano and Yamori (2021) to propose a proactive attitude paradigm that could potentially facilitate teachers to implement continuous, sustained disaster mitigation education.

Limited information is available, but much literature portrays geography education as a strategic subject for disaster mitigation education. A study on the Malaysian curriculum showed that geography education has listed types of natural disasters alongside the priority actions for DRR (Hawa et al., 2023). Similarly, Sun et al. (2024) performed content analysis of secondary school geography textbooks in China and the United States. They found that a major portion of disaster-related content focused on "understanding disaster risk" and enhancing disaster preparedness" (p. 6). This might facilitate teachers in addressing students' understanding and preparedness. Insignificant content concerning disaster risk management might prevent a coherent understanding of systemic approaches needed for disaster mitigation education. Additionally, Masocha et al. (2025) argued that school curricula tended to overly emphasize the knowledge dimension while inadequately addressing practical skills, attitudes, and community participation. Therefore, pedagogical approaches geared toward more active, experiential, and inquiry-based learning within the community contexts become important.

Other teachers may take advantage of cross-disciplinary curriculum and extracurricular programs. This knowledge is demonstrated through a semi-systematic literature review focused on the 29 publications about school ecosystem-based disaster risk education in well-reputed journals from 2000 to 2020 (Rahma et al., 2024). The review has revealed that disaster education was not holistically implemented with other important aspects, such as climate change and sustainability. Jaffar et al (2024) reported that extracurricular programs helped introduce knowledge, skills, and competencies regarding disaster mitigation among students. This was especially apparent when related stakeholders collectively played roles in managing the programs.

The fact that new knowledge concerning disaster education continues to grow means it has largely been understudied in physical education studies. Meanwhile, the nature of the subject matter alongside its pedagogies has unique potential for delivering disaster education. Indeed,

studies on disaster education have explored various aspects of the programs that may go hand in hand with physical education (PE). These aspects comprise pedagogical and learning approaches toward the program design, learning activities, and impacts that are congruent with those in PE. In the context of Brazilian landslides, for example, de Mendonca and Valois (2017) focused on designing a semester-long course to provide alternatives to dominant engineering works toward DRR. The researchers approached their program from a cultural perspective by establishing a meaningful learning paradigm and the balance between theoretical and practical sessions. Furthermore, physical education curriculum in many parts of the world combines theory and practice about, through, and in movements (see Brown, 2013). Meaningfulness as well as meaninglessness of students' experiences in PE have also been developed in Meaningful Physical Education (MPE). Featuring social interaction, fun/delight, challenge, movement competency, and personally relevant learning (Beni et al., 2019; Fletcher et al., 2018, 2021), the pedagogical principles of MPE include democratic approaches and reflective processes, also promising to approach meaningful disaster education.

Furthermore, information on game-based learning in disaster education seems to be conclusive (e.g., Arakawa et al., 2024; Contreras, 2022; Gargiulo et al., 2024; Marahatta et al., 2024; Pandya et al., 2024; Tsai et al., 2015). By using simulation, strategy, and augmented reality games, such an approach to learning can potentially engage and motivate students through collaborative learning and real-time feedback. For example, Marahatta et al. (2024) developed interactive games designed for preparedness and response to natural disasters in Nepal. Findings showed that the games played a role in empowering children from underserved communities, as well as promoting disaster preparedness and response despite limited resources available in the communities.

In spite of this invaluable understanding, research on physically active game-based learning appeared to have a minor contribution to the body of knowledge. The work from (Guinto & Logan, 2022) developed a sport-based initiative for a post-disaster event. By involving PE teachers and students affected by typhoon Haiyan in the Philippines, their psychosocial-based program revealed that sport-related activities served beyond what sports could offer. It supported the survivors with aspects of psychosocial care and facilitated post-disaster recovery. Another study by (Newland & Legg, 2024) echoed similar findings, that a physical activity program specifically designed to support the affected communities was able to redevelop feelings of belonging, social connection, and vital roles of leadership in addition to the benefits of exercise. In addition to this limited information, one dimension of disaster mitigation being addressed tended to be measures being taken to reduce the destructive effects of disaster events. Agenda items are apparent here in which attention should also be given to reducing the harmful impacts of hazards that remain potential to happen. The purpose of the current study was to investigate Indonesian PE teachers' opinion about their subject matter in connection with disaster education and their pedagogical practices to implement it.

METHOD

The study employed a qualitative method, methodologically framed by an interpretivist paradigm. The study took place in a school district located right at the hillside of an active volcano in central Java. Living in the Ring of Fire with first-degree seismic zone status and volcanic activity, the residents encountered frequent eruptions and earthquakes. The district is also situated on the northern tip of a metropolitan city that was devastated by the 6.2 Richter earthquake in 2006. More than one hundred thousand people were affected by the earthquake, and more than six thousand people were killed.

Participants of the study were middle school physical education specialists selected by purposive sampling. The criteria for inclusion included their schools being located in the high-risk areas of natural disasters. They have also worked in the geographical area for at least 5 years. A number of 10 males and 4 females physical education teachers participated in this study. Their ages ranged from 30 to 55 years old with the average age being 34 years old.

Data was collected through semi-structured interviews. An interview protocol was developed with three overarching questions regarding their experiences with natural disasters, their ideas about the subject matter in connection with natural disasters, and their teaching practices of disaster preparedness and education. The protocol was also reviewed by three experts and then piloted to enhance credibility of the study. Informed consents were obtained from the participants prior to conducting the interviews. All interviews were digitally recorded with a total length of the recordings being 590 minutes. They were also verbatim transcribed for further analysis.

The data is analyzed by the thematic analysis of Braun and Clarke (2006). The procedure included data familiarization through which the researchers read and reread the transcripts. Then, initial coding was performed inductively by working closely with participants' statements and paying attention to implicit meanings. The next steps were to identify and develop themes, to categorize codes, and then to develop network visualization. Lastly, themes were defined and named prior to describing the results. A computer assisted with qualitative data analysis, namely ATLAS.ti 25 were used to help with all the analysis process.

FINDINGS AND DISCUSSION

Findings

Analysis demonstrated three constructed themes. These are the contexts in which the participants practiced disaster education, the arguments about PE as a vehicle for disaster education, and their actual practices of teaching disaster education within the subject matter. The following subheadings describe the analysis.

Context matters

The participants lived in an area exposing them to the ever-present risk of natural disaster. Located at the base of the volcano as well as sitting atop a geological fault line, they were constantly exposed to the unpredictable threat of volcanic eruptions and earthquakes. The city is also situated on the edge of the island facing the Indian Ocean. If a large-scale earthquake were to occur, a tsunami might potentially devastate much of the southern part of the city. All participants were knowledgeable about the hazards and risks of natural disasters in their areas. For example, Bintoro described,

In the South Mountains Districts, schools are at risk of landslides, sir, and also areas alongside the beaches. In the northern part of the city, a bit up toward the volcano, the volcano crater is a real threat, and also at schools in the west. There, the problems are more complex, caused by cold lava floods. We live in a ring of fire, right? So, potentials or possibility of a natural disaster might happen at any time.

Analysis showed that all participants reported their experiences of having at least one large-scale natural disaster either before or after being appointed as their teachers. Murti as a pseudonym, who was a senior female teacher, was about to go to her school when a 2006 earthquake shook the city in the early morning. Despite major devastation, she kept going because she wanted to take care of the students who might already be there. But rumors about the incoming tsunami made her decide to go to a higher place instead. "I remember how messy at that time, people panicked and ran around to save themselves. They all went north because it was said the ocean water had reached Piyungan (nearby neighborhood)." (Murti, interview with teachers, 2025).

The youngest participant, Binto as a pseudonym, was still an elementary school student when that event occurred. Living in such proximity to the volcano, Binto reacted to the earthquake as it was related to the eruption. He described, "I rushed out of the house because of the quake, and spontaneously we looked at the lava dome. We really concerned about Merapi." (Binto, interview with students, 2025). Bintoro's expression represented how natural disaster was perceived as a constant threat to the residents of the communities.

Most teachers also identified that several natural disasters coexists during their career-long journey at schools. This could range from floods to volcanic eruptions. For example, Agung

described one morning in 2014 when Mount Kelud erupted. It was a terrible eruption with which its volcanic ash had paralyzed several cities in most parts of the Java island. His story about the event was heroic because the school community worked together to evacuate the students and send them home safely. Meanwhile, the most severe, large-scale, devastating disasters right in the areas were the 2006 earthquake and simultaneously volcano eruption. In 2010, another great eruption also happened again.

The context in which the participants' experience took place also included their students. Despite frequent earthquakes and volcanic eruptions, they had no or little experience of natural catastrophic events. By the time this study was conducted, they either had not been born yet or were still toddlers. One of the interviewees, Ibni as a pseudonym said, "Even though the kids live in the volcanic hazard zones, they haven't yet experienced huge eruptions themselves." (Ibni, interview with teachers, 2025).Furthermore, most participants stated that they had assumed dual responsibilities when it came to school emergencies, whether they were minor accidents or natural disasters.

Having no direct experience made the instructions a little challenging. In the situation, there is an impromptu and cultural practice that PE teachers would expectedly be in charge of taking the lead in handling urgent situations and emergency preparedness. Aji said, "we have to be upfront in the sense of giving command. I also experienced that in my two previous schools. We have been encouraged to be the commanders." (Aji, interview with teachers, 2025). PE teachers are more likely to assume that doing the commands, might look for the kids, and put them in an emergency assembly point. These dual responsibilities of PE teachers, as both educators and leaders in emergencies, underscored the salient role they play in ensuring student safety. In short, this emphasized the importance of their authority, preparedness, and responsibility.

In addition, the educational system, both nationally and locally, has provided contexts in which the participants' experiences of disaster education took place. The national education system was somewhat centralized in one way or another. For example, the national government has established educational standards that all schools need to follow. More specifically, the national curriculum has been put into effect in the last three decades, during which local governments have little or no authority to adapt to their local contexts. This included adapting the standards for disaster education needed in areas where natural disasters lurk. All teachers participating in the current study stated that there was no opportunity for disaster education to be officially integrated into the PE national curriculum. Murti, as a pseudonym, an experienced teacher, described that there were once content standards called for the delivery of safety education by which disaster education could be integrated. "Previously, the curriculum allowed for the integration of disaster mitigation education, although only in a limited capacity. At that time, I taught the content, and it proved to be meaningful. Students gained essential knowledge, particularly regarding tectonic disasters such as earthquakes, which equipped them with a basic understanding of how to respond if such events occurred" (Murti, interview with teachers, 2025). Implicit in the narrative is a sense of contrast between the earlier curriculum and the current one. The participant's recollection suggests that the earlier framework allowed space for contextually relevant and locally meaningful knowledge, whereas such space appears to have diminished in the present curriculum arrangement. The account therefore, not only describes pedagogical practice but also reflects a perceived shift in curricular priorities and the types of knowledge deemed legitimate within formal education.

Arguments about the importance of PE

Considering the context in which the schools were situated, all the participants argued that PE played an important role in disaster education. Agung said, "Yes, PE is very useful. Because we live in an at-risk area, whatever the disasters. For us, foremost, we are very close to the volcano, and other disasters can still happen, such as earthquakes and typhoons." (Agung, interview teachers, 2025). Despite the existence of interventions from local governments, they seemed to be sporadic disaster education programs. The government has formed school-based disaster preparedness for schools located in high-risk areas. Some non-profit organizations also contributed through their own program development. However, none of these programs were

long-lasting, mainly because of their dependence on the availability of public funding as well as the political interests of the local representatives. As a result, grassroots disaster management authorities could only suggest that schools regularly conduct disaster education programs on their own. PE teachers, among other school communities, had to navigate through the available schools' resources to deliver such programs. For example, the teachers who participated in this study identified specific potential contributions that PE could make. These include learning in terms of physical fitness and development, as well as the applicative and transferable natures of the subject matter. Prominent information about the dimension of physicality in PE for delivering parts of disaster education is mainly through teaching about disaster preparedness. All participants believed that embedded in the subject matter were physical aspects. Through the orientation of PE as education of the physical, they considered that disaster preparedness required students' physical fitness to respond quickly in emergencies.

PE was promising in helping students develop those skills and competencies. Furthermore, analysis revealed that participants paid attention to the significance of personal effectiveness under mass panic situations. This included abilities to make fast and accurate decisions, leadership roles, and responsibilities that could likely be learned from activities in PE. A middle school teacher in her mid-career, Sito, shared her argument that teenage years were a momentum to teach such personal effectiveness through PE. "Sometimes they haven't yet been good in decision making. They just tend to follow what others do. I think PE for disaster education should help children develop abilities to make decisions, leadership, and self-responsibility. If they get used to dealing with simulated disaster situations, possible fatalities could be minimized." (Sito, interview teachers, 2025)

Further analysis showed participants' beliefs regarding the nature of PE pedagogies that uniquely provided application and transfer. They credited that inherent in their teaching was the facilitation of learning knowledge and skills through practice and application. Mayowi, another interviewee, stated that such learning might not explicitly be the curriculum intention, but she believed that the applicative nature of PE pedagogies can ultimately be transferred to real-life situations. Equally important, data showed the emphasis of an interdisciplinary approach to disaster education. Participants reported shared responsibility in delivering such learning.

However, school-wide programs or other subject matters were considered to lack transferability, focusing on the knowledge development per se. Ability to transfer learning in real situations was attributed to PE as much as its pedagogical practice that included applicative aspects. The distinction between conceptual knowledge and practical enactment was further emphasized by another participant. "I think if it is applicable for knowledge and understanding, how to do this and that. But in PE, you've got how to practice it," (Merry, interview with teachers, 2025). Her statement highlights a perceived difference between subjects that primarily transmit cognitive understanding and those that provide embodied, experiential learning.

This contrast suggests an implicit hierarchy between declarative knowledge and procedural competence within the curriculum. The participant's reflection indicates that preparedness is not merely a matter of understanding instructions but of rehearsing action. In this sense, PE becomes a site where knowledge is enacted rather than merely internalized, revealing tensions between curricular domains that privilege cognitive mastery and those that cultivate embodied readiness.

PE pedagogical practices for disaster mitigation education

Data analysis resulted in several sub-themes, including the insertion of disaster education into the curriculum, warming up routines, and game-based content. These pedagogical practices apparently emerged from the geographical as well as education policy contexts and the participants' line of reasoning for implementing disaster education in PE. The following paragraphs describe detailed aspects of PE pedagogical practices for disaster education.

The fact that the PE national curriculum did not explicitly mandate content related to disaster education, participants navigated their practices of delivering disaster education by inserting it into the already overloaded content. Within the current curriculum, there was one possible way to teach disaster mitigation, which was through content about first aid. Apart from that content, all participants had to insert mitigation education sporadically throughout the

mandated curriculum. They believed that disaster education had to be continuously carried out. Students living in high-risk areas needed to be reminded all the time about seemingly unpredictable natural disasters, even if they only had a couple of minutes to do it. More specifically, they took advantage of the nature of the psychomotor domain by periodically performing disaster simulations and evacuation drills. Although their pedagogical practices might not be systematic and coherent, teachers utilized the curriculum resources available to them. If they had taught mandatory content, learning could potentially be boring, and teaching might be challenging. Agung shared his experience, "If I had had specific materials to be delivered, my students would be uninterested. But if I insert disaster education into an existing lesson, they'll happily take it" (Agung, interview with teachers, 2025). However, about half of the participants argued that the effectiveness of the delivery was so dependent on teachers' creativity and innovation. Sito argued, "If it ain't assigned in the curriculum and we want to do the insertion, that's dependent on each teacher's innovation," (Sito, interview with teachers, 2025).

Having no place within the national curriculum, inserting disaster education has been practiced in PE through warming up as well as cooling down sessions. It reveals the importance of warming up to energize before actual learning. This was especially true when it involved game-based activities. Participants considered such warming up to be fun and engaging activities. The games provided opportunities for students to learn about disaster preparedness, especially concerning emergency rescue protocols. Hadi said, "It is applied using games with running. Later, in a group of five, they are instructed to get together in one place and run toward a certain target point. The purpose is that if there is an earthquake, for example, they must go to the assembly point," (Hadi, interview with teachers, 2025). Similarly, Ibnu, who worked with the community near the volcano, took advantage of warming-up sessions for teaching evacuation procedures. "We teach students how to handle it and how to evacuate. I used to warm up with action-reaction. If there is a natural disaster, how to act accordingly can be learnt from the warming-up sessions. So, it is expected that students acknowledge what to do when the volcano erupts," (Ibnu, interview with teachers, 2025).

Despite many of the participants focusing on the warming-up sessions, some others also used the time in cooling-down sessions to sneak disaster education into the subject matters. This was usually when they needed to address aspects of knowledge related to disaster education. After high energy from physical activity, learning such knowledge would require a conducive environment. Bintoro shared his reasons for practicing his pedagogy, "While my students were cooling down, while the temperature cools off, while their breath slows down, easy, so I can facilitate learning by connecting what they've learnt to disaster preparedness."

In addition to warming-up and cooling-down sessions, the unique instructional characteristics of PE have been argued to be opportunities for teaching disaster education. Some participants (N=5) stated that their instructional practices resembled instructions under emergencies. More specifically, the teachers described that students needed to understand signs and safety procedures and strictly enact those when a natural disaster occurred. Failure to abide by the procedures could result in more destructive and fatal disaster impacts.

Instructions in PE contained direct command which could be a teaching of disaster preparedness, despite the actual occurrence could be a different scenario. For example, Ibnu said, "I teach my students routines. If I blow my whistle, a very long whistle, all must gather in one assembly point. They got used to it, and this may work to prepare them for disaster. Though I have no idea if it really happened, and when they panic," (Ibnu, interview with teachers, 2025). Other participants informed that they could incorporate mitigation strategies through their pedagogy and learning content they facilitated. Bintoro described his experience of teaching movement skills, with instructions being given as to mirroring instructions for safety procedures. If we want to stimulate, we then pretend that there is a whistle-blower, meaning there is a typhoon coming. Once the whistle sounds, they gotta be lying on the ground or in a position as low as possible above the ground. Then, with two whistles, they must move to a safe place. Something like that.

The data demonstrated pedagogical practices of facilitating disaster education through actual curriculum delivery. In other words, participants applied such education within the content

coverage being officially mandated by the national government. Rather than sporadically inserting messages of mitigation education into lesson routines such as warming up and cooling down, teachers in this study were more systematic and structured. They carefully crafted pedagogical actions for disaster preparedness, evacuation protocols, and safety procedures alongside learning PE materials, notably through game-based activities and fitness units.

What was deemed to be most salient for disaster education were physical fitness components, most notably agility and reaction capacities. Other components important for disaster preparedness included strength, endurance, power, and speed. Therefore, teachers' pedagogical practices within the curriculum framework comprised the facilitation of learning those components as well as their development. For example, participants took advantage of sport-based content to develop speed and reaction time. Hadi described his experience, "In a soccer unit, I help students develop their speed and reaction. I also add strength within the unit, or also in the volleyball unit." Analysis also revealed that some of these teachers developed their own games that were specifically designed for disaster evacuation protocols. Agung created what he called the Right-Left Game. "I mean, if I say, 'go to the right', they have to go to their right side. Or, if I say, 'go to the left', they must go left. But the next level of the game is to do the opposite of what I say. This way, I teach them how to be alert," (Hadi, interview with teachers, 2025). Bintoro echoed the same thing, "I use running games, I mean running as a reaction for some signs. This will train their reaction, teach them concentration, and equip them with focus," (Bintoro, interview with teachers, 2025)

As they believed that the state of having physical fitness was central, fitness units were often tied to preparedness. Aji described his practices, "There is also content about physical fitness. There we go. There are fitness components, such as agility, that I helped students relate to their readiness for emergencies," (Aji, interview with teachers, 2025) More specific activities, including circuit training, were also deemed to be strategic to address all aspects of physical development. All these capacities were considered salient for saving lives in the event of an emergency.

Discussion

The current study focused on how PE teachers living in disaster-prone areas perceived their roles in disaster education and how they enacted related pedagogical practices. Physical education has long been considered a social construction through which its natures and purposes have evolved from one historical period to another (Kirk, 2012; Kirk & Macdonald, 1998). Specific aspects of PE practices, such as ableism, gender, and body surveillance, have also been studied (Azzarito, 2009; Evans & Penney, 2008; Hay & Macdonald, 2010). Along with the notion of disaster education as also socially constructed (Oliver-Smith, 2016), PE teachers participating in this study actively constructed their subject matter in relation to disaster education. In other words, this active construction can be regarded as how PE teachers enacted proactive participation for broader disaster education efforts (Kitagawa, 2021). Analysis apparently showed a confluence of contextual realities, their beliefs and arguments about the roles they could play, and their pedagogical creativity within the bounded contexts of disaster-prone zones. Together, they shaped PE teachers' unique contributions to disaster mitigation education in Indonesia.

In fact, their situated practices served as an important foundation for disaster education. The lived experiences of being exposed to natural disasters have provided the teachers as well as their students with deep contextual knowledge of disaster risks and the calls for their management. The pedagogical creativity displayed by PE teachers in this study can be seen as a manifestation of social capital within the school community. As Tohani and Wibawa (2019) found in communities on the slopes of Mount Merapi, social capital, including shared values, trust, and networks, plays a vital role in disaster management by enhancing community awareness and solidarity. This deep-seated contextual knowledge, however, is coupled with significant personal and professional challenges. As Utomo et al. (2019) found, teachers in disadvantaged areas, which often overlap with disaster-prone zones, face unique pressures that can impact their teaching motivation. Their study highlights that in such contexts, external factors like school climate and internal factors like self-concept and basic psychological need satisfaction are crucial in shaping

a teacher's motivation to teach effectively. Therefore, for the PE teachers in this study, their proactive engagement in disaster education is not only a response to environmental threats but also a reflection of their resilience and motivation, which must be continually supported by a positive school climate and opportunities for professional fulfillment.

This contextual knowledge is salient for approaching disaster education by employing innovative learning such as place-based education (Koopman, 2023; Shiwaku & Fernandez, 2011) or experiential learning (Sutton & Kaufmann, 2018). Unfortunately, such innovative practices were challenging when the national curriculum was insufficiently supportive. More specifically, studies have informed that centralized curriculum may be driven by external forces such as economic interest and neoliberal conditions and therefore at risk of being disconnected from local educational needs (Ditchburn, 2012; Stefenon, 2021). Data analysis has emphasized that specific societal and geographical contexts call for decentralized curriculum design that enables adaptation and flexibility, especially in the high-risk areas of natural disasters.

One way or another, the national curriculum has embedded disaster topics into school curricula at all educational levels and some subject areas, notably geography, sciences, and social studies (Partini & Hidayat, 2024). Specific to the PE curriculum, there seemed to be no explicit mandate for delivering disaster education. Instead, the participants identified only a narrow channel through which some aspects of disaster education could creatively be touched upon. This has led PE teachers in this study to innovatively improvise their pedagogical practices in any way they could. Without disregarding their efforts, however, existing studies demonstrated that reliance on one single aspect of DRR (i.e., teacher innovation) or a less systematic approach can imperil consistency, equity, and effectiveness of disaster education delivery (Amri et al., 2022; Djalante et al., 2012).

Furthermore, analysis revealed that PE teachers assumed responsibility as emergency leaders in addition to their main role as educators. There is little information from the literature about PE teachers' vital function to ensure student safety in a disaster. While school leadership is valuable in disaster response (Nakano & Yamori, 2021), PE teachers' preparedness to command and coordinate emergencies is largely underexplored in literature. This study's findings begin to fill that gap by showing how PE teachers leverage their classroom authority. Their ability to take command during drills and simulations may be closely linked to their accumulated years of teaching experience. This is supported by Adewale and Moyo (2025), who demonstrated a significant relationship between teaching experience and the effective management of disruptive student behaviours. In the context of disaster education, an experienced teacher's refined classroom management skills, such as giving clear commands, maintaining order, and ensuring student compliance, become directly transferable to leading evacuation protocols and safety drills. Consequently, the pedagogical leadership displayed by PE teachers in emergencies is likely a product of their prolonged classroom experience, reinforcing the value of retaining seasoned educators in schools located in high-risk areas.

Hence, the participants also consistently argued about their pedagogical potential for transforming students' capacities in emergency management. The ability of PE teachers to take command during drills and simulations is crucial for developing what Dwiningrum et al. (2019) describe as student resilience, which encompasses emotional regulation, optimism, and self-efficacy, which are essential competencies for effective disaster response. Although their claims are supposedly interesting and backed up by previous research (Guinto & Logan, 2022; Newland & Legg, 2024), a deeper discussion should include basic principles of physical training through which frequent and intense regimes are required for achieving fitness levels. It is also further worth noting that the dilemma appears when merely improving students' fitness levels, since many more educational potentials that PE can offer are undermined (Quennerstedt, 2019).

More discussion also needs to take pedagogical approaches into account. Competencies such as student agency, decision making, and leadership are expected to be meaningfully learnt through student-centered pedagogies instead of teacher-centered, top-down approaches to learning (Beni et al., 2019, 2022; Fletcher et al., 2018, 2021). The fact that disaster education involves transdisciplinary studies is so does its delivery. When PE is argued to be a part of comprehensive disaster education, integrated competencies of knowledge, attitude, and social

skills (Masocha et al., 2025) also necessitate PE to be located within a broader interdisciplinary endeavor instead of an independent solution.

Knowledge has become the focus of investigation among disaster education researchers. Their studies revealed that not all types of knowledge are equal in terms of their applicability within emergencies (i.e., Gaillard & Mercer, 2013). As Weichselgartner and Pigeon (2015) argued, applied knowledge is more likely to be actionable. Findings in educational literature recently advocate deeper learning, which emphasizes student-led learning, collaboration, the use of digital technologies, and real-world learning experiences (Kovač et al., 2023; Winje & Løndal, 2020). At this point, more learning dimensions in PE need to be coherently considered to accomplish the depth as well as the promise of developing applied types of knowledge for disaster management.

Additionally, data analysis showed promising PE pedagogies through the applied nature of learning. For example, as much of PE learning involved game-based activities, dominant pedagogical approaches for integrating disaster education also employed physical games as well as disaster simulation games. Researchers have long paid attention to studying the use of games in delivering disaster education (e.g., Arakawa et al., 2024; Contreras, 2022; Gargiulo et al., 2024), suggesting the alignment between pedagogical practices among the participants and broader empirical findings. But again, issues and challenges appear to be on the liability of the promising claims of PE and its actual outcomes in regard to disaster education. At this point, assessment becomes the central focus. PE scholars have advanced their assessment research as well as its strategies, aligning with student-centered pedagogies through authentic, performative assessment (i.e., Killian & Mays Woods, 2021; Patel, 2024). Nonetheless, disaster education is inherently interdisciplinary, in which assessment strategies within PE alone may be insufficient to portray the learning outcomes regarding disaster education. A more comprehensive assessment framework with school-wide assessment administration should essentially reflect the interdisciplinary nature of disaster education.

CONCLUSION

This study shows physical education (PE) teachers' conceptualization and enactment of disaster education within their professional practices. Analysis demonstrates that participants take responsibility for providing leadership under emergencies and delivering school-based disaster reduction risk (DRR) education. Living through the natural disasters themselves, these teachers navigate ways to craft innovative context-based pedagogical practices to infuse disaster education. These practices include the use of warming-up routines, game-based learning and simulation, and fitness-related content. All of these are deemed to be aligned with emergency preparedness.

Despite being preliminary, the current study discloses potentials of PE as a strategic approach for disaster education. Inherent within PE pedagogies are applied, experiential, and possibly interdisciplinary characteristics. Further development of disaster education through PE is certainly an agenda for both research and its application. Interpretation of the results also indicates that reliance on individual teacher initiative exposes systemic gaps in policy coherence, resource provision, and curriculum flexibility. Without institutional support, these promising practices risk remaining isolated and unsustainable.

Finally, recent advocates for a more integrated approach in disaster education should take into account the unique contribution of PE. It also recommends deemphasizing the prescriptive qualities of policy, such as the national curriculum, allowing local authorities to adopt context-based needs to embed disaster education into the PE curriculum, promote interdisciplinary collaboration across subjects, and develop comprehensive assessment frameworks. Positioning PE as an essential component of disaster risk reduction in education can enhance student preparedness, community resilience, and holistic learning in vulnerable regions like Indonesia.

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