Towards a Disaster Preparedness School: Mapping of Disaster Mitigation Evacuation Routes at SMP Muhammadiyah Sewon Bantul, Special Region of Yogyakarta

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Abstract. Indonesia is a country with a large population, with geographical conditions traversed by confluence of earth's plates that are actively moving, so that the area is prone to disasters. With these natural disasters, residents must be prepared for various kinds of disasters in order to save lives and minimize material losses and casualties. The level of preparedness for natural disasters should be instilled from the earliest possible age. One of the Muhammadiyah schools that is being reviewed in this service proposal is Muhammadiyah Middle School Sewon Bantul. This junior high school is located in Bandung Kulon, Pendowoharjo, Sewon, Bantul, Special Region of Yogyakarta. Looking historically, the Special Province of Yogyakarta is one of the areas in Indonesia which is prone to natural disasters such as earthquakes, exposure to volcanic ash from Mount Merapi, and cold lava. This school has general junior high school grade levels, namely grades seven, eight, and nine. From preliminary surveys and personal communications made to school administrators, it is known that there is no information and planning regarding natural disaster preparedness, and infrastructure related to evacuation routes and gathering points in the event of a natural disaster such as an earthquake. Departing from the problems found and described above, it is deemed necessary to carry out community service at the school in relation to mapping the existing conditions of spatial functions, planning evacuation routes and assembly points, as well as outreach regarding disaster preparedness. It is hoped that with this community service, students can better understand and be aware of the importance of being prepared for natural disasters such as earthquakes, not causing panic, and reducing the risks of losses that can result from natural disasters. In the long term, it is hoped that with optimal assistance, teachers can guide students so they can be more prepared for natural disasters such as earthquakes and furthermore, insert in the subjects taught to junior high school students related to natural disaster preparedness.

Keywords: evacuation route, disaster mitigation, junior high school, disaster preparedness education

1 Introduction
1.1 Muhammadiyah as Islamic Organization and Relation to Muhammadiyah’s schools

Muhammadiyah is a prominent Islamic organization with a multifaceted approach encompassing education, healthcare, and social services. The organization has significantly impacted the development and progress of Muslims in Indonesia, reflecting its commitment to Islamic values and societal welfare [1–23]. Muhammadiyah's influence extends across

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various sectors, including education, healthcare, and social welfare, making it a comprehensive Islamic organization with a wide-ranging impact. In the realm of education, Muhammadiyah has established a network of schools and educational institutions, reflecting its dedication to advancing Islamic education and knowledge dissemination [1,5,6,18–20,22]. The organization's educational initiatives are deeply rooted in Islamic values and principles, aiming to instill these values in students while providing quality education. Furthermore, Muhammadiyah's involvement in healthcare is evident through the ownership and management of hospitals, reflecting its commitment to providing medical services aligned with Islamic principles [2,21,24,25]. The organization's hospitals serve as essential healthcare facilities, contributing to the well-being of the community while upholding Islamic values in the provision of medical care. Additionally, Muhammadiyah's engagement in social services, including orphanages and humanitarian efforts, underscores its dedication to addressing societal needs and promoting social welfare [3,4,9,14,15]. The organization's initiatives in supporting destitute families, empowering communities, and fostering Islamic values exemplify its holistic approach to social development and welfare. Overall, Muhammadiyah's multifaceted endeavors in education, healthcare, and social services reflect its comprehensive commitment to Islamic values and societal advancement. The organization's impact extends across various domains, contributing to the well-being and development of communities in Indonesia.

One of the Muhammadiyah schools that is discussed in this study is Junior High School Muhammadiyah Sewon Bantul. This junior high school is located in Bandung Kulon, Pendowoharjo, Sewon, Bantul, Special Region of Yogyakarta. Looking historically, Yogyakarta Special Region Province is one of the regions in Indonesia that is prone to natural disasters such as earthquakes, exposure to volcanic ash from Mount Merapi, and cold lava. This school has general junior high school class levels, namely grades seven, eight, and nine. From preliminary monitoring (preliminary survey) and personal communications made to school administrators, it is known that there is no information and planning regarding preparedness for natural disasters, and facilities and infrastructure related to evacuation routes and gathering points in the event of a natural disaster such as an earthquake.

1.2 The importance of evacuation route in school

In the context of designing evacuation routes for schools, it is crucial to consider various factors such as fire hazards, earthquake scenarios, pedestrian behavior, and the use of elevators for evacuation. Evacuation route selection models play a significant role in planning and optimizing evacuation procedures [26]. Theoretical models, such as the social force model, provide essential design guidelines for transportation and building environments, offering strategies for emergency evacuation in various natural or man-made disasters [27]. Additionally, evacuation modeling serves as a useful visual tool for disaster managers to review current evacuation strategies, estimate shelter capacities, and develop evacuation route planning [28]. Furthermore, the simulation of pedestrian outflow related to the evacuation of a building is a critical aspect of designing effective evacuation routes for schools [29]. This involves considering the capabilities of models used within the proposed approach and comparing simulation results with data recorded from experiments conducted in school settings [30]. Additionally, the use of elevators for evacuation in fire emergencies presents specific technical challenges and considerations, which are essential for designing comprehensive evacuation routes in school buildings [31]. Moreover, it is important to address the needs of individuals with mobility impairments when designing evacuation options, including the use of occupant evacuation elevators [32]. Furthermore, the planning of evacuation routes is highlighted as a key and important part of the evacuation process, emphasizing the significance of well-designed routes in ensuring the safety of school occupants during emergencies [33].
to consider the age profiles of students and their behavior in emergency evacuation situations [34]. Additionally, the development and implementation of a generic framework for fire safety management in school facilities are essential for ensuring comprehensive safety measures, including effective evacuation routes [35]. Furthermore, the perception of traffic safety in school areas and the management of teachers' work safety also contribute to the overall safety and preparedness of school environments for emergency evacuations [36,37]. Overall, the design of evacuation routes in school settings requires a multidisciplinary approach, considering factors such as fire hazards, pedestrian behavior, elevator usage, and the specific needs of individuals with mobility impairments. By integrating theoretical models, simulation techniques, and comprehensive safety frameworks, schools can develop effective evacuation routes to ensure the safety of students, teachers, and staff during emergency situations.

Based on the problems found and described above, community service is deemed necessary to be carried out at the school in relation to mapping the existing conditions of space functions, planning evacuation routes and gathering points, as well as outreach regarding disaster preparedness. It is hoped that with this activities, students will be able to better understand and be aware of the importance of being prepared for natural disasters such as earthquakes, not causing panic, and reducing the risks of losses that can arise from natural disasters. In the long term, it is hoped that with optimal assistance, teachers can guide students to be more prepared for natural disasters such as earthquakes and, furthermore, include subjects taught to junior high school students related to natural disaster preparedness.

2 Methodology
2.1 School’s Location

The location of the community service partner is Muhammadiyah Sewon Bantul Junior High School (SMP), Yogyakarta Special Region. This school institution is located in Bandung Kulon, Pendowo Harjo, Sewon, Bantul postal code 55185. This school has general education levels, namely three classes: seventh, eighth and ninth grades. For the target of the process of mapping and socializing disaster mitigation evacuation routes, eighth grade with a total number of 92 students and supporting teachers is the target of this community service. The situation and conditions of the school are presented in Figure 1 below.

**Figure 1.** Front view of Muhammadiyah Middle School Sewon Bantul DIY.

Community service partners are partners that are not economically productive because they are Muhammadiyah educational institutions. There are several problems that this school still has, including: the absence of evacuation routes and complementary facilities, including
directions and signposts. Apart from that, there are several other problems, such as improving the quality of bathrooms, increasing road safety education, and other conditions. In this proposal, the issue raised will focus on mapping evacuation routes to increase awareness about preparedness for natural disasters such as earthquakes.

2.2 Methodology

2.2.1 Offsite Reconnaissance and Surveys

Before designing and installing evacuation routes, knowledge is needed about the existing conditions at the school. Below in Figures 2 and 3, the visual survey carried out by the writing team is shown, namely looking at and photographing routes and points that have the potential to become gathering points.

Figure 2. Offsite survey: classroom hallway.  
Fig. 3. Offsite survey: existing school parking location.

2.2.2 Design and Signing Productions

After conducting the survey, the next stage is to design and produce signage for the evacuation route. Below in Figure 4 is an illustration of the team taking measurements to be drawn on the map.

Figure 4. The team measured the width of hallway. And Figure 5. The team presented the result of evacuation route.

2.2.3 Implementation and Demonstrations

After designing and producing plans and evacuation routes, the next step is to present the design results to users, in this case the students of Sewon Bantul Muhammadiyah Middle School. Below in Figure 5, the team makes a presentation in front of students.

2.2.4 Questionnaires distributions

Before and after the results presentation, questionnaires were given to students at school, using a pre-test and post-test. Below in Figure 6 an example of a questionnaire is shown.
3 Result and Discussions

3.1 Design and evacuation routes

The design of the evacuation route is adapted to the existing conditions at the school. One of them is the area of the room, as well as the width of the lane and the capacity of the assembly point if a disaster occurs. Below in Figure 7, the results of the design created by the team are presented.

![Design result of evacuation route map for the school.](image)

Fig. 7. Design result of evacuation route map for the school.

3.2 Demonstration to stakeholders

Submission of designs and design production results are conveyed to users, namely school students, by presenting them in front of the class. The presentation was attended by student representatives and all students paid solemn attention to the presentation of the results, as shown in Figure 8.
3.3 Installations of evacuation route maps and signings

Evacuation maps are affixed to each classroom door, as shown in Figure 9. Apart from that, assembly point meeting signing is also installed in the largest area, namely on the school ground, as shown in Figure 10.

3.4 Result of questionnaires

The results of the pre-test show the knowledge possessed by students before the presentation, and the results of the post-test are increased knowledge regarding evacuation routes, after the results are presented. It can be seen in Table 1 that there is an increase in knowledge as evidenced by the increase in correct answers to the four questions asked.

Table 1. Result of Pre-Test and Post-Test to the students and teachers about the evacuation routes.

<table>
<thead>
<tr>
<th>Question 1. The following actions must be taken if an earthquake occurs...</th>
<th>Pre-test (Before demonstrations)</th>
<th>Post-test (After demonstrations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer 1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don't panic, protect your head, take cover under a table if you are indoors</td>
<td>84.2%</td>
<td>100%</td>
</tr>
<tr>
<td>Don't panic, protect your head, take cover under the stairs</td>
<td>13.2%</td>
<td></td>
</tr>
<tr>
<td>Be alert and look for trees for shelter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediately scream and run into the classroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test (Before demonstrations)</td>
<td>Post-test (After demonstrations)</td>
<td></td>
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<tr>
<td>----------------------------------</td>
<td>----------------------------------</td>
<td></td>
</tr>
<tr>
<td>Question 2. Of the following pictures, which one is not an evacuation sign?</td>
<td>Answer 2.</td>
<td></td>
</tr>
<tr>
<td>• Evacuation route map</td>
<td>• Evacuation point meetings</td>
<td></td>
</tr>
<tr>
<td>• Yellow-black sticker lines on stairs</td>
<td>• Stop sign</td>
<td></td>
</tr>
<tr>
<td>• Signing for evacuations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Pie Chart](chart1.png)

Question 3. Which parts of the body need to be protected by the hands, when the earthquake is over and moving to evacuate?

Answer 3.

- Head
- Backside
- Stomach
- Feet

![Pie Chart](chart2.png)

Question 4. After an earthquake occurs, who should be helped to evacuate via evacuation routes?

Answer 4.

- Sick and injured students
- The oldest student
- Youngest students
- The healthiest and fittest students

![Pie Chart](chart3.png)
4 Conclusions

In conclusion, the implementation of the evacuation route map and singing installation for junior high school students at Muhammadiyah Sewon, Bantul, has proven to be a resounding success. The initiative has not only enhanced the students' knowledge of emergency evacuation procedures but has also captured their high attention levels during presentations. The positive outcomes of this project are evident in the commendable results achieved. Through this innovative approach, we have not only instilled crucial life-saving skills but also fostered an engaging and effective learning environment for the students. This endeavor stands as a testament to the positive impact that creative educational methods can have on students' understanding and retention of important information. Moving forward, it is essential to build upon these achievements, continually refining and expanding initiatives that promote both learning and safety within the school community. Figure 11 showed the proof of excitement of student after the activity.

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