

The Effect Of Fire Simulation For Student's Knowledge About Fire In SMA X Depok 2022

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Abstract. Fire is one of the disasters that often occur and result in losses, both to people, assets, and productivity. Fires can occur due to the use of fire, gas explosions, electrical short circuits, HP exploding, natural factors, building conditions, such as the distance between buildings, materials, access to rescue, and weather factors. A school must meet the requirements of safety, health, comfort, and security. Schools must have a stable and sturdy building structure and a safe zone to withstand natural disasters. They should also have an active and/or passive fire protection system to prevent and deal with fire disasters. Knowledge and attitudes are the first parameters of preparedness, which form the basis of every school element's behavior in disaster preparedness. The research objective is to determine the differences in knowledge scores before and after a fire simulation. This study uses a knowledge questionnaire that has been tested for validity. The sample size is 37 respondents, and the data is analyzed using a paired T-test. The results of the study showed differences in knowledge before and after the fire simulation (p -value = 0.002). Therefore, researchers suggest that schools routinely carry out simple fire simulations in collaboration with the Depok City Fire Department and incorporate topics regarding fire disasters in the curriculum. School can also conduct virtual fire drills or use other methods and media such as video fire simulations, fire safety posters, or safety inductions conducted before starting the first class of the day.

Keywords: Fire, simulation, knowledge, student

1 Introduction

Almost all situations and places where activities are carried out have the possibility of risk, including the home, the street, the workplace, and even schools. Fatigue, health problems, injuries, and even severe accidents can occur if these threats are not appropriately managed. As a workplace, schools have various potential dangers and K3 risks. Therefore, it is necessary to create a safe, healthy and productive learning environment for students, teachers and school employees.

A school must meet safety, health, comfort and security standards, in accordance with

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Minister of Education Regulation no. 24 of 2007 concerning Standards for Facilities and Infrastructure for Elementary Schools/Madrasah Ibtidaiyah (SD/MI), Middle Schools/Madrasah Tsanawiyah (SMP/MTS), and High Schools/Madrasah Aliyah (SMA/MA). In terms of safety, schools must have sturdy and stable building structures and zones that are safe from earthquakes and other natural disasters. In addition, schools must have active and/or passive fire protection systems to prevent and deal with fires and lightning, as well as early warning and accessible evacuation routes in the event of a fire or other natural disaster. [1]

One of the most frequent disasters is fire, which damages people, assets and productivity. Fires in factories or other buildings are not the same as fires in multi-storey buildings. The number of people living in multi-storey buildings, such as school buildings, varies considerably based on age, physical condition, health, education and knowledge about fire. Each school floor usually has furniture or facilities and infrastructure to support teaching and learning activities. Schools are prone to fire spread due to the amount and type of highly flammable materials. It is not uncommon for multi-storey buildings such as schools to have a stack effect, which means smoke spreads from the ground floor to the top floor quickly and makes it easier for fire to spread. This will make rescue more difficult, especially in situations where access in and out of the building is limited.[2], [3].

From 2014 to 2018, local fire departments in the United States responded to an average of 3,230 fires on school property, from preschool to twelfth grade. According to Campbell, these fires on school property resulted in an average of one civilian death, 39 civilian injuries, and direct property damage, amounting to \$37 million annually [4]. From 2019 to 2021, 602 fires occurred in West Java, Indonesia.[5] Meanwhile, fire incidents in the city of Depok showed an increase from 2013 to 2015. There were 142 cases in 2013, 195 cases in 2014, and 226 fire cases in 2015. A total of 142 cases occurred in 2013, 195 cases in 2014 and in 2015 there were 226 fire cases. A total of 142 cases occurred in 2013, 195 cases in 2014 and in 2015 there were 226 fire cases [6]. In 2021, 124 cases were reported. Despite decreased cases, fire prevention and management supervision are essential in industries, hospitals, public places, and schools.

One of the causes of fires is a need for a more sufficient understanding of fire safety. Students have a responsibility to study diligently and ensure that they are in a healthy, safe, and comfortable environment at school. Every student should know how to avoid dangers that could jeopardize their safety. Fire safety training and education are necessary for fire prevention and management within the fire management system. This training should be provided to students, educators, and school staff to enhance their awareness of how to extinguish fires, evacuate, and recover from fires. [7], [2]

Safety education can help people better understand fire safety. Safety education is the process of teaching people how to protect themselves and avoid injuries and accidents .[8] According to Notoatmodjo, knowledge or cognitive aspects greatly influence actual actions (visible behavior). This is because people who act based on understanding will tend to take sustainable actions compared to people who do not act based on knowledge. This shows that students who have an understanding of fire safety will be more responsive when facing a fire disaster. [9]

Safety education can be provided through safety campaigns, case studies, training and workshops, and counseling. Fire simulation is one way to teach fire safety . Simulation is a

learning method that uses simulated situations to help students understand the actual situation. [8],[10],[11],[12],[13],[14],[15] Pasaribu & Angin-angin's research (2020) investigated the knowledge and attitudes of high school students regarding preparedness for earthquake disasters and found that this knowledge was related to preparedness for earthquake disasters.[16] It is in line with Utama & Dewi's research (2020) found that knowledge about disaster response can increase both before and after disaster response training.[17]

SMA X Depok is a State High School in Bedahan, Sawangan District, West Java. The school is in a housing complex, so a fire could enter the school building if it started from home. At the front of the school building, there are rooms for the principal, deputy principal, administration, and classrooms. The middle and back of the school building consists of two levels, which include class X, XI, and XII buildings, as well as a prayer room, school canteen, and parking area. One of the school safety and health facilities is the UKS room, which is equipped with first aid equipment. In addition, during the teaching and learning process, electronic devices such as LCDs are needed; computers in computer laboratories and administration rooms; and chemicals in chemistry laboratories, which have the potential for explosions and fires. School building fires are included in the class A fire category but can cause loss of life, assets, and environmental damage.

Furthermore, fires can occur in schools. Most property damage in secondary and middle schools is caused by fires between midnight and dawn when the buildings are likely unoccupied. More than two out of five fires (44%) in secondary and middle schools are intentionally set, while one out of five fires results from playing with a heat source. Additionally, fires are more likely to originate in secondary and middle schools from bathrooms or locker rooms (32%) than in other areas. [4]

The results of a survey of five students indicate that three of them do not know the components of fire, five others are unaware of the elements of fire, and three answered that they should run in the event of a fire. Additionally, according to the researcher's findings, no active or passive fire protection systems is in place. Furthermore, the researcher's observation results show that there is no fire protection system, both active and passive. Active fire protection systems such as fire detectors, sprinklers, hydrants, fire alarms, and fire extinguishers (APAR) should be implemented to minimize the fire risk. Additionally, no passive fire protection systems observed, including evacuation routes, evacuation signs, and an assembly point where occupants can gather during self-rescue. The researcher's interview with one of the teachers revealed that they had not conducted fire education or training since the beginning of the pandemic in 2020. Before the pandemic, the local government had conducted such training, but it has yet to be continued. The school is also situated in a residential area and borders residential houses, which increases the possibility of a fire from nearby homes spreading to the school.

Nevertheless, this training can assist in rescuing students from fire disasters, thereby reducing the casualties caused by it. Researchers wanted to understand what students knew before and after fire response training. Therefore, they conducted a fire drill simulation for the students of SMA X Depok in 2022.

2 Methods

This research is a quasi-experimental study, where the researchers may only sometimes have complete control over the experimental situation and conditions. This research design uses a single pre-experimental group as both the treatment and control group. The study involved 41 students from the IPA 2 class, with the most significant sample being 37 individuals. The formula for the dependent t-test hypothesis was used to calculate the sample size. The difference in means was calculated for the group that was measured twice, once before (pre) and once after (post) the intervention. This research was conducted at SMA X Depok in November 2022 using a questionnaire on knowledge and fire response. Before the study commenced, the questionnaire's validity was tested on 30 students at SMK X Tangerang in 2022. In this study, bivariate analysis was conducted using the dependent T-test. The dependent T-test is performed when the data is usually distributed. However, if the data is not normally distributed, the test used in this study is the non-parametric Wilcoxon test. If $p > 0.05$, the null hypothesis (H_0) is accepted, indicating no relationship between the independent variables. If $p \leq 0.05$, H_0 is rejected, and the alternative hypothesis (H_a) is accepted, signifying a relationship between the independent variables. This research has passed an ethics review with the number 0923-08.032/DPKE-KEP/FINAL-EA/UEU/AUG/2023.

3 Results and Discussion

3.1 Description of Average Knowledge Before and After Fire Simulation in Students of SMA Negeri 5 Depok in 2023

Table 1 shows that the description of knowledge about fire from 37 attending students before the simulation had an average (mean) knowledge score of 27.70, with a minimum score of 23, a maximum score of 31, and a standard deviation of 2.26. On the other hand, the description of knowledge about the fire after the simulation from the same 37 attending students had an average (mean) knowledge score of 28.62, with a minimum score of 24, a maximum score of 32, and a standard deviation of 1.934. This is in line with Kriswanti, who found that students' knowledge before the fire simulation had an average (mean) of 42.4 and after the fire simulation had an average (mean) of 46.5.[18]

Table 1. Distribution of Student Knowledge Before and After Fire Simulation at SMA Negeri 5 Depok in 2022

Variable	N	Median	Minimum	Maximum	St. Deviation
Knowledge before the simulation	37	28	23	31	2,26
Knowledge after the simulation	37	28,62	24	32	1,934

Before the intervention of the thirty-two knowledge questions about fire and fire management, three questions showed a more significant proportion of incorrect than the proportion of correct. Most of the students gave wrong answers on sand is not a fire extinguishing medium as many as 22 students (59.5%), how to use a fire extinguisher as many as 20 students (54.1%), and foam is not a fire extinguishing medium as many as 19 students (51.4%). After the intervention, incorrect answers on sand not being a fire extinguishing medium decreased by 2.7%, incorrect answers on how to use a fire extinguisher decreased by 8.15%, and foam not being a fire extinguishing medium decreased by 2.8%.

The research results show that students have talked with school friends, family, and other friends about rescue, evacuation, and first aid during a fire. Apart from that, they also hear from books, posters, and notice boards as well as from electronic media such as radio and television. There are three questions where the proportion of wrong answers is greater than correct answers, according to geography subject teachers. According to the teacher, not all students knew about fire extinguishing media, how to extinguish with APAR, and fire response during research. Firefighters in Sawangan-Depok simulate an earthquake in 2019. However, the class XI IPA2 students who took part in this activity had already graduated, so the information they got did not reach them.

Fire is a chemical reaction that occurs between fuel oxygen and produces heat, which is called the ignition process. Fire is also an oxidation-reduction chemical reaction that produces heat (exothermic) with oxidants and reductants that produce heat or energy. When fire is uncontrolled, it produces an oxidation-reduction reaction that produces continuous heat, which is called a fire. This extinguishing method definitely uses extinguishing media. Water, sand, foam, carbon dioxide (CO₂), dry chemical powder, and halon are some types of extinguishing media.[7], [3]

One of the programs in building fire safety management is training and simulation. Training aims not only to prevent fires but also to address the initial ignition point to prevent it from escalating. Portable fire extinguishers, abbreviated as APAR, are one of the active fire protection measures. There are various types of APARs tailored to their intended use. The steps for extinguishing fires using APAR involve pulling the pin or seal of the APAR, directing the APAR hose at the center of the fire source in the direction of the wind, pressing the lever to release the contents of the APAR, and sweeping the fire extinguishing media from left to right or vice versa. [7]

The research results show that the average knowledge of students can be considered good because students have discussed fire safety, evacuation, and first aid during fires with their families, friends at school, or other friends. Additionally, they have heard about these topics from electronic media such as radio or television, books, posters, or bulletin boards. However, there are still 3 questions where the proportion of incorrect answers is higher than the correct ones. According to the geography teacher, during the research, the students had not yet reached the material on fire safety, so not all students were familiar with fire extinguishing media, how to use fire extinguishers (APAR), and fire response. In 2019, the fire department personnel in Sawangan-Depok conducted a disaster simulation activity, specifically for earthquakes, in which the participating students had already graduated, so the information they received did not reach the students in the XI IPA2 class. However, the disaster simulation activity has yet to be conducted again since then.

In conclusion, the fire simulation for Class XI IPA 2 students improved their knowledge of fire and fire prevention. It is in line with Rahmawati & Susilowati, which showed a change in knowledge before and after the fire simulation. Before the simulation, 83% of students still had insufficient knowledge, but after the intervention, the proportion of students with insufficient knowledge decreased to 37%, while those with sufficient knowledge increased to 13%. [19]

3.2 Analysis of the difference in knowledge related to fire safety among students before and after the fire drill at SMA Negeri 5 Depok in 2022

Before conducting statistical tests, it is necessary to perform a normality test first. The purpose of the normality test is to determine whether the data follows a normal distribution or not. The test that can be used is the Shapiro-Wilk test because the sample size is < 50. Table 2, regarding the normality test using the Shapiro-Wilk test, shows that the knowledge scores before and after the fire drill exhibit a significant result with a p-value > 0.05, precisely 0.104. This indicates that the data follows a normal distribution, allowing for the statistical tests conducted before and after the fire drill on students' knowledge in Class XI IPA2 at SMA X Depok.

The statistical analysis using a paired T-test on the data from 37 students in Class XI IPA2 shows a significant difference in the average knowledge scores before and after the fire drill. The difference in mean knowledge scores is -0.92, with a standard deviation of 1.66 and a 95% confidence interval ranging from -1.471 to -0.367. The p-value obtained from the analysis is 0.002, less than the significance level of 0.05. This indicates that there is a significant difference between the knowledge of students before and after the health education intervention at SMA X Depok in 2022.

Table 2. Knowledge Normality Test

Variable	Shapiro Wilk		
	N	P value	Conclusion
The difference in knowledge before and after the fire drill simulation	37	0,104	Normal

Tabel 3 The Difference in Fire-Related Knowledge Among Students Before and After Fire Drill Simulation at SMA Negeri 5 Depok in 2022

Variable	N	Mean Different	The standard deviation of differences	95% CI		P value
				Lower	Upper	
Students' knowledge before fire drill - Students' knowledge after fire drill	37	-0,92	1,66	-1,471	-0,367	0,002

Table 3 shows that out of the 37 students at SMA Negeri 5 Depok in 2022, there is a difference in the average knowledge scores of students before and after the fire drill simulation, amounting to -0.92, with a standard deviation of 1.66 and a 95% confidence interval (CI) ranging from -1.471 to -0.367. The analysis results indicate a p-value of 0.002, which is less than 0.05. This means that there is a significant difference in students' knowledge before and after the fire drill simulation at SMA Negeri 5 Depok in 2022. The research results indicate a significant difference in students' knowledge related to fire before and after the fire drill simulation. This is supported by several studies that have stated that there is a significant impact before and after fire training or simulation on students' knowledge of fire and fire prevention. [19], [20], [21], [22], [23], [24]

Before the fire drill simulation was conducted, some respondents still had inadequate knowledge, especially regarding the use of fire extinguishing media, portable fire extinguishers (APAR), emergency responses, fire extinguishing methods, and the components of fire. However, after participating in the fire drill simulation and receiving education on fire safety, students' knowledge improved. Some students from class XI IPA 2 mentioned that they had received information about fire, evacuation, and first aid during fires from their families or friends, through radio or television broadcasts, reading books, or posters displayed on bulletin boards.

Some respondents did not know much about fires before the simulation, especially about the use of fire extinguishing media, light fire extinguishers (APAR), emergency measures, how to extinguish fires, and fire-forming components. However, students' knowledge increased after participating in fire simulations and receiving instructions about fires. Most students in class XI IPA 2 said they read books or posters posted on notice boards, listened to the radio or watched television, and learned about evacuation and first aid during fires from their friends or family. Interviews with geography teachers showed that class XI IPA2 students did not receive the information they obtained from the earthquake simulation held by the Depok City Fire Department in 2019. However, disaster simulations are no longer carried out.

This shows that SMA X has not implemented building fire safety management. Building fire safety management is part of building management to ensure the safety of building occupants from fire by ensuring the readiness of fire protection installations so that they always perform well and are ready to use. Building fire safety management includes aspects of fire protection facilities such as fire extinguishers, hydrants, detectors, early warning systems, emergency response organizations, life-saving facilities such as evacuation routes, emergency stairs, emergency communication systems, guidance, and training provided to teachers, staff, and students.

According to Budiman and Agus, a person's knowledge is a process that continues to change, where their understanding changes because they receive new understanding. [25] Education, age, experience, environment, social culture, and availability of information are all factors that influence knowledge. If someone is injured or experiences a fire, it is very likely that students, teachers, and employees have an attitude to prevent fires and have facilities or media that teach fire safety. [25], [26] The same point is made by Aini & Daniah and Huseyin & Satyen stating that students should be educated regularly to retain memory and be able to implement disaster prevention measures. Fire simulations can be used for

educational activities aimed at increasing people's knowledge about fire safety and how to handle fires appropriately.[21], [24]

Fire simulation is a practical learning technique aimed at improving mental, physical, and technical skills. Simulation learning methods involve students in situations that mimic real situations, often full of challenges and obstacles, which helps them adapt and make decisions. Learning experiences like this change behavior, foster values, increase understanding of concepts, and increase student knowledge. Sociodrama is a type of simulation that can be carried out because it presents various situations that require the audience to interact socially to solve social problems. [27], [28],[29]

The results of this research are in accordance with the ideas of Lawrence Green, who states that having knowledge is an important part of enabling someone to do the things they want. [9] In this context, students experienced an improvement in their understanding and skills related to self-rescue from disasters after participating in the fire drill simulation. Increased knowledge has a positive impact on students' ability to respond to fires effectively. Enhancing knowledge and awareness of fire disasters and their mitigation is a pre -fire response effort to reduce and minimize the impact of fires. Individuals who have been exposed to fire safety training will respond to fires more appropriately. They will make more rational and accurate decisions during emergencies and hazards .[30], [3], [31], [24] Therefore, the researcher recommends that schools conduct fire safety education through fire drill simulations, which can be done in collaboration with the Depok City Fire Department. The Fire Department always welcomes schools that want to learn about fire safety and emergency response. In fact, according to an interview with one of the fire department officers, they regularly conduct outreach and community empowerment on fire safety. Schools can also conduct virtual fire drills (virtual simulations) or use other methods and media such as fire drill videos, fire emergency posters, or safety inductions that can be done before starting the first class.

As previously stated, SMA SMA X Depok would be better if it carried out fire safety management in school buildings. This will be a concerted and planned effort to handle emergency situations quickly and appropriately. The implementation of fire safety at SMA X Depok would be more effective if they establish a comprehensive and planned fire safety management for the school, which is an integrated effort to address emergencies quickly and accurately. Mubarak stated that improving students' knowledge is not only influenced by educational factors but also by age, interest, experience, environmental culture, and the availability of information.[18] Experiences such as injuries or experiences during a fire, a culture of environmental safety, can lead students, teachers, and staff to have an attitude of preventing fires and the presence of facilities or media that provide information related to fire safety. Therefore, the researcher suggests that the school implement fire safety management to optimize fire safety at SMA X Kota Depok.

4 Conclusion

There is a difference in the knowledge of Class XI IPA 2 students before and after the fire drill simulation at SMA X Kota Depok. Overall, SMA X Kota Depok has not yet implemented fire safety building management (fire protection facilities, training, and education, emergency response organization, life-saving equipment), which is almost

nonexistent or has never been conducted. This indicates a relatively low level of policy and commitment from the government, the school, and the community in the SMA X Kota Depok school environment. The school should conduct regular fire drill simulations with the Depok City Fire Department. The government and the school should implement a fire safety policy and commit to providing fire protection facilities, emergency response organizations, life-saving equipment, and training and education for all students, teachers, and staff in the SMA X Kota Depok environment.

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