



Design of an Occupational Safety and Health (OSH) at the Vocational School's Laboratory of Gadjah Mada University, Yogyakarta

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Abstract

Vocational schools as educational facilities that provide various practical training activities involve numerous processes and tasks with potential hazards, requiring the implementation of occupational safety and health (OSH) programs. However, the existing OSH programs in the laboratories of the Vocational School of Universitas Gadjah Mada (UGM) are still considered inadequate. This study employed an applied engineering design research approach following a design cycle consisting of problem identification, analysis, concept development, and program creation. The expected outputs of this research include OSH program planning in the form of visual workplace design, fire protection system design, first aid kit placement and fulfillment planning, and the provision of personal protective equipment (PPE) to support learning activities and laboratory work in the Departments of Civil Engineering, Mechanical Engineering, and Electrical Engineering and Information Technology at the Vocational School of UGM. In addition, the research outputs include technical systems in the form of procedures, standard operating procedures (SOPs), and recommendations for implementing occupational safety and health programs in the laboratories of the Vocational School of UGM.

INTRODUCTION

The Vocational School is one of the higher education programs that focuses on preparing students with practical skills required in industrial environments (Sudira, 2016). According to Wijaya and Suparno (2023), graduates who receive learning facilities at vocational schools demonstrate a 37% higher level of job readiness compared with graduates from conventional education programs. The skills acquired by vocational students are developed through a greater proportion of practical training than theoretical learning, with approximately 70% of practicum activities and 30% theoretical instruction (Sukoco et al., 2019).

According to Law Number 1 of 1970 concerning Occupational Safety, vocational schools as educational institutions are categorized as workplaces that must fulfill occupational safety requirements. The implementation of occupational safety and health (OSH) in educational facilities is essential for fulfilling the rights and protection of students, lecturers, educational staff, employees, and visitors from occupational accidents. In addition, OSH implementation aims to protect assets and resources within educational facilities, including classrooms, meeting rooms, laboratories, and their associated equipment (Ferina, 2025). Occupational safety requirements regulated in Law Number 1 of 1970 include preventing and reducing accidents; preventing, controlling, and extinguishing fires; providing first aid assistance in accidents;

providing personal protective equipment (PPE) for workers; and establishing emergency response procedures to enable self-rescue during fires or other hazardous events.

Vocational schools have the advantage of producing graduates with stronger workplace competencies because they combine academic education with industrial practices and professional requirements, one of which is conducted through laboratory activities. The practicum process not only develops technical skills but also strengthens students' ability to identify risks and make decisions required in professional environments (Ramadhani & Saputra, 2022). Laboratory activities in vocational schools involve various processes and tasks with potential hazards, requiring the design of occupational safety and health (OSH) programs. Such programs are not only forms of regulatory compliance and institutional responsibility to protect students' safety and health but also serve to protect assets, learning activities, and institutional reputation. Furthermore, OSH implementation aims to foster awareness of personal safety and health within educational environments and daily activities (Fitrijaningsih et al., 2023; Kavouras et al., 2022; Pertiwi et al., 2025; Şenkal et al., 2021).

According to Habidin et al. (2018), students exposed to OSH programs during practical training demonstrate more consistent preventive behaviors when entering professional work environments. OSH programs that can be implemented in vocational laboratories include the availability and proper use of personal protective equipment (PPE), installation of workplace safety signs and visual management systems, and the provision of safety information to familiarize students with potential hazards associated with specific tools and work areas. Considering the benefits and importance of implementing OSH programs in laboratories, it is necessary to evaluate and design OSH implementation strategies at the Vocational School of Universitas Gadjah Mada (UGM) (Cahyati et al., 2026; Karim & Hariyono, 2018; Mulyana et al., 2021; Salsabila & Tejamaya, 2020; Sanaky et al., 2025; Shahab, 2025).

The OSH program implemented in the laboratories of the UGM Vocational School remains inadequate in several aspects. A study by Lubis et al. (2025) at the Physics Laboratory of the University of Bengkulu identified critical safety deficiencies, including expired fire extinguishers, exposed electrical terminals, incomplete first aid kits, lack of standard operating procedures (SOPs), and insufficient lighting. These findings are consistent with the safety issues identified in this research. Several deficiencies include limited implementation of workplace visual management systems and OSH signs, which are often restricted to posters regarding PPE use and general safety messages, despite the need for more specific hazard identification signs related to equipment and work activities. Muhamadiah et al. (2025) similarly found that safety implementation in vocational school computer laboratories had not fully met occupational safety requirements due to limited OSH training, incomplete safety facilities, absence of written SOPs, inconsistent PPE compliance, inadequate supervision, and insufficient evaluation documentation. The availability of first aid kits in many laboratories is also limited, with some facilities only providing empty displays without adequate monitoring of contents. Fire protection management in several laboratories remains limited to the availability of a single fire extinguisher unit per laboratory. Furthermore, PPE availability is often not aligned with laboratory activities, and the quantity provided remains insufficient for the number of students participating in practical sessions (ASSEM, 2024; Izzuddin et al., 2025; Melaku et al., 2025; Remperas & Calzada, 2025; Ribeiro & de Freitas Ventura, 2026).

Based on these conditions, this study aimed to evaluate and design the Occupational Safety and Health (OSH) program at the UGM Vocational School, particularly in laboratory environments, through the preparation of accident prevention and control programs, fire management systems, first aid facility planning, and assessment of PPE suitability. The research also aimed to develop emergency response guideline documents as information resources for building users. Therefore, the results of this study are expected to contribute to the improvement of OSH implementation in educational facilities with similar characteristics and serve as a reference for Universitas Gadjah Mada in strengthening the protection of students, lecturers, educational staff, employees, and visitors through the provision of a safe, healthy, and emergency-ready learning environment.

METHODS

This study employed an Applied Engineering Design Research approach to develop solutions through problem identification, needs analysis, concept development, and product preparation stages. The designed outputs included the Occupational Safety and Health (OSH) program for the UGM Vocational School laboratories, consisting of workplace visual management systems, fire management systems, first aid kit placement and completeness planning, and the provision of personal protective equipment (PPE). All designs were developed by considering facility conditions, human resources, and laboratory characteristics through Hazard Identification, Risk Assessment, and Determining Control (HIRADC).

The research was conducted from August 1 to October 31, 2025, at the Vocational School of Universitas Gadjah Mada, covering laboratories within the Departments of Civil Engineering, Electrical Engineering and Informatics, and Mechanical Engineering. The research subjects consisted of 14 laboratories. The developed OSH program was subsequently socialized to laboratory personnel and evaluated to assess its suitability with laboratory safety implementation needs.

RESULT AND DISCUSSION

This research was conducted in fourteen laboratories spread across three departments, namely the Department of Civil Engineering (seven laboratories), the Department of Electrical Engineering and Informatics (three laboratories), and the Department of Mechanical Engineering (four laboratories). Data collection was carried out through direct observation of four aspects of Occupational Safety and Health (K3) and analysis through Hazard Identification, Risk Assessment, and Determining Control (HIRADC) to determine the risk level of each identified hazard. The risk assessment aims to establish OHS control priorities based on the likelihood (L) of the hazard occurring and the severity (S) of the impact in laboratory as shown in Table 1.

Table 1. HIRADC Laboratory of Vocational School UGM

No	Activity	Potential Hazard	Impact	L	S	Risk Value	Risk Category	Existing Control	Planned Control
1	Use of electrical equipment	Short circuit, electric shock	Injury, Fire	4	4	16	High	Installation available	Warning signs, SOPs, Fire Extinguishers
2	Activity involving moving machine	Crush, mechanical injury	Serious injury	3	4	12	Medium	Limited supervision	Visual workplace, work instructions
3	Use of laboratory tools/materials	Grazes, irritation	Minor injury	3	2	6	Medium	Non-uniformity	Signs, PPE requirements
4	Crowded work area	Trips, falls	Minor injury	3	2	6	Medium	Limited routes	Area layout, visual safe routes
5	Fires	Fire, smoke	Injury, facility damage	3	5	15	High	Fire extinguishers available	Fire Extinguisher markings, ERP
6	Minor work accident	Injuries, unconsciousness	Activity disturbance	3	3	9	Medium	Limited first aid kits	First aid kits according to standards
7	Activity without PPE	Direct exposure to hazard	Injury	3	3	9	Medium	Low compliance	PPE provision and requirements

Based on the risk assessment results above, it is known that several laboratory activities have high and medium risk levels. High risks require control priorities, while medium risks require controls to reduce the risk level to an acceptable level. Therefore, planned controls are focused on administrative and technical controls, including workplace visualization, fire suppression systems, first aid kit availability, and the suitability and availability of personal protective equipment (PPE).

The need for the number of Light Fire Extinguishers (APAR) in each laboratory is calculated referring to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number 04 of 1980 as shown below.

$$\begin{aligned}
 \text{Area protected by APAR} &= \pi \times r^2 \\
 &= 3,14 \times 7,5^2 \\
 &= 176,625 \text{ m}^2
 \end{aligned}$$

$$\text{Quantity of APAR} = \frac{\text{Area protected (m}^2\text{)}}{176,625 \text{ m}^2}$$

The completeness of the P3K box is assessed based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 15 of 2008, while the suitability of PPE is assessed based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 8 of 2010. The following are presented the findings of each laboratory along with their documentation.

In the Department of Civil Engineering, there are seven laboratories that are observed, namely the Laboratory of Soil Mechanics, Environmental Engineering, Plumbing, Wood Structures, Concrete Structures, Steel Structures, and Building Materials. These seven laboratories have different characteristics of practicum activities and potential hazards so that the findings in each laboratory also vary.

The Soil Mechanics Laboratory is used for testing moisture content, specific gravity, melt limits, plasticity limits and indexes, limits and shrinkage factors, grain size distribution, and soil compaction, with potential hazards in the form of dust exposure, use of mechanical tools, heavy loads, and electrical risks from supporting equipment. In terms of workplace visuals, PPE posters have been installed on the laboratory wall, but floor markings are only found around the workbench used to implement social distancing during the Covid-19 pandemic, while the area around risky instruments such as drying ovens has not been marked or warning signs of heat and electricity hazards. In the aspect of fire management, the results of the calculation of fire extinguishing needs based on a room area of 270 square meters show the need for 2 units, while the available only 1 unit of dry chemical powder, is placed next to the door with the top of the fire extinguisher 165 centimeters from the floor without a marker sign on it, and the last maintenance date was recorded on October 21, 2024 even though the pressure indicator is still in the green zone. The P3K box was found in the work area in the form of a wooden cabinet with dirty and stained surface conditions, had a red cross symbol but without type identification or a content checklist on the inside of the box, with contents consisting of only a few liquid drugs and sanitary napkin gauze without a clear grouping. For PPE, it is recorded that 8 pairs of safety shoes, 12 work gloves, 300 masks, 2 protective glasses, and 35 safety helmets are available, with laboratory coats and closed shoes that are required before the practicum takes place.



Figure 1. Soil Mechanics Laboratory

Environmental Engineering Laboratories are used for environmental quality testing and the use of certain chemicals, with potential hazards in the form of exposure to chemicals and the use of electrical equipment such as aeration, sedimentation, hot plates, and ovens. A large number of PPE posters and signs prohibiting smoking and mixing chemicals without labels have been installed, but floor markings for hazardous areas have not been implemented, and warning signs on several instruments such as acid cabinets, filter columns, sedimentation apparatus, permeability and fluidisation apparatus, and hot plates have not been consistently installed even though the ion exchange apparatus has been equipped with corrosive material signs. The need for fire extinguishers based on an area of 110.25 square meters is 1 unit and has been available, but it is placed with a fire extinguisher peak of 179 centimeters from the floor without signs, with the last maintenance recorded on October 21, 2024. The P3K box is available on the instrument table in a plastic cabinet in good condition but without type labels or checklists, with contents in the form of liquid medicines, bandage gauze, quick wound plaster, eye drops, iodine, counterpain ointment, as well as some additional drugs such as entrostop, paracetamol, and oralit that are not actually mandatory. The PPE available is only an orange safety vest in sufficient quantities for one practicum session, stored in a stacked condition without a special storage system.



Figure 2. Environmental Engineering Laboratory

The Plumbing Laboratory is used for practicum activities of piping installations and sanitation systems, with potential hazards in the form of pinching, being overtaken, and slipping pipes, slipping due to wet work areas, the use of work tools, and electrical risks from supporting equipment. Visual workplaces in the form of PPE posters for safety helmets and no-smoking signs have been installed, but floor markings for hazardous areas have not been implemented. The need for fire extinguishers based on an area of 90 square meters is 1 unit and is available in dry chemical powder, but placed directly on the corner floor of the room next to the tool cabinet without a marker, with the last maintenance that has passed 6 months even though the pressure is still in the green zone. P3K boxes are not available at all in this laboratory. PPE has also not been provided, students are only required to use laboratory coats and closed shoes during the practicum.



Figure 3. Plumbing Laboratory

The Wood Structure Laboratory is used for practicum involving wood materials and the use of cutting equipment and testing machines, with potential hazards in the form of wood chips, cut wounds, and the risk of fire due to flammable materials. PPE posters in the form of safety helmets, wearpacks, safety gloves, safety shoes, and signs prohibiting the use of mobile phones have been installed. The need for fire extinguishers based on an area of 216 square meters is 2 units, while what is available is only 1 unit, placed on a table near the door which is quite difficult to reach without a sign, with a pressure indicator that is already in the red zone so that the fire extinguisher is not suitable for use. The P3K box is available on a table near the main door in a plastic cabinet in good condition but without type labels or checklists, with contents in the form of liquid medicine, bandage gauze, small wound plaster, burn ointment, iodine, alcohol, as well as additional drugs such as napacin and paracetamol. PPE has not been provided other than the required laboratory coats and closed shoes.

The Concrete Structure Laboratory is used for testing and practicum related to concrete materials and structural elements, with potential hazards in the form of heavy loads, the use of mechanical test equipment, the risk of physical injury, and noise. The PPE poster which includes safety helmets, wearpacks, safety gloves, safety shoes, safety goggles, masks, and ear muff has been installed quite completely. The need for a fire extinguisher based on an area of 126 square meters is 1 unit and has been available in dry chemical powder, placed on the wall next to the main door with a height of 160 centimeters from the floor without a marker, with the last maintenance that has also passed 6 months. The P3K box is available on the wall near the main door in good condition and neatly arranged, easy to identify, reach, and view, with relatively better completeness than other laboratories although it still needs improvement. The PPE available includes a large number of masks and safety gloves, several units of full body harnesses, and several ear muffs that can be used by students.



Figure 4. Concrete Structure Laboratory

The Steel Structure Laboratory is used for practicum involving metal materials and testing of steel structural elements, with potential hazards in the form of cuts, material impacts, mechanical risks, and electricity. The PPE poster and the appropriate tool use procedure signs have been installed quite complete. The need for fire extinguishers based on an area of 126 square meters is 1 unit and is available in dry chemical powder, placed on the wall next to the main door with a height of 165 centimeters from the floor without a sign. The P3K box is available on the wall near the main door in good condition and neatly arranged, with relatively better equipment than other laboratories. For PPE, only a small number of safety gloves were found for one practicum session, with no special storage, while potential hazards such as cutting sparks, metal dust, and noise were not fully covered.



Figure 5. Steel Structure Laboratory

The Building Materials Laboratory is used for testing various types of construction materials using laboratory test equipment, with potential hazards in the form of dust, the use of test equipment, the potential for minor injury, and potential noise. The PPE poster that includes safety helmets, wearpacks, safety gloves, safety shoes, and ear muff has been installed quite completely. The need for a fire extinguisher based on an area of 110.25 square meters is 1 unit and has been available, placed on the wall next to the main door with a height of 180 centimeters from the floor without a marker, with the last maintenance that has also passed 6 months. The P3K box was found on the wall near the main door in the form of a wooden cabinet with dirty and stained surfaces, had the symbol of the red cross but the contents were only liquid medicine, bandage gauze, and quick wound plaster. The PPE available is in the form of

yellow safety vests and safety helmets with enough for one practicum session, but the safety vest storage is still in an open condition.



Figure 6. Building Materials Laboratory

In the Department of Electrical Engineering and Informatics, there are three laboratories observed, namely the Laboratory of Technology, Applications, and Networks, Instrumentation and Control, and Software Engineering. The potential hazards in these three laboratories are dominated by risks from electricity, computer hardware and software, and work ergonomics.

The Technology, Applications, and Network Laboratory is used for practicum activities related to the use of computers, network devices, and low-voltage electrical installations, with potential hazards in the form of the risk of mild electric shock, overheating of the device, improper wiring, and ergonomic risks due to prolonged use of computers. The observation results showed that there was no visual workplace in the form of electrical hazard signs, cable line markings, and network equipment identification labels, so not all users or laboratory visitors knew about the potential dangers that existed. The need for fire extinguishers based on an area of 105 square meters is 1 unit, but there is no fire extinguisher available at all in this laboratory. P3K boxes are also not yet available, although practicum activities still have potential dangers in the form of minor injuries due to electrical equipment and network cables, scratches during device installation, and health problems such as eye irritation and work fatigue.



Figure 7. Technology, Applications, and Network Laboratories

The Instrumentation and Control Laboratory is used for practicum involving sensors, actuators, control panels, and automation systems, with potential hazards in the form of electric shock, short circuits, and equipment misoperation. There is no visual workplace in the form of electrical hazard signs and equipment identification labels, just like the conditions in the

Technology, Application, and Network Laboratory. The need for fire extinguishers based on an area of 100 square meters is 1 unit, but it is not yet available. P3K boxes are also not yet available, as well as Personal Protective Equipment for laboratory users, although practicum activities involve electrical installation and the assembly process of tools that risk scratches and minor electric shocks.



Figure 8. Instrumentation and Control Laboratory

The Software Engineering Laboratory is used for practicum activities for the development and testing of computer-based software, with relatively low risks in the form of ergonomic interference, work fatigue, and electrical risks from computer devices. There is no workplace visual in the form of safety signs or work ergonomics posters. The need for fire extinguishers based on an area of 54.08 square meters is 1 unit, but there are no fire extinguishers available in this laboratory. P3K boxes are also not yet available, although there are still potential hazards in the form of minor injuries due to electrical equipment and network cables as well as health problems such as eye irritation and work fatigue.



Figure 9. Software Engineering Laboratory

In summary, the results of observations in three laboratories in the Department of Electrical Engineering and Informatics show a similar pattern, namely the lack of visual workplaces, fire extinguishers, and P3K boxes, although the level of risk in each laboratory varies from low to moderate.

In the Department of Mechanical Engineering, there are four laboratories that are observed, namely the Laboratory of Control and Automation, Materials and Production Processes, Welding, and Mechanical and Industrial Equipment, with potential hazards related to the use of machines, mechanical equipment, automation systems, heat, and electrical energy.

The Control and Automation Laboratory is used for practicum activities related to control systems, sensors, actuators, and electrical-based and pneumatic automation, with potential

hazards in the form of the risk of electric shock, automatic system operation errors, and technical hazards due to the use of panels and work devices. On the laboratory floor, floor marking has been installed in the form of a green safe work area and a yellow safe path. The need for fire extinguishers based on an area of 144 square meters is 1 unit and is available in dry chemical powder, placed on the wall next to the main door with a height of 180 centimeters from the floor without a sign, with the last maintenance recorded on November 7, 2024. The P3K box was found in the form of a wooden cabinet with dirty and stained surface conditions, without a red cross symbol, type identification, or a contents checklist, with only the contents in the form of quick-wound plaster and cotton. PPE is not yet available in this laboratory.



Figure 10. Control and Automation Laboratory

The Materials and Production Process Laboratory is used for practicum activities for testing materials and manufacturing processes, with potential hazards in the form of exposure to heat, material debris, noise, and mechanical risks from production equipment. Floor marking has been installed, accompanied by signs of hazardous chemicals, irritants, corrosives, explosives, and oxidizers in the area of storing and using chemicals, equipped with mandatory PPE signs in the form of gloves, masks, and safety glasses. The need for fire extinguishers based on an area of 138.24 square meters is 1 unit and has been available, placed on the wall next to the main door with a height of 180 centimeters from the floor without signage, with the last maintenance recorded on November 7, 2024. The P3K box was found in the form of a wooden cabinet with dirty and stained surfaces, with only the contents of quick-wound plaster and cotton. PPE is not yet available for laboratory users.



Figure 11. Materials and Production Process Laboratory

Welding Laboratories are used for welding practicum activities that have a high level of risk, such as exposure to heat, sparks, light radiation, welding fumes, and potential fire. Ergonomic poster regarding the welding position when welding is installed. The need for fire extinguishers based on an area of 118.08 square meters is 1 unit and is available in dry chemical powder, placed on the wall next to the main door with a height of 120 centimeters from the floor without a marker, with the last maintenance recorded on November 7, 2024. P3K boxes are not yet available in this laboratory, although practicum activities are directly related to high-risk hot work. The PPE available is only in the form of a welding hood, without body, hand, breathing, or hearing protection.



Figure 12. Welding Laboratory

The Laboratory of Mechanical and Industrial Equipment is used for practicum operation of industrial machinery and mechanical equipment, with potential hazards in the form of the risk of pinching, cutting, noise, and vibration. PPE posters are already available in the laboratory work area. The need for fire extinguishers based on an area of 388.8 square meters is 3 units, while what is available is only 1 unit, placed on a table next to the main door without a sign. P3K boxes are available in plastic cabinets that are in good condition and in accordance with standards in terms of physicality, but only contain red medicine and are installed at an angle so that they do not meet the requirements of function, security, and ease of access. PPE is not available at all to laboratory users.



Figure 13. Laboratory of Mechanical and Industrial Equipment

Overall, the recapitulation of findings in fourteen laboratories shows quite diverse variations in conditions in each aspect of K3 observed. In the visual aspect of the workplace, most laboratories in the Department of Civil Engineering and Mechanical Engineering already have PPE posters, although warning signs on risky instruments and floor markings on hazardous areas are still not consistently applied, while the three laboratories in the Department of Electrical Engineering and Informatics do not have visual workplaces at all. In the aspect of fire extinguishers, the calculation results show that twelve of the fourteen laboratories have a need of 1 unit, while the Laboratory of Soil Mechanics and Wood Structures requires 2 units, and the Laboratory of Mechanical and Industrial Equipment requires 3 units; Of these, eleven laboratories already have fire extinguishers according to or close to needs, while three laboratories in the Department of Electrical Engineering and Informatics do not have fire extinguishers at all. In terms of P3K boxes, seven laboratories already have P3K boxes even with varying contents, while the other seven laboratories do not have P3K boxes at all. In terms of PPE, it was found that the availability and suitability of PPE types vary greatly between laboratories, ranging from those that are quite complete such as in the Soil Mechanics and Concrete Structure Laboratory, to those that are not available at all such as in the Plumbing Laboratory, Wood Structure, Instrumentation and Control, Control and Automation, Materials and Production Processes, and Mechanical and Industrial Equipment.

Based on the findings that have been presented, the following discussion is prepared based on the four aspects of Occupational Safety and Health (K3) studied, namely visual workplaces, fire management systems, First Aid Boxes in Accidents (P3K), and Personal Protective Equipment (PPE), by comparing the existing conditions in fourteen laboratories with applicable standards and laws and regulations.

Visual Workplace

Visual workplace is one of the important elements in the implementation of K3 because it functions as a visual communication medium that helps laboratory users recognize potential hazards without having to read long written instructions. Based on the observations, most laboratories in the Department of Civil Engineering and Mechanical Engineering already have PPE posters showing the types of personal protective equipment that must be used, but warning signs on high-risk instruments such as drying ovens in the Soil Mechanics Laboratory, acid cabinets and hot plates in the Environmental Engineering Laboratory, have not been installed consistently. This condition is quite unfortunate because these instruments are the main source of danger that should receive more attention through the installation of heat, electricity, and hazardous chemical warning signs. In addition, floor markings to mark safe work areas and hazardous areas have also not been applied evenly; Only the Control and Automation Laboratory and the Materials and Production Process in the Department of Mechanical Engineering have implemented floor marking in the form of green safe work areas and yellow safe lines, while other laboratories have not implemented similar marking despite having equivalent potential hazards.

More worrying conditions are found in three laboratories in the Department of Electrical Engineering and Informatics, namely the Laboratory of Technology, Applications, and Networks, Instrumentation and Control, and Software Engineering, which do not have a visual

workplace of any kind. In fact, the three laboratories have real potential electrical hazards, such as the risk of mild electric shock and short circuits due to low-voltage electrical installations and control panels. The absence of warning signs in these laboratories has the potential to increase the risk of work accidents due to the ignorance of users, especially for new students or visitors who are not familiar with the potential dangers in the laboratory environment. Therefore, the consistent implementation of visual workplaces in all laboratories is one of the improvement priorities, considering that the implementation costs are relatively low compared to the potential losses due to work accidents that can be prevented through the installation of proper signs and markings.

Comparisons between departments also show that the quality of the visual workplace that has been installed is not completely consistent in terms of design and placement. Some laboratories such as Concrete Structure and Steel Structure already have fairly comprehensive PPE posters, covering almost all types of PPE needed according to the characteristics of the job, while other laboratories such as Plumbing only have signs for one or two types of PPE, such as safety helmets, without covering other types of hazards such as wet work areas that are at risk of slipping. Thus, the preparation of visual workplaces should ideally not only consider the existence of signs in general, but also the suitability of the type of signs with the specific potential hazards identified in each laboratory, so that the safety message conveyed is really relevant and effective in shaping the safety awareness of laboratory users.

Fire Suppression System

The fire management system was evaluated based on the suitability of the number and placement of Light Fire Extinguishers (APAR) to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number 04 of 1980 concerning the Requirements for the Installation and Maintenance of Light Fire Extinguishers. Based on the results of the calculation using the formula of area divided by 176,625 square meters, it was found that the Laboratory of Soil Mechanics and Wood Structure each required 2 units of fire extinguishers but only 1 unit was available, while the Laboratory of Mechanical and Industrial Equipment required 3 units but only 1 unit was available. The shortage of fire extinguishers needs to be a special concern because the large area increases the range that laboratory users must travel when a fire occurs, so the addition of fire extinguishing units as needed will accelerate the fire extinguishing response in the early stages.

In addition to the quantity aspect, there were also discrepancies in the aspect of the placement of fire extinguishers in almost all laboratories that already had fire extinguishers. The height of the peak placement of the fire extinguisher, which should be at 1.2 meters from the floor according to the standard, in fact was found to vary between 120 to 180 centimeters, even in the Plumbing and Wood Structure Laboratory, the fire extinguisher was found to be placed directly on the floor or on a table, instead of hanging on a wall or bracket as required. Placement that does not meet these standards can make it difficult to access during emergencies, especially for users with shorter postures. In addition, almost all of the observed fire extinguishers are not equipped with marker signs on them, so the existence of fire extinguishers becomes less prominent and difficult to find quickly in emergency conditions, even though markers are important visual elements to accelerate the identification of fire extinguisher locations.

In terms of maintenance, it was found that most fire extinguishers have passed the routine maintenance schedule that should be carried out once every 6 months, with the last maintenance date recorded in the range of October to November 2024. Although most pressure indicators still show a green zone which means the pressure is still in good condition, maintenance delays still risk lowering the reliability of the fire extinguisher when it is really needed, as found in the Wood Structure Laboratory whose pressure indicator is even in the red zone and is not suitable for use. This condition emphasizes the importance of more disciplined and documented maintenance scheduling so that all fire extinguishers in the building environment are always in a ready-to-use condition. The three laboratories in the Department of Electrical Engineering and Informatics that do not have fire extinguishers at all are findings that need to be prioritized for handling, considering the potential danger of electrical short circuits that are quite significant in the three laboratories.

P3K Box

The availability of First Aid in Accidents (P3K) boxes is evaluated based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 15 of 2008 concerning First Aid in Workplace Accidents, which requires the provision of a minimum type C P3K box for work areas with medium to high risk levels. The observation results showed that seven of the fourteen laboratories did not have P3K boxes at all, namely the Plumbing Laboratory, Timber Structures under certain conditions, as well as all laboratories in the Department of Electrical Engineering and Informatics and the Control and Automation and Welding Laboratory in the Department of Mechanical Engineering. The absence of this P3K facility is a worrying finding, especially in Welding Laboratories which have a high level of risk due to heat work, where the first treatment of burns should be carried out immediately after the incident to minimize the severity of injuries.

In seven laboratories that already have P3K boxes, a variety of conditions were found both in terms of physical and completeness of contents. From the physical side, the P3K boxes in the Laboratory of Soil Mechanics, Building Materials, Control and Automation, and Materials and Production Processes still use wooden cabinets with dirty and stained surface conditions so that they are less hygienic, in contrast to the standard that requires strong, durable, easy to clean, and white materials with a clear red cross mark. Meanwhile, P3K boxes in the Environmental Engineering Laboratory, Wood Structures, Concrete Structures, Steel Structures, and Machinery and Industrial Equipment have used plastic cabinets that are more in line with standards. In terms of marking, almost all existing P3K boxes have not been equipped with identification of the type of P3K type C or checklist of contents on the inside or door of the box, making it difficult to routinely check the completeness of the contents.

In terms of completeness, it was found that most of the P3K boxes did not meet the minimum standards, with the contents dominated by liquid medicines and simple sanitary napkins, even in some laboratories it was found that medicines that were not actually mandatory in the P3K box, such as entrostop, paracetamol, and oralit in the Environmental Engineering Laboratory. The minimum conditions are found in the Control and Automation Laboratory as well as the Production Materials and Process Laboratory which consists only of quick-wound plaster and cotton, and the Laboratory of Mechanical and Industrial Equipment which contains only red drugs with a box position that is installed at an angle. Comparatively better conditions are found in the Laboratory of Concrete Structure and Steel Structure, which,

although still requires refinement of content, is generally neatly arranged and easily accessible. The significant difference in conditions between laboratories shows that the management of P3K boxes has not been carried out in a standardized manner throughout the building.

This gap in the aspect of the P3K box is in line with the absence of a schedule for regular inspection and replenishment of the contents of the P3K box in all observed laboratories. Without a routine inspection mechanism, the condition of P3K boxes has the potential to continue to decline over time, both because used items are not immediately replaced and because expired medicines are not immediately disposed of. Ideally, each P3K box is equipped with a periodic inspection checklist form that includes the date of the inspection, the name of the inspector, and a list of items that need to be refilled, as exemplified in the inspection report of the P3K box that is referenced in this study.

Personal Protective Equipment (PPE)

Personal Protective Equipment is evaluated based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 8 of 2010 concerning Personal Protective Equipment, which places PPE as the last layer of protection in the hierarchy of K3 risk control, so its effectiveness is highly dependent on the completeness of the type, suitability with potential hazards, and the behavior of its use. The results of the observations showed that six of the fourteen laboratories have not provided PPE at all to their users, namely the Plumbing, Wood Structures, Instrumentation and Control, Control and Automation, Materials and Production Processes, and Mechanical and Industrial Equipment Laboratories. This condition shows that the aspect of self-protection against potential occupational hazards in these laboratories is entirely dependent on the user's personal equipment, without clear standards from the laboratory manager.

In laboratories that have provided PPE, variations in the suitability of the type of PPE to the specific potential hazards of each laboratory are found. The Soil Mechanics and Concrete Structure Laboratory is classified as having relatively good PPE completeness in terms of type, although the number of Soil Mechanics Laboratory is still insufficient to accommodate 30 to 40 students in one practicum session, so it is necessary to increase the minimum number to 40 units for safety helmets, protective glasses, and safety shoes. In contrast, the Environmental Engineering and Building Materials Laboratory only provides PPE with limited functions, namely safety vests that basically function to increase visibility on field activities, not to protect against exposure to chemicals or dust that are the main potential hazards in both laboratories. Similar conditions were found in the Steel Structure Laboratory which only provides a limited number of safety gloves, even though metal material cutting and testing activities have potential hazards in the form of splashes, metal dust, and noise that should require eye, breathing, and hearing protection.

The most significant finding was found in the Welding Laboratory, which despite having the highest level of risk among all laboratories observed due to exposure to heat, sparks, light radiation, and welding fumes, provided only a welding hood as the only type of PPE. The absence of wearpacks or aprons, heat-resistant gloves, respiratory masks, and hearing protection in these high-risk laboratories indicates a significant gap between the level of activity risk and the level of protection available. In general, the pattern found in the PPE aspect shows that the provision of PPE is not fully based on the specific risk assessment of each

laboratory, so a more systematic approach is needed in determining the type and amount of PPE that is in accordance with the hazard characteristics of each laboratory.

Overall, the discussion of the four aspects of K3 shows that the gap between existing conditions and applicable standards varies between laboratories, with a general pattern that laboratories in the Department of Electrical Engineering and Informatics tend to have the least completeness of K3 facilities, while laboratories in the Department of Civil Engineering are relatively better even though they still need improvements in the aspects of placement, marking, and maintenance. Laboratories in the Department of Mechanical Engineering show a diverse pattern, with the completeness of fire extinguishers which is generally quite good, but the availability of P3K and PPE boxes is still lagging behind, especially in laboratories with high risk levels such as the Welding Laboratory.

The gap pattern found also shows that the level of completeness of K3 facilities in a laboratory is not always proportional to the level of risk of activities carried out in it. For example, the Welding Laboratory that has the highest risk level does not have a P3K box and only has one type of PPE, while the Software Engineering Laboratory that has a relatively low risk level also does not have a visual workplace, fire extinguisher, or P3K box. This indicates that the provision of K3 facilities so far has not been fully based on the results of systematic risk identification and assessment in each laboratory, but is more influenced by different management policies between departments. This gap is an important basis for the design of the K3 improvement program that will be described in the next sub-chapter, to ensure that all laboratories meet applicable occupational safety and health standards consistently and proportionate to the level of risk of each one.

CONCLUSION

This study showed that laboratories in three departments of the UGM Vocational School still required improvements in the implementation of the Occupational Safety and Health (OSH) program and emergency response management. The evaluation results from the laboratories of the Departments of Civil Engineering, Mechanical Engineering, and Electrical Engineering and Information Technology indicated that several OSH aspects had not yet met safety requirements, including limitations in fire extinguisher availability, improper fire extinguisher placement, lack of specific safety signs, absence of evacuation maps, incomplete first aid kits, and insufficient personal protective equipment (PPE). These findings indicated that OSH program implementation in the laboratories still needed to be improved according to the risk levels of each laboratory. Therefore, further research is recommended to strengthen comprehensive OSH implementation and ensure the safety and health of all laboratory users.

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