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OPTIMIZING THE APPLICATION OF OCCUPATIONAL SAFETY AND HEALTH (K3) CULTURE IN THE LEARNING PROCESS OF MECHANICAL ENGINEERING PRACTICE

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Abstract. The implementation of OSH in the workplace is a necessity for companies or institutions that brings great benefits to all workers and is not felt as a burdensome burden but rather awareness of workers from the risk of materials. Indonesia still has a low level of work safety when compared to developed countries, this makes the risk and level of work accidents in Indonesia still high. This study aims to find solutions to the problems that hinder the application of OHS in mechanical engineering practice. This study uses a qualitative approach to describe the application of occupational safety and health in the mechanical engineering workshop, descriptive methods used in this study, in the form of interviews, observations, and documentation to collect the necessary data. SMK Negeri 2 Pengasih has included K3 planning as a guideline for implementing practical learning in the workshop. Teacher supervision and guidance in its application is quite good regarding the work to be done. However, OHS evaluation has not been fully conducted in practical learning at school. This is related to policy and improvement of evaluation development as a basis for implementing further learning. From the evaluation, shortcomings can be identified so that better planning can be made for workshop practice for students of SMK N 2 Pengasih.

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INTRODUCTION

Education is a learning process to develop students' potential, skills, and personal characteristics through conscious and planned efforts (Setiawan & Purnomo, 2019). In Indonesia, one of the levels of education before entering college is vocational high school or Sekolah Menengah Kejuruan (SMK). Vocational high schools, especially those majoring in Engineering, have a high potential for work accidents because there are many practicums. Based on this, paying attention to the Occupational Safety and Health (OSH) of educators and students is an important thing to do during the learning process. Educational goals can be achieved if the learning process also goes well (Setiawan & Al-Hudha, 2021).

Work safety issues are strongly linked to work-related accidents, not only in the industrial sector but also in other sectors. The rate of work accidents in Indonesia is still high and tends to increase every year. One practical measure that can be implemented to prevent such accidents and ensure a safe and healthy work environment is occupational safety and health (K3) inspection (Hidayah & Zaman, 2022).

Occupational safety and health (OSH) or Keselamatan dan Kesehatan Kerja (K3 in Indonesia) is an aspect or element of health that is closely related to the work environment and work (Amponsah-Tawiah et al., 2016). Work safety has a direct or indirect impact on increasing worker efficiency and productivity (Ahmad & Suliawati, 2023; Makadao et al., 2017). Furthermore, OSH or K3 is an initiative aimed at protecting workers. Its primary goal is to maintain a safe and healthy environment for employees, which allows them to utilize all

available resources optimally and efficiently, without any potential danger or risk of work accidents (Kavouras et al., 2022; Febrianti et al., 2021), so that supervision is conducted on all aspects such as workers, machines, materials, and those covering the work area (Reza & Azwir, 2019). Nowadays, Indonesia still has a low level of work safety when compared to developed countries which are aware of how important it is for regulations and regulations regarding OSH or K3 to be implemented in their country.

The implementation of OSH or K3 in the workplace is a necessity for companies or institutions that brings great benefits to all workers and is not felt as a burdensome burden but rather makes workers aware of the dangerous risks (Haryanto, 2013), so OSH or is very important to be implemented in every place. work to ensure workforce safety so that it can increase productivity (Schulte et al., 2019). The Indonesian government has regulated the Occupational Safety and Health Management System (SMK3) through Government Regulation (PP) Number 50 of the Year (2012). Article 5 of the PP explains that every company in Indonesia is obliged to implement SMK3 in their respective work environments. It is the responsibility of all parties involved, particularly in the industrial sector, to implement OSH. Those concerned must actively participate in various K3 efforts in their respective functions and capacities, continuously working to integrate OSH into the work culture of all activities (Tambunan et al., 2021).

The implementation of OSH or K3 culture prevents cases of accidents and work-related illnesses, for this reason, competent supporting staff are needed, namely human resources (HR) who are reliable and also qualified in the field of OSH, so that optimal results can be achieved immediately. Competence is a person's ability to do or complete a particular job or task, this ability is supported by the skills, knowledge, and work attitudes they have. This can also complete tasks or work according to targets (Primasanti, & Indriastiningsih, 2019). To reduce workplace accidents, educational institutions must implement OSH effectively7. Law No. 1 of 1970 in the Republic of Indonesia, concerning Work Safety, is not only applied in industry but also in vocational high schools considering the importance of implementing OSH. For this reason, special attention is needed in facilities and infrastructure and can be practiced in daily learning activities or in school and industrial practical activities to introduce and raise awareness of students regarding osu (Ichsan Ali et al., 2022). Vocational High Schools aim to produce skilled graduates who are competent in their respective fields and can apply their skills in the workforce (Efronia & Mukhaiyar, 2020).

This research is based on several previous research references. The first research optimized the implementation of laboratory occupational safety and health (OSH) or kesehatan dan keselamatan kerja (K3) at Al-Ittihad Vocational School through communication activities. The method used is group communication in the form of OSH counseling and training, interpersonal communication with the head of the laboratory, as well as media communication through installing OSH signage and video safety briefings. The results found that OSH awareness was still low, leadership commitment was limited, there was no division of OSH responsibilities, and minimal OSH standards and infrastructure. The recommendations given are the installation of OSH signage, video safety briefings, and OSH education for students and other laboratory users (Sari et al., 2023). The second research is the implementation of occupational safety and health (OSH) in laboratories and workshops of the Electronics and Informatics Engineering Education Department, FT UNY. The results show that the OSH management system at the site still needs to be improved. OSH planning has not yet achieved effectiveness, OSH implementation is still lacking, and OSH evaluation needs to be conducted continuously. It was concluded that administrative factors, supervision, and improving OSH culture need to be conducted comprehensively to achieve an effective OSH management system (Wulandari, 2018). The third research concerns optimizing the implementation of OSH in the laboratory of the Department of Mechanical Engineering, State University of Malang. The results show that laboratory conditions in terms of OSH still do not meet standards, even though the department has tried to implement OSH. Inhibiting factors include students' lack of awareness about OSH and inadequate OSH facilities such as PPE and ventilation. It is

recommended to pay more attention to OSH standards and install supporting facilities such as fire extinguishers and regulations in each laboratory (Wahyunan et al., 2015). The fourth research concerns the analysis of OSH in the learning process at the Mechanical Workshop, Department of Machine Maintenance and Repair Engineering, Fakfak State Polytechnic. The results show that the implementation of OSH is considered quite good in terms of student knowledge, but not so good in terms of OSH facilities such as P3K or first aid boxes, fire extinguishers, and SOPs. The implementation of OSH in workshops includes a workshop area, ventilation system, lighting, demarcation lines, PPE, and OSH banners but is not yet optimal. Inhibiting factors include student awareness and the lack of lecturers' explanations about OSH (Tahir & Jarianti, 2021).

Based on the four previous research references, this research conducted an innovation and update regarding the implementation of OSH in the innovation vocational school practicum workshop, namely complete research procedures from data collection to data analysis, detailed in the discussion and analysis of research findings related to OSH, comprehensive in providing recommendations for improvements to the OSH system. This research aims to provide a description and results of the implementation of OSH machining practice workshops that are relatively more complete in explaining the research procedures and more in-depth in the data analysis and recommendations provided.

RESEARCH METHODS

This research uses a qualitative approach to describe the implementation of occupational safety and health in the Mechanical Engineering Workshop of Pengasih 2 Vocational High School. The aim is to find solutions to the obstacles that hinder the implementation of this practice. The descriptive method was used in this research, where the researcher was the main instrument. In his role, the researcher will actively interact, conduct interviews, observe, and document to collect the necessary data. All of this aims to describe in detail the OSH or K3 conditions at that location.

This study was conducted at the Mechanical Engineering Workshop located in Pengasih 2 Vocational High School. The sources of data in this research included the workshop head, teachers who taught practical subjects, and workshop technicians. Additionally, written sources, observation results, and documentation were obtained from the relevant agency, which is the Department of Machining Engineering at Pengasih 2 Vocational High School. The data collection techniques used in this research were observation, questionnaires, and documentation. The data analysis process in this research consisted of four phases: (1) Data collection, (2) Data reduction, (3) Data presentation, and (4) Data verification.

The technique used to test the credibility or trustworthiness of the research results and the validity of the data in this research is technical triangulation, and using reference materials. Triangulation techniques involve cross-checking data from different sources and methods to ensure its credibility (Lawlor et al, 2016). One way to ensure the accuracy of data obtained through interviews is by verifying it through observation and documentation. The reference material mentioned here serves as evidence to support the data discovered by researchers (Monday, 2020). In this research, interview data will be corroborated with the results of observations and other interviews. On the other hand, the condition of the workshop will be supported with photographs. The conceptual framework of the research can be seen in Figure 1.

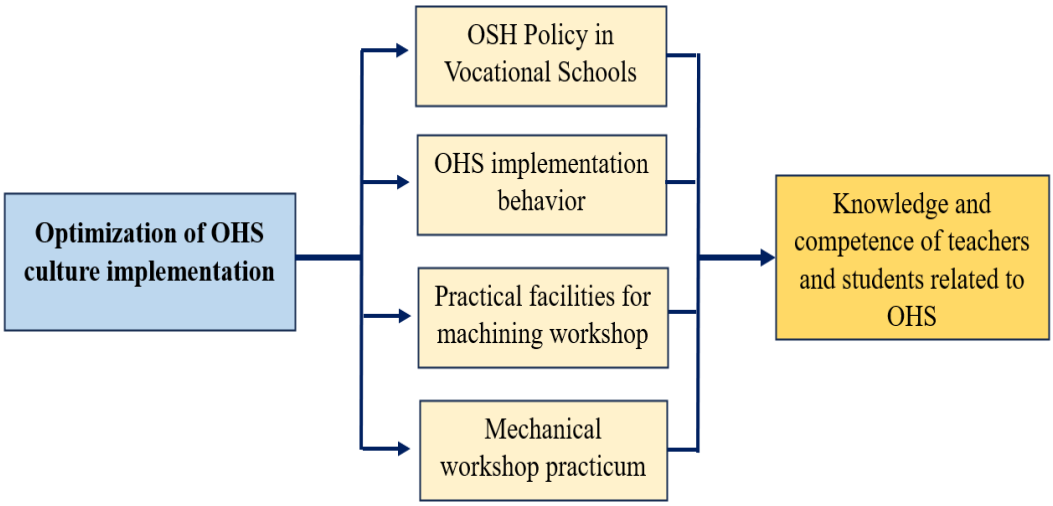

Figure 1. Research conceptual framework

RESULTS AND DISCUSSION

1. Condition of the Mechanical Engineering Workshop Laboratory at Pengasih 2 Vocational High School in terms of Occupational Safety and Health (OSH / K3)

Mechanical Engineering Laboratory area. From Table 1, the laboratory area meets the minimum area requirements according to Minister of National Education Regulation No. 40 of 2008 with a total of 20 students in the Machining Laboratory (Peraturan Menteri Pendidikan Nasional Republik Indonesia, 2008).

Table 1. The condition of the laboratory area at Pengasih 2 Vocational High School is compared with the size of the work area according to Permendiknas No. 40 Tahun 2008

No	Laboratory Type in Mechanical Engineering	Laboratory area (Actual Condition)	The size of each student's work area according to Permendiknas No. 40, 2008	Minimum space for 20 students	Standards Compliance
1	Machining Laboratory	170 m^2	8 m^2	160 m^2	Meet minimum standards
2	Bench Work Laboratory	120 m^2	8 m^2	160 m^2	Does not meet minimum standards
3	Welding Laboratory	150 m^2	6 m^2	120 m^2	Meet minimum standards

According to Table 1, each student needs a minimum work area of 6-8 m2 to conduct practicum tasks comfortably. The table also displays the standard area required for practicum facilities as per government regulations. This allows students to work comfortably without feeling overcrowded or distracted by others. All practicum resources, including equipment, supplies, and other materials, must meet the minimum standards to ensure the smooth execution of practicum tasks and optimal achievement of learning objectives.

2. Laboratory Conditions

Vocational school laboratory equipment and ventilation standards based on Minister of National Education Regulation No. 40 of 2008 and SNI 03-6572-2001 can be used as a reference for assessing standards for the Mechanical Engineering Workshop at SMK Negeri 2 Pengasih. Equipment standards include equipment needed by practitioners during practical activities in workshops, such as personal protective equipment, hand tools, machines and so on. Meanwhile, ventilation standards relate to air circulation in the workshop space so that practitioners receive sufficient air supply and avoid dust pollution and machine fumes. By referring to national standards, the condition of the Mechanical Engineering Workshop at the Vocational School can be assessed as adequate or not.

a. Ventilation

One of how the application of K3 culture in mechanical engineering workshop practicum can be realized is by providing adequate ventilation in the workshop. The ventilation system at the research location can be seen in Table 2.

Table 2. Laboratory ventilation area at Pengasih 2 Vocational High School and comparison according to Indonesian National Standard - SNI 03-6572-2001 (Permendiknas, 2008)

No	Laboratory Type	Laboratory area (Actual Condition)	The ventilation area is 5% of the laboratory area (SNI Standard)	Laboratory ventilation area (Actual Condition)	Standards Compliance
1	Machining Laboratory	170 m^2	10 m^2	9 m^2	Does not meet minimum standards
2	Bench Work Laboratory	120 m^2	6 m^2	8 m^2	Meet minimum standards
3	Welding Laboratory	150 m^2	4,3 m^2	7,5 m^2	Meet minimum standards

Good ventilation plays a role in maintaining air circulation so that practitioners are not disturbed by air pollution such as engine exhaust and metal dust. Based on SNI 03-6572-2001, natural ventilation of at least 5% of the workshop space needs to be provided. Apart from that, mechanical ventilation such as exhaust fans is also needed to control air pollution from machine tool activities. The actual condition of ventilation can be seen in Figure 2. An evaluation of the ventilation of the mechanical engineering workshop at Pengasih 2 Vocational High School needs to be conducted, whether it meets standards or needs improvement. With optimal ventilation, it is hoped that workshop practicums can run more healthily and comfortably for students and teachers.

Figure 2. Air Ventilation in Workshop

b. Lighting

The learning process at Pengasih 2 Vocational High School is only conducted from morning to noon, there are no activities conducted at night. Based on that, the school only applies natural lighting. Natural lighting from the transparent polycarbonate roof is only able to illuminate the Bench Work Laboratory at Pengasih 2 Vocational High School, while the Machining and Welding Laboratory requires artificial lighting because natural lighting is not bright enough for the workshop area. The lighting conditions at the research location can be seen in Figure 3. Evaluation of artificial lighting in mechanical engineering workshops needs to be conducted whether it is sufficient to standard or whether the light intensity needs to be increased so that practical activities are safer and more comfortable.

Figure 3. Lighting Conditions in the Workshop

c. Yellow Line (Floor Marking)

Yellow line or floor marking on a production or workshop area typically represents a designated area for caution or warning. The yellow line in the Machining Laboratory at Pengasih 2 Vocational High School has started to fade so it is less clear, while in the Bench Work, Welding and Metal Casting Laboratory there is no demarcation line. The appearance of the yellow line at the research location can be seen in Figure 4. According to SNI 13-6350-2000, demarcation lines are boundary marks in the form of lines on the floor with different colors according to their use. It is necessary to pay attention to the application of demarcation lines in vocational schools so that practicums are safer and avoid potential work accidents. Therefore, it is necessary to evaluate the condition and update the demarcation lines in the Mechanical Engineering Workshop laboratory at Pengasih 2 Vocational High School.

Figure 4. Yellow Line or Floor Marking

d. Machine Protective Cloth

In the Machining workshop in Mechanical Engineering department as shown in Figure 5, there are several lathes and milling machines that have protective cloth covering their surface. This white cloth protects the machine from metal dust and coolant during practical use. If any metal dust or liquid sticks to the cloth, it can easily be cleaned by changing it. However, other

machines like grinders or saws do not have cloth protectors due to budget constraints. It is important to protect the machines with fabric so they remain durable for a longer period. The commitment that must be made is cloth protectors can be provided for all important machines in the workshop, making the environment cleaner and safer for students during practical sessions at Pengasih 2 Vocational High School.

Figure 5. Machine Protective Cloth

e. Work Safety Warning Signs

In the Mechanical Engineering department at Pengasih 2 Vocational High School, there are only five OSH posters installed, even though the number of machines is quite large so the risk of occupational hazards is also high if you are not careful. In the Metal Casting and Welding Lab, there are only two warning posters each, even though metal casting and welding activities are high risk so more posters or warning signs should be placed. Most of the areas at the research location as in Figure 6 do not have warning signs or posters. So, to improve the OSH culture, it is necessary to evaluate and install additional safety signs and stickers, especially in high-risk areas or machines. In this way, practitioners and other workshop users can become more aware of potential dangers and always be alert and careful during practicum.

Figure 6. Unavailability of Work Safety Warning Signs

f. CNC Machine Area Conditions

The CNC area in Machining Workshop as shown in Figure 7 is built in 2022. As a new building, the laboratory conditions are still not neatly arranged and need further adjustments regarding several things: Tools or tools for CNC practicum are still limited to standards for milling machines and CNC lathes. Special cutting tools such as reamers, taps, dies, and drills are still lacking. Practical materials such as wood, plastic, aluminum, and iron for practicing CNC programming and feeding are also still in short supply. Students still often bring materials from home for practical work. Safety equipment such as welding glasses, dust masks and ear protection headsets are also still inadequate. Therefore, the school needs to provide further equipment and practical materials so that learning activities in the CNC workshop lab can optimally equip the skills of Pengasih 2 Vocational High School students.

Figure 7. CNC Area in Machining Workshop Conditions

g. Use of Personal Protective Equipment (PPE)

In the Pengasih 2 Vocational High School machine workshop, the use of Personal Protective Equipment (PPE) was conducted in an orderly manner and according to procedures to ensure the work safety of students and teachers. Some of the mandatory PPE used when practicing in a machine shop include:

- Mask: Everyone is required to wear a mask when in the workshop area to protect against machine dust and dirt.
- Gloves: Used when handling work objects or tools with the potential to injure hands. Gloves are made from materials that are resistant to friction and tearing.
- Clear glasses: Clear glasses to protect the eyes from sparks, dust, and metal chips.
- Safety shoes: Shoes that cover the entire foot are used to protect the feet from falling objects or spilled hot liquids.
- Wearpack: Functions to protect clothes from machine dirt or oil.

The rules regarding how and when to use PPE are written in SOP and adhered to with discipline. Teachers as educators always supervise and remind them of their use. Examples of students using PPE can be seen in Figure 8. With consistent application, this PPE helps prevent work accidents in all workshops in Mechanical Engineering department at Pengasih 2 Vocational High School.

Figure 8. Use of Personal Protective Equipment (PPE)

h. Fire Extinguisher (APAR)

To anticipate fires in the Mechanical Engineering department at Pengasih 2 Vocational High School, the school provides the sufficient number of fire extinguishers (APAR) and is placed at strategic points. An example of a fire extinguisher used at the research site can be seen in Figure 9. The types of APAR as a light fire extinguishers available are powder and foam-based APAR. Powder is suitable for extinguishing fires on solid materials such as paper, wood, and plastic. Meanwhile, foam is more suitable for flammable liquid materials such as gasoline, oil and lubricants. Fire extinguishers in the Pengasih 2 Vocational High School machine shop are placed at a maximum distance of 5 meters from potential fire hazards. Some points that are equipped with APAR are near the workshop entrance, corner of the CNC machine room, next to the grinding table, and near the chemical storage cupboard. All APARs are still in good condition, the cylinders are full and ready to use. Cleaning staff routinely clean the dust on APAR cylinders so that they are always in top condition. With this adequate availability, APAR is ready to help extinguish potential fires in the Pengasih 2 Vocational High School workshop.

Figure 9. Availability of Fire Extinguisher (APAR)

3. Review of Occupational Safety and Health Implementation in the Mechanical Engineering at Pengasih 2 Vocational High School Workshop

Based on the results of observations conducted at the Mechanical Engineering at Pengasih 2 Vocational High School, data and information were obtained regarding the conditions for

implementing occupational safety and health (OSH or K3). In general, the implementation of K3 in workshops is still not optimal and needs improvement and increased awareness from various parties. The condition of safety facilities in workshops such as fire extinguishers, first aid kits, K3 signs, and others are physically available, however, some tools are not ready and safe to use. For example, the light fire extinguisher (APAR) cylinder in the workshop has never been periodically checked and refilled, so its condition is questionable as to whether it will still function properly when a fire emergency occurs. Likewise, the first aid kit contained incomplete contents and some of the medicines had expired.

The lack of discipline among students and teachers has contributed to the suboptimal Occupational Safety and Health (OSH) in workshops. Some students still do not wear complete Personal Protective Equipment (PPE) during practical work, such as masks, gloves, and safety shoes. Most students are not aware of the importance of cleaning the machines and workshop environment after use, which can result in the spread of metal dust that can cause lung disease. On the other hand, teachers are sometimes inconsistent in enforcing the rules for using PPE and cleaning the workshop.

It is important to improve work safety facilities such as machine grounding, machine guards, exhaust fans, and ventilation to minimize work accidents. Unfortunately, some machines still lack proper grounding installation and the exhaust fans do not function effectively in reducing metal dust and exhaust gas pollution. This can potentially harm the respiratory health of both students and teachers. There is a limited amount of OSH training for students and teachers. While they have theoretical knowledge about OSH, they lack practical training on implementing OSH in workshops. As a result, this lack of knowledge causes a lack of awareness in implementing OSH during practicum. Additionally, there has been no training on fire evacuation techniques, leaving students and teachers confused on what to do in case of a fire.

Overall, the OSH program at Pengasih 2 Vocational High School in theory already exists in the form of OSH policies and procedure manuals, but its implementation is still not optimal. Limited funds are also one of the obstacles in realizing the OSH program. So schools have not been able to provide adequate OSH support facilities and good training. Based on the results of observations, interviews, and discussions with teachers and technicians, several suggestions for improvements that can be made to increase the implementation of OSH in the Machining Engineering Workshop include:

- Conduct regular inspections of OSH equipment and improve inadequate facilities such as fire extinguishers, exhaust fans, grounding, and others.
- Increased discipline of students and teachers in implementing OSH rules and providing sanctions for those who violate them.
- Providing basic OSH training for both students and teachers, at least twice a year.
- Increased supervision of workshop management in implementing OSH, including weekly safety patrol activities.
- Increase collaboration with related external parties, both government agencies and private companies, to share information and knowledge regarding the implementation of OSH in workshops.

Continuous improvement in various aspects is essential for the optimal implementation of K3 in the Mechanical Engineering Department at Pengasih 2 Vocational High School. It is important to create a culture of good OSH or K3 for all school members. This will ensure a safe practicum environment, prevent work accidents, and increase student productivity in learning. To build a strong K3 culture, there is a need for joint awareness and commitment between school principals, teachers, technicians, students, and parents.

CONCLUSIONS AND SUGGESTIONS

Pengasih 2 Vocational High School has incorporated Occupational Safety and Health (OSH) or K3 planning as a guide for practical learning in workshops. The teachers as educators provide good supervision and guidance in implementing OSH, but the evaluation of OSH in

practical learning has not been fully conducted in the school. This is due to the lack of policies and development of evaluation as a basis for further learning.

To improve the conditions, a reporting system method needs to be implemented to rehabilitate and standardize work performance. The following recommendations can be conducted in stages: setting targets, choosing an approach, establishing procedures, and conducting continuous evaluation of OSH conditions in vocational school workshops. The availability of OSH equipment in workshops is still very low compared to the user ratio. Although the OSH management system has been implemented, it still needs further improvement. Therefore, the OSH management system must be carefully planned based on the real conditions in the workshop.

To identify potential dangers, the workshop environment and equipment conditions must be known. OSH implementation must be conducted according to the plan by all parties in the workshop, including teachers, technicians, and students. If planned, the potential for accidents can be reduced or even eliminated. Evaluation as the next stage must be conducted gradually and continuously. From the evaluation, deficiencies can be identified so that better plans can be prepared for the workshop practice of Mechanical Engineering Department students at Pengasih 2 Vocational High School.

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