Risk Analysis of Occupational Health and Safety in Mechanical Engineering Workshop Room at VHS Taman Siswa 2 Jakarta Using the HIRARC Method

Triyono, Riska Kurnia, Fikri Azhar, Himawan Hadi Sutrisno, Jafar Amirruddin, Nugroho Yoga

[1]Fire Material and Safety Laboratory, Jakarta State University, Indonesia
E-mail: triyono.fttm@yahoo.com

ABSTRACT

Many people are not aware of the occupational health and safety risks that exist in the work environment. Therefore, it s necessary to carry out a hazard risk analysis to find out the hazards contained in the environment. This study conducted an analysis of occupational health and safety risks in a machining engineering workshop at VHS Taman Siswa 2 Jakarta. This type of research is a descriptive research with a qualitative approach using the case study method. The data analysis model uses the *Miles and Huberman technique*, by reducing data, presenting data, and drawing conclusions or verification. From this study, 41 hazards were identified with 24 low risk hazards, 11 moderate risk hazards, and 6 high risk hazards. Risk control in the workshop consists of 26 planned risk control measures and 10 unplanned risk control measures. The reseacher suggest that the management of VHS Taman Siswa 2 Jakarta can carry out internal audits and scale checks by paying attention to the OHS culture in the machining workshop area by involving all workshop users, namely the head of the workshop, teachers, technicians, and students.

Key Words: Occupational Health and Safety, Risk Analysis, Risk Level.

INTRODUCTION

Occupational Health and Safety (OHS) is one of the areas of the public health that focuses on the working community both in the formal sector and in the informal sector. Occupational Health and Safety has three main components, namely work capacity, work environment, and workload. The three components have a good and harmonious interactive relationship to produce optimal occupational health [1-4]

Handling OHS problems in the workplace must be carried out thoroughly, including in workshops and laboratories in an educational institution [5]. According [6], education plays a very important role in realizing quality human resources and being able to compete in the era of globalization.

Every workplace should implement occupational health and safety, especially in vocational high school, which will later be dealing directly with materials, equipment that have potential hazards [7]. One of the important aspects for a vocational school that manages infrastructure which includes school buildings, workshops, and laboratories, learning activities using tools and machines, is the aspect of occupational health and safety for school residents [2, 3, 8-10].

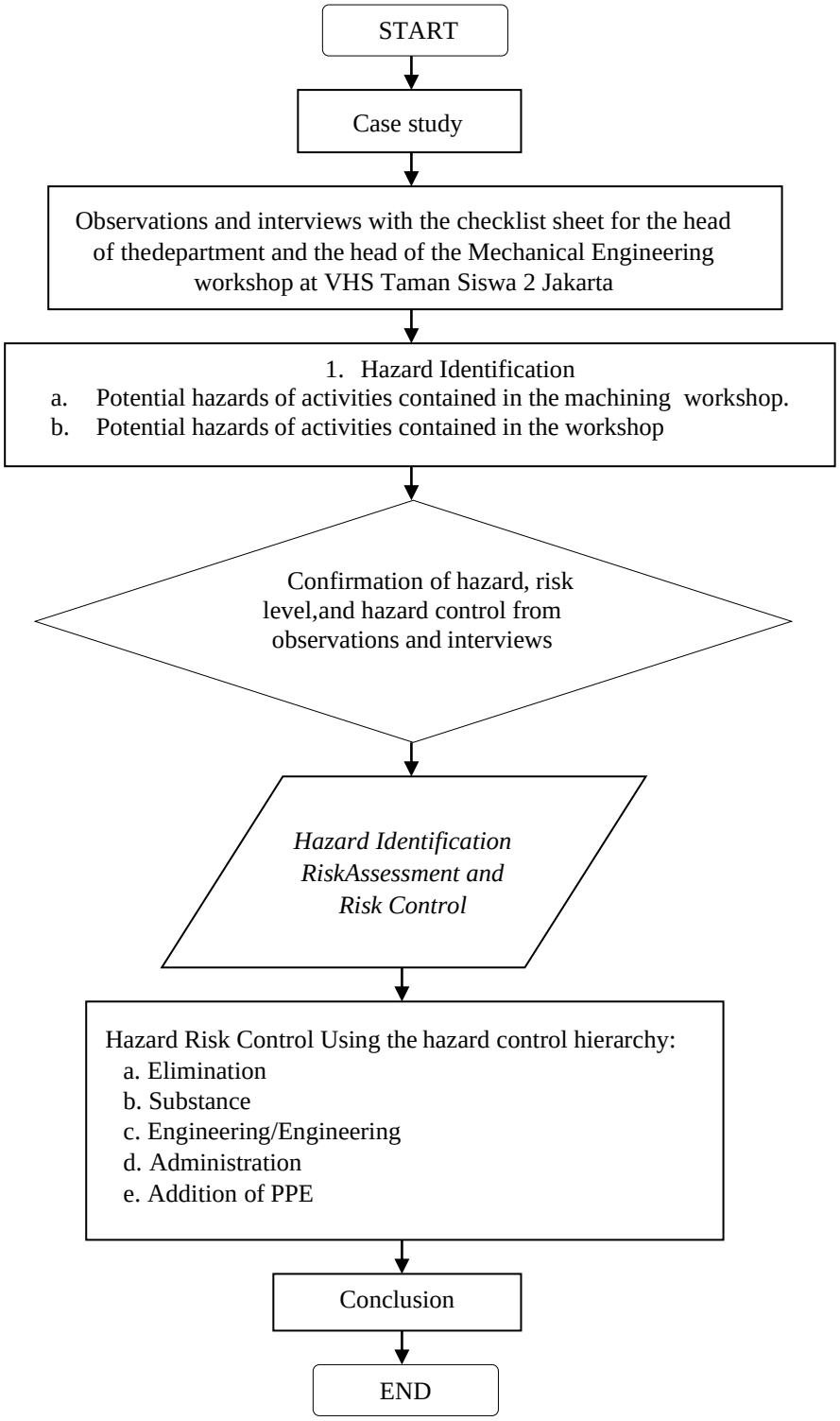
Potential threats to occupational health and safety in general in the vocational high school enviroment include the location of the workshop where the workplace is very close to classrooms and offices which are at risk of noise originating from the operation of tools and machines, the use of heat sources in the workplace [4, 11-13]. Fire accidents can occur anywhere and anytime, so having knowledge to anticipate fires is very important, then the increased knowledge about fire hazards is expected to be a determining factor in the reduction of fire rates in the future. (Sutrisno et al., 2021) Therefore, it is necessary to analyze the potential hazards that occur in the workplace.

There are many cases of neglect of the dangers that threaten only for reasons of work efficiency, for example the use of tools or materials that do not meet the requirements but are forced to be used . Optimization efforts are needed, but must meet occupational safety and health requirements [5]. There are several facilities that must be designed such as: emergency stairs, emergency exits, corridors, emergency lights, directional signs, to alternative power sources in the event of a disaster [14, 15].

At VHS Taman Siswa 2 Jakarta, there have been approximately 4 work accidents in 2015-2020. This shows that students awareness of OHS behavior is still very lacking. Judging from the results of observations and observations of the machining practicum, it is clear that students use equipment and machines that are prone to work accidents, so it can be concluded that knowledge about OHS machining students at VHS Taman Siswa 2 Jakarta is still very lacking and the management system must be changed so that accidents during practicum can be prevented and avoided.

MATERIALS AND METHODS

The analysis of this research uses the HIRARC method with the data analysis technique of the *Miles and Huberman* model . The *Miles and Huberman* model analysis process consists of three step . First, do the reduction data by collecting workshop condition data from observations which are categorized into 7 variables, including workshop conditions and potential hazards in turning, milling, drilling, grinding, welding, and bench work activities. The second is by presenting data in the form of a HIRARC table and the last one is interesting conclusions or verification of the risks that occur. The flow chart can be seen in the below.



Observation and Interview

Observations and interviews were conducted at the machining workshop of VHS Taman Siswa 2 Jakarta by filling out the checklist sheet for the head of the department and the head of the machining workshop for VHS Taman Siswa 2 Jakarta.

Hazard Identification

After getting the results from observations and interviews, then determine what potential hazards occur in the machining workshop at the school.

Determining the Level of Hazard Risk

Determining the level of this hazard risk through the HIRARC method based on the *likelihood* and *consequence* values.

Hazard Confirmation, Risk Level, and Hazard Control

By doing an analysis using the HIRARC method, you will get the potential hazards that occur, the level of risk that exists, and how to control these hazards.

Hazard Risk Control

This hazard risk control is the final result of the above analysis. After knowing what the potential hazards are, how many levels of risk there are, then developing hazard risk controls to reduce the hazards that occur in the workplace.

RESULTS AND DISCUSSION

Based on several series of activities carried out, the results of each activity are:

1. Observation and interview

Based on the results of observations and interviews, the results obtained are photo documentation, conditions, and potential hazards contained in the workshop, which are as follows:

No.	Documentation	Workshop Condition	Danger Occurs
1.		There are not instructions for use on lathes, mills, drills, grinders, welding, and bench work.	Student potential experience error in operation machine that can cause injury or accident work.

2.		There are not posters related to the importance of OHS and the dangers posed when using the machines.	Students can be indifferent, careless, so no knowing as a result and cause accident work.
3.		There aren't evacuation route.	Process evacuation can be delayed which because accident or fire becomes more big.
4.		Between the grinding area and the welding area are too close.	Student/teacher could experience eye injury because of area grinding and welding too close. Because in grinding and welding area has different PPE.
5.		Extinguisher light fire that located outside workshop.	Because the fire extinguisher not at within the area workshop, it can be panic when there is a fire.

6.		There is a hand washing area in the machining room which can cause the wet floor to be slippery due to splashing water.	Floor which slippery could cause student/teacher experience injury due to slip
7.		There are not markings for areas requiring special PPE such as grinding and welding areas.	Cause accident or consequent disease work/practicum which is conducted students/teachers.
8.		There isn't safety in the grinding area.	Splashes of grinding metal or grams can hit students/teachers in the vicinity. It can cause various diseases if exposed continuously.

After getting the results of the workshop conditions, then proceed with the identification of the hazards that exist in the VHS Taman Siswa 2 Jakarta workshop.

2. Hazard Identification

At the VHS Taman Siswa 2 Jakarta workshop, there are 6 process activities, namely the turning process, the milling process, drilling, grinding, welding, and bench work processes. There are several potential hazards that occur in each process of these activities, namely:

a. Turning process

In the types of activities that exist in the turning process, there are potential hazards, namely:

No.	Type Activity	Potential Hazards
1.	Install Chisel	Get hit by a sharp chisel

		Blunt chisel : - Could cause sound noisy other hearing - Could cause hot too much - Could result in chisel broken could bounce and hurt students Chisel no installed with correct on tools post - Installation which no right can result in chisel easy blunt even broken - Chisel which no installed with correct could bounce and injure students
2.	Install object work	– The workpiece is not properly attached to the tight. – Could result in object work damaged even can bounce off injuring students.
3.	Laying keys	Putting keys close with part moving machinery can cause keys the shift and then bounce hurt students
4.	Process Turning	– Caught bounce used turning which hot cause irritation to skin – Dress or wearpack which have arm length can be wrapped around the spindle machine which turn

From the results above, the potential hazards were seen through the types of activities and interviews with the head of the workshop and teachers from SMK Taman Siswa 2 Jakarta.

b. Milling Process

In the types of activities that exist in the milling process, there are potential hazards, namely:

No.	Type Activity	Potential Hazards
1.	Installing the milling knife	Injured from being scratched by a milling knife sharp
2.	Install object work on vise	Installation object work which not enough tight may cause the workpiece or eyes knife milling broken and bounce hurt student
3.	Process practice milling	– Hair and dress arm long could entangled axis machine which turn. – Exposed flakes used milling which hot could cause skin irritation.

c. Drilling Pocess

In the types of activities that exist in the drilling process there are potential hazards, namely:

No.	Type Activity	Potential Hazards
1.	Install eye Drill	Wounded because scratched drill bit which sharp
2.	Install object work on vise	Installation of workpieces that are not tight can the drill bit to break and bounces that can hurt students.
3.	Process Drill	– Hair and dress arm long could entangled axis machine which turn – Exposed to debris from the drilling hot can skin irritation

4.	Clean chips used drilling	Used drilling or chips which generated usually long and sharp and could hurt student hand.

d. Grinding Process

In the types of activities that exist in the grinding process there are potential hazards, namely :

No	Type of activity	Potential Hazards
1.	Installing the workpiece	Installing a workpiece that is not properly positioned can result in pinched hands.
2.	Hone	- Sparks resulting from grinding can be irritating if in contact with skin. - The dust produced can interfere with breathing. - Fingers can scald due to the heat of the workpiece that has been grinded. - Sparks can ignite objects in the vicinity of flammable grinding machines.
3.	Use of grinding machines on transportation routes	Metal sparks can hit other students.

e. Welding Process

The welding process there are potential hazards, namely:

No.	Type Activity	Potential Hazards
1.	Connecting welding mass pliers	If you connect the pliers when the time is out of focus, it can your hands to get pinched.
2.	Install electrode	When no be careful, your hand can pinched plier sholder electrode
3.	Process welding	- If the ventilation system isn't good then smoke burning results welding can confined in the room and inhaled by students. - Exposed to ultraviolet and infrared radiation red could cause irritation on skin. - Splash results weld could caught student andcause scald or burns
4.	Process cool material	Hand can touched hot metal.
5.	Clean material with slag hammer	- You can hit your hand with a hammer if you not be carefully - Hand student can scratched sharp materials

f. Bench Work Process

In the types of activities that exist in the bench work process, there are potential hazards, namely:

No.	Type Activity	Potential Hazards
1.	Hone	Your hand can be pierced by sharp and fine bits of shavings
2.	Saw off	Hand wounded and can scratched saw blade
3.	Work Plate	The potential of the student's hand is scratched by the sharp and rough edge of the plate

3. Determining the Level of Hazard Risk

After getting the results from observations, interviews, and identifying the hazards, the next step is to determine the level of risk of these hazards. To determine the level of hazard risk using the HIRARC method, by obtaining the following results:

a. Turning Process

No	Type of activity	Danger	Potential Hazards	Frequency	Severity	Risk *Ranking*	Risk Level
1.	Installing Chisel	Sharp chisel	The use of sharp chisels can injure student's hands	2	1	1	Low
		Dull chisel	Can cause noise that interferes with hearing	3	2	6	Moderate
			Can result in broken chisels that can bounce and injured students	1	2	2	Low
			Generates excessive heat that can hit student's hands	2	2	4	Low
		The chisel is not properly attached to the tool post	Improper installation can result chisel being easily blunted and even broken and bounced, injuring students.	2	2	4	Low
2.	Installing the workpiece	The workpiece is not properly attached to the chuck	Can cause the workpiece to be damaged and even bounce off injuring students	2	1	2	Low

3.	Laying the keys	Place the key close to the moving parts of the machine.	Causing the keys to shift and then bounce off injuring students	1	3	3	Low
4.	Turning process	Hot and sharp.	Being hit by a hot turning former bounce can cause akin irritation	3	2	6	Moderate
		Long sleeve wearpackand long hair	Student with long sleeve wearpack and long hair can get wrapped around when the rotating machine spindle	1	3	3	Moderate
Australian Standard on Risk Management AS/NZS 4360 : 1999							

b. Milling Process

No	Type of activity	Danger	Potential Hazards	Frequency	Severity	Risk *Ranking*	Risk Level
1.	Installing the milling knife	Use of a sharp milling knife	Injured by being scratched by a sharp milling knife	2	1	2	Low
2.	Mounting the workpiece on the vise	The workpiece is not suitable for placement	Installation of a workpiece that isn't tight can cause the workpiece or milling blade to break and bounce, injuring students	2	1	2	Low
3.	Process of milling the	Long sleeve wearpack and long hair	Student with long sleeve wearpack and long hair can get wrapped around when the rotating machine spindle	1	3	3	Moderate
			Exposed to hot milling flakes can cause skin irritation	3	2	6	Moderate
Australian Standard on Risk Management AS/NZS 4360 : 1999							

c. Drilling Process

No	Type of activity	Danger	Potential Hazards	Frequency	Severity	Risk Ranking	Risk Level
1.	Installing the drill bit	Sharp drill bit	Student's hands can be scratched by a sharp drill bits.	2	1	2	Low
2.	Mounting the workpiece on the vise	Improper workpiece installation	That workpieces are not securely fastened can cause the drill bit to break and bounce. The student can be hit by drill bit.	2	1	2	Low
3.	Drilling process	Long sleeve wearpack and long hair	Student with long sleeve wearpack and long hair can get wrapped around when the rotating machine.	1	3	3	Moderate
		Drilling flakes	Exposed to hot drilling flakes can cause skin irritation	3	2	6	Moderate
4.	Cleaning up drilling scraps	Long and sharp cuttings	The drilling marks or scraps produced are usually long and sharp so they can injure student's hands	3	1	3	Low

Australian Standard on Risk Management AS/NZS 4360 : 1999

d. Grinding Process

No	Type of activity	Danger	Potential Hazards	Frequency	Severity	Risk Ranking	Risk Level
1.	Installing the workpiece	Installing the workpiece is not in accordance with the placement	Can cause pinched hands	2	1	2	Low

2.	Grinding process	Grinding sparks	Sparks resulting from grinding can be irritating if in contact with the skin.	3	2	6	Moderate
		Grinding dust	The dust produced can interfere with breathing.	3	2	6	Moderate
		Hot grinding object	Fingers can scald due to the heat of the workpiece that has been grinded	2	2	4	Low
		Use of grinding machines on transportation routes	Metal sparks can hit other students	1	1	1	Low

Australian Standard on Risk Management AS/NZS 4360 : 1999

e. Welding Process

No	Type of activity	Danger	Potential Hazards	Frequency	Severity	Risk Ranking	Risk Level
1.	Connecting the pliers	Installing carelessly	Connecting the pliers if you don't concentrate can cause your hands to get pinched.	2	1	2	Low
2.	Installing the electrodes	Installing carelessly	If you're not careful, your hands can get pinched by the electrode holder.	2	1	2	Low
3.	Process welding	The ventilation system is not good	The ventilation system is not good, so the smoke from the welding combustion is trapped in the room and inhaled by student.	3	3	9	High
		Exposure ray ultraviolet and infrared red	Exposure to radiation ultraviolet light and infrared could cause	3	3	9	High

			irritation on skin.				
		splash results welding	Result splash weld can hit by students and cause blister or wound burn	3	2	6	Moderate
4.	Process cool material	Object work	Hand can just touch metal hot	3	1	3	Low
5.	Process clean material with a hammer slag	Processingwith no careful	Can just hand hammered if not be careful	2	1	2	Low
			Hand student can scratched material which sharp	2	1	2	Low

Australian Standard on Risk Management AS/NZS 4360 : 1999

f. Bench Work Process

No	Type of activity	Danger	Potential Hazards	Frequency	Severity	Risk Ranking	Risk Level
1.	Hone	Sharp and smooth flakes	The hand is pierced by sharp and fine splinter shavings	2	1	2	Low
2.	Sawing	Sharp saw blade	Hands can be injured and scratched by saw blades	2	1	2	Low
3.	Plate work	Sharp and rough plate edges	Can cause injury to students	3	1	3	Low

Australian Standard on Risk Management AS/NZS 4360 : 1999

g. Conditions at the Workshop

No	Workshop Condition	Danger	Potential Hazards	Frequency	Severity	Risk Ranking	Risk Level
1.	There are no instructions for use on	Machine use error	Students have the potential to make mistakes in operating	1	3	3	Moderate

	lathes, mills, drills, grinders, welding and bench work.		machines that can cause work injuries/accidents				
2.	There are no posters related to the importance of OHS and the dangers posed when using machines.	The attitude of students who are in different to the dangers of practicum	Students can be in different, act careless, so no know as a result and cause accident work	2	1	2	Low
3.	No evacuation route instructions	It is not clear which evacuation route exists	Process evacuation can be delayed which cause accident or events like fire becomes the more critical.	1	4	4	High
4.	The grinding area and the welding area are too close together	Differences in the use of PPE	Student/teacher could experience eye injury because of area grinding and welding too close. Because in area grinding and welding different PPE.	1	2	2	Low
5.	Extinguisher light fire that located outside workshop	Inappropriate placement offire extinguishers	Cause panic on when it happened accident work as fire because of the fire extinguisher not at within the area workshop.	1	4	4	High
6.	There is a hand washing area in the machining room which can cause the wet floor to be slippery due to splashing water.	Slippery floor	Floor which slippery could cause student/teacher experience injury due to slip	2	2	4	Low
7.	There are no markings for areas requiring special PPE such as grinding and welding areas.	Unclear safety sign	Cause accident or consequent disease work/practicum which is conducted students/teachers.	4	3	12	High
8.	There is no safety in the	Sparks	Metal sparks resulting from grinding or grams	4	2	8	High

	grinding area		can hit students/teachers in the vicinity which have the potential to cause various diseases if exposed continuously.				
Australian Standard on Risk Management AS/NZS 4360 : 1999							

4. Hazard Confirmation, Risk Level, and Hazard Control

After conducting an analysis using the HIRARC method, you will get the potential hazards that occur, the level of risk that exists, then confirm with the head of the workshop. If it is correct, then plan to control the risk of the hazard.

5. Hazard Risk Control

When it is known the identification of hazards, potential hazards, and the level of existing hazard risks, then plan to control these hazard risks. Controls carried out by VHS Taman Siswa 2 Jakarta area .

a. Conditions at the Workshop

No	Workshop Condition	Danger	Potential Hazards	Hazard Control	*Action Plan*		
					Action	*By Who*	*when*
1.	There are no instructions for use on lathes, mills, drills, grinders, welding and bench work.	Machine use error	Students have the potential to make mistakes in operating machines that can cause work injuries/accidents	Provide information about the SOP for using the machine by attaching it to the machine	-	-	not planned
2.	There are no posters related to the importance of OHS and the dangers posted when using machines.	The attitude of students who are different to the dangers of practicum	Students can be in different, Act careless, so no know as a result and cause accident work	Make posters about the importance and the dangers of prioritizing occupational safety and health by sticking it on the wall room	-	-	Not planned
3.	No evacuation route instructions	It is not clear which evacuation route exists	Process evacuation can be delayed which cause accident or events like fire Becomes the	Provide evacuation route information by sticking a sticker or sign on the	-	-	Not planned

			more critical	floor or on the wall of the room			
4.	The grinding area and the welding area are too close together	Differences in the use of PPE	Student/teacher could experience eye injury because of area grinding and welding too close. Because in area grinding and welding different PPE his	- Moving welding and grinding areas - Provides a barrier between the welding area and grinding area	-	-	Not planned
5.	Extinguisher light fire that located outside workshop	Inapprop ria te placeme nt of fire extinguis hes	Cause panic on when it happened accident work as fire because of the fire extinguisher not at within the area workshop.	Move the fire extinguisher into a machining workshop that can be easily reached	Move the fire extinguisher to a machine room that is easily accessible and visible	head of the workshop	Done this semester
6.	There is a hand washing area in the machining room which can cause the wet floor to be slippery due to splashing water.	Slippery floor	Floor which slippery could cause student/teacher experience injury due to slip	Moving the handwashing area to the outside of the machining workshop, for example, next to the entrance to the machining workshop	-	-	Not planned
7.	There are no markings for areas requiring special PPE such as grinding and welding areas.	Unclear safety sign	Cause accident or consequent disease work/practicum which is conducted students/teachers.	Provide information about areas that require special PPE by sticking it on the wall or on the machine or tool used	-	-	Not planned

8.	There is no safety in the grinding area	Sparks	Metal sparks resulting from grinding or grams can hit students/teachers in the vicinity which have the potential to cause various diseases if exposed continuously.	Provide barriers or provide insulation, especially in the grinding area	-	-	Not planned

b. Turning Process

No	Type of activity	Danger	Potential Hazards	Hazard Control	Action Plan		
					Action	By Who	When
1.	Installing Chisel	Sharp chisel	The use of sharp chisels can injure students hands	When installing / replacing the tool do not hold the tip of the tool. Position holding the chisel securely	Give direct directions about how to install and replace chisel before to do practice	Teacher with head workshop	Done this semester
		Dull chisel	Can cause noise that interferes with hearing	Sharpen the chisel. if the problem is not resolved then you should use earplugs	Provide direct directions on how to install and replace the chisel before doing the practicum	Teacher with head workshop	Done this semester
			Can result in broken chisels that can bounce and injure students	Use a chisel that is still sharp and safe to use as well as the appropriate placement so that it doesn't loosen on the tool post	Provide direct directions on how to install a chisel on the toolpost before doing the practicum	Teacher with head workshop	Done this semester

			Can cause excessive heat and touch students hands	Use coolant during the turning process. If you have to remove the chisel, wait until cold chisel	Warn students not to hold the chisel right away if it has not been cooled	Teacher with head workshop	Done this semester
		The chisel is not properly attached to the tool post	Improper installation can cause the chisel to be easily blunted and even broken and bounced, injuring students	Always check the center position of the chisel, make sure the bolts on the toolpost bind the chisel well	Always give directions to always check the chisel on the toolpost is tight or not	Teacher with head workshop	Done this semester
2.	Installing the workpiece	The workpiece is not properly attached to the chuck	Can cause the workpiece to be damaged and even bounce off injuring students	Make sure the workpiece is gripped properly and the workpiece feeding process is not too heavy in	Always provide direction to ensure that the workpiece is properly secured to the chuck	Teacher with head workshop	Done this semester
3.	Laying the keys	Place the key close to the moving parts of the machine.	Can cause the keys to shift and then bounce off injuring students	Do not put keys or tools on a fixed head, because they can fall on the spindle when rotating	Always remind students not to carelessly put tools around the machine at the same time practice	Teacher with head workshop	Done this semester
4.	Turning process	Hot and sharp.	Being hit by a hot turning former bounce can cause irritation to the skin	Protects sensitive body parts, such as the eyes. Can also use cover / cover on spindle	-	-	Not planned
		Long sleeve shirt and long hair	Wearpacks that have long sleeves and long hair can get wrapped around the rotating machine spindle	Shaving hair without wearing long sleeves and wearing a hat if necessary	Make rules to always keep students hair clean and tidy	Teacher with head workshop	Done this semester

c. Milling Process

No	Activity Type	Danger	Potential Hazards	Hazard Control	Action Plan		
					Action	By Who	when
1.	Installing the milling knife	Use of a sharp milling knife	Injured by being scratched by a sharp milling knife	When installing/ replacing the blade, do not touch and touch the bottom edge of the blade. Position the blade securely.	Provide direct directions on how to install and replace the chisel before doing the practicum	Teacher with head workshop	Done this semester
2.	Mounting the workpiece on the vise	The workpiece is not suitable for placement	Installation of a workpiece that isn't tight can cause the workpiece or milling blade to break and bounce, injuring students	Make sure the vise that binds the workpiece is in a tight position and is not backless (dol). During the milling process, always check whether the vise is still binding workpiece tightly.	Always give direction and supervise to ensure the workpiece is properly checked on the chuck	Teacher with head workshop	Done this semester
3.	Process of milling the workpiece	Long sleeve wearpeack and long hair	Hair and long sleeves can get caught in the rotating shaft of the machine	Shave hair, not long. Stand not too closeto the rotating parts of the machine, or wear a hat if necessary	Make rules to always keep students hair clean and tidy	Teacher with head workshop	Done this semester
			Exposed to hot milling flakes can cause skin irritation	Protects sensitive body parts, such as the eyes. Can also use a cover/cover	Provide rules to always use PPE such as goggles and provide cover on the machine	Teacher with head workshop	Done this semester

d. Drilling Process

No	Type of activity	Danger	Potential Hazards	Hazard Control	Action Plan		
					Action	By Who	when
1.	Installing the drill bit	Sharp drillbit	Students hands can be scratched by a sharp drill bit	When installing / replacing the tool do not hold the tip of the tool. Position the chisel securely.	Provide direct directions on how to install and replace the chisel before doing the practicum	Teacher with head workshop	Done this semester
2.	Mounting the workpiece on the vise	Improper workpiece installation	Installation of a workpiece that is not tight can cause the drill bit to break and bounce off the student	Make sure the vise that binds the workpiece is in a tight position and is not stuck.	Always giving direction and supervising to ensure the workpiece is properly checked on gripper	Teacher with head workshop	Done this semester
3.	Drilling process	Long sleeve shirt and long hair	Hair and long sleeves can getcaught in the engine shaft that rotates	Shave hair, not long. Stand not too close to rotating machine parts, or if necessary wear a hat	Make rules to always keep students hair clean and tidy	Teacher with head workshop	Done this semester
		Drilling flakes	Exposed to hot drilling flakes can cause skin irritation	Protects sensitive body parts, such as the eyes. Can also use the cover/cover on the spindle	Provide rules to always use PPE such as goggles and provide	Teacher with head	Done this semester
4.	Cleaning up drilling scraps	Long and sharp cuttings	The drilling marks or scraps produced are usually long and sharp so that they can injure students hands	Remove the entangled and snagged scrapsusing pliers. Rotated counter clockwise to untie it.	Always remind students to wear gloves to protect their hands from sharp cuts	Teacher with head workshop	Done this semester

e. Grinding Process

No	Type of activity	Danger	Potential Hazard	Hazard Control	Action Plan		
					Action	By Who	when
1.	Installing the workpiece	Installing the workpiece is not in accordance with the placement	Can cause pinched hands	Position your hands when installing the workpiece, don't hold the vise	Always giving direction and supervising to ensure the workpiece is properly checked on gripper	Teacher with head workshop	Done this semester
2.	Grinding process	Grinding sparks	Sparks resulting from grinding can be irritating if in contact with the skin	Make sure the grinding machine uses a cover so that the sparks from grinding do not directly hit the students.	Provide rules to always use PPE such as goggles and cover the machine	Teacher with head workshop	Done this semester
		Grinding dust	The dust produced can interfere with breathing	placed near the exhaust fan. Immediately rinse body parts exposed to residual dust after grinding so as not to cause irritation or itching. itchy skin	-	-	Not planned
		Hot grinding object	Fingers can scald due to the heat of the workpiece that has been grinded	Provides coolant for workpieces that have been grinded	Warn students not to hold the chisel right away if it has not been cooled and use it always gloves	Teacher with head workshop	Done this semester
		Use of grinding machines on transportation routes	Metal sparks can hit other students	Move the grinding machine to a safer place so it doesn't hit other	Move it to a safer place so as not to interfere with practicum	Teacher with head workshop	Done this semester

				students	activities		

f. Welding Process

No	Type of activity	Danger	Potential Hazards	Hazard Control	Action Plan		
					Action	By Who	when
1.	Connecting the pliers	Installing carelessly	Connecting the pliers if you don't concentrate can your hands to get pinched.	Always wear gloves and concentration during practicum.	Remind and supervise students to always be careful when connecting the pliers before practice.	Teacher with head workshop.	Done this semester
2.	Installing the electrodes	Installing carelessly	If you're not careful, your hands can get pinched by the electrode holder.	Always wear gloves and focus during practicum.	Remind and supervise students to always be careful when connecting the pliers before practice.	Teacher with head workshop	Done this semester
3.	Process welding	The ventilation system is not good	The ventilation system is not good, so the smoke from the welding combustion is trapped in the room and inhaled by student.	Engineer the welding area to provide exhaust so that the welded fumes can be carried out of the room.	-	-	Not planned
		Exposure to ultraviolet and infrared rays	Exposure to ultraviolet and infrared radiation can cause skin irritation.	Always use anapron and welding mask when doing practicum	Remind and supervise students to always be careful when welding and not to joke	Teacher with head workshop	Done this semester

		Welding splash	Welded sparks can hit a person and cause a scald or burn	Always use gloves, an apron, and a welding mask so that the sparks from the weld don't directly hit the body student	Remind and supervise studentsto always be careful and use PPE when doing welding and not to joke	Teacher with head workshop	Done this semester
4.	Process cooling material	Object work	Hand can be touched by hot metal	Wear gloves and make sure the workpiece is cool with coolant so that safe to hold	Warn students not to hold the chisel directly if it has not been cooled and always use gloves.	Teacher with head workshop	Done this semester
5.	The process of cleaning the material with a slag hammer	work carelessly	- The hand can be hit by hammer if not be careful - The hand can be scratched by sharp material	Use gloves when hammering in the workpiece and focus while doing so	Giving directions to students to always wear gloves and be careful during practicum	Teacher with head workshop	Done this semester

g. Bench Work Process

No	Type of activity	Danger	Potential Hazard	Hazard Control	Action Plan		
					Action	By Who	When
1.	Hone	Sharp and smooth flakes	fine splinter shavings	Always clean the surface of the file with a wire brush especially before starting hone	Remind students to always clean the file before and after practicum	Teacher with head workshop	Done this semester
2.	Sawing	Sharp saw blade	Hands can beinjured and scratched by saw blades	Start by sawing slowly with a pulling motion until it starts smooth and then put pressure on the saw	Always provide direction and supervision to ensure the plate bending	Teacher with head workshop	Done this semester

					process is in accordance with theory		
3.	Work on plate	Sharp and rough plate edges	Students can get hurt	- Bend the remaining plate when cutting using manual scissors. - cutting the sharp corners of the plate	Always provide direction and supervision to ensure the plate bending process is in accordance with theory	Teacher with head workshop	Done this semester

The results of the research from all the descriptions of the activities above at the Machining Workshop of VHS Taman Siswa 2 Jakarta can be seen in the table as follows:

No.	Indicator	Risk of Danger	Risk Rating				Hazard Control	
			Low	Moderate	High	Extreme	Planned	Unplanned
1	Workshop Condition	8	3	1	4	-	1	7
2	Turning Activities	9	6	3	-	-	3	1
3	Milling Activities	4	2	2	-	-	4	-
4	Drilling Activities	5	3	2	-	-	5	-
5	Grinding Activities	5	3	2	-	-	4	1
6	Welding Activities	7	4	1	2	-	6	1
7	Bench Work Activities	3	3	-	-	-	3	-

From the table above, data analysis was carried out using the model technique of *Miles and Huberman* by reducing data, presenting data, and drawing conclusions or verifying that the results of the research there were 41 hazards identified by:

1. 24 low hazards whose risk levels can still be managed. An example of a low risk hazard is getting injured while installing a sharp chisel; injured because of placing an object that is not in the right place so that the milling blade bounces off; scratched by a sharp drill bit; and scalding hands when handling grinding objects.

2. 11 moderate hazards whose risk level is classified as serious injury and can be treated in hospital. Examples are exposed to sparks from welds that cause burns; hair or clothes that get wrapped around the machine while it is turning; exposed to hot milling flakes that cause skin irritation; and hearing loss caused by the noise generated by blunt chisels.

3. 6 high hazards with high risk of causing serious injury and record permanent and substantial financial losses. Examples are not exposed to ultraviolet and infrared radiation which can cause skin irritation; a bad ventilation

system can cause students to inhale the fumes of the combustion resulting from welding; placement of fire extinguishers that can cause panic and large fires; the absence of an evacuation route which makes the accident worse; and the absence of safety in the grinding area which causes the metal to be splashed from the grinding results which has the potential to be exposed to various diseases if exposed continuously.

There are several controls that have been planned by the school to reduce the dangers that occur in the workshop. There are 26 planned controls, such as removing light fire extinguishers; using a chisel that is still sharp and safe; using coolant during the turning process; shaving hair and not wearing long-sleeved wearpack when practicum; and move the grinding machine to a safer place. In addition, teachers and workshop heads always remind students before practicum to comply with occupational safety and health in the workshop. There are also controls that have not been planned by the school as many as 10 controls, for example providing information on SOPs; making posters about occupational safety and health; provide evacuation routes; engineer the welding area to provide exhaust; provide a barrier to the grinding area; and moving the hand washing station outside the machining workshop.

CONCLUSION

Based on the research data, it can be concluded that from analyzing using the HIRARC method with the model technique of Miles and Huberman, there are 41 hazards were identified with a risk level consisting of 24 low hazards, 11 moderate hazards, and 6 high hazards. Meanwhile, the risk control in the workshop consists of 26 planned risk control measures and 10 unplanned risk control measures. The researcher suggests that the management of VHS Taman Siswa 2 Jakarta can carry out internal audits and scale checks by paying attention to the occupational safety and health culture in the machining workshop area by involving all workshop users, with the head of the workshop, teachers, technicians, and students.

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