Short Communication

HIRARC Development from Industrial Case-Based Study for TVET Students Using Peeragogy Learning Method

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Article history

Received 9/8/2023
Accepted (Panel 1) 11/9/2023
Accepted (Panel 2) 2/10/2023

ABSTRACT: *Hazard Identification, Risk Assessment and Risk Control (HIRARC) is used as a risk analysis tool in many industries in Malaysia, such as manufacturing, construction, agriculture, public services, hotels, and restaurants. Therefore, Technology and Vocational Education and Training (TVET) students need to understand HIRARC in preparation for the real workplace. Proficiency in HIRARC requires students to understand key terms, such as hazard, standard operating procedure (SOP), risk analysis, likelihood and severity, and methods to control risk levels with appropriate and efficient countermeasures. For the diploma in process engineering (Petrochemical), HIRARC is introduced in the Occupational Safety and Health for Engineering subject. This study proposes peeragogy learning as a method to enable process engineering students to explore and develop HIRARC based on industrial case-based studies under the supervision of their lecturer. They can help students learn better while providing teachers with better ways to teach.*

Keywords: *Department of Occupational Safety and Health (DOSH), Hazard Identification, Risk Assessment and Risk Con trol (HIRARC), Peeragogy, Standard Operating Procedure (SOP), Technology and Vocational Education and Training (TVET)*

1.0 INTRODUCTION

Hazard Identification, Risk Assessment and Risk Control (HIRARC) provides a structured and comprehensive approach for managing workplace risks. The implementation of HIRARC helps organisations comply with safety regulations, reduce risk levels, and promote a safe working environment. The development of HIRARC was based on the 2008 Guidelines for

HIRARC produced by the Department of Occupational Safety and Health (DOSH). The following reasons highlight the importance of implementing the HIRARC.

1. **Safety:** HIRARC is primarily used for safety management. It helps to identify potential hazards, assess associated risks, and implement control measures to prevent accidents, injuries, or fatalities. Prioritising safety is crucial for protecting employees, visitors, and public.

2. **Legal Compliance:** Many countries and industries have regulations and legal requirements related to risk management and safety. Conducting HIRARC helps organisations comply with these laws and regulations, thus reducing the risk of legal consequences and penalties.

3. **Cost Savings:** Effective risk management can lead to cost savings. By identifying and mitigating risks early, organisations can reduce expenses related to accidents, injuries, property damage, and insurance premiums. This can improve the financial health of organisations.

4. **Reputation Management:** Incidents involving safety breaches or accidents can damage an organisation's reputation. HIRARC helps prevent such incidents, which, in turn, maintains the reputation and credibility of the organisation.

5. **Employee Morale:** A safe working environment can enhance employee morale and job satisfaction. When employees feel safety is a priority, they are more likely to be engaged, productive, and loyal to the organisation.

6. **Efficiency and Productivity:** HIRARC can improve the efficiency of operations by proactively addressing risks. It helps organisations identify bottlenecks, inefficiencies, and potential disruptions and take the necessary steps to mitigate them.

7. **Continuous Improvement:** HIRARC is not a one-time process; it is an ongoing cycle. Regularly reviewing and updating risk assessments allows organisations to adapt to changing circumstances, technologies, and environments by fostering a culture of continuous improvement.

8. **Environmental Protection:** HIRARC is not limited to safety, as it also includes environmental risks. It helps organisations to identify and address risks that may harm the environment by allowing for more sustainable and responsible practices.

In summary, the HIRARC is important because it helps organisations identify, assess, and control risks in a systematic and structured manner. This would not only enhance safety but also have broader positive impacts on the financial stability, reputation, employee well-being, and overall efficiency of an organisation.

Peeragogy, or 'peer-directed pedagogy', is a collaborative and participatory approach to learning and education that emphasises the active involvement of learners in shaping the learning process. In peeragogy, the traditional roles of teachers and students are blurred and the focus shifts towards a community-driven learning experience. This method is inspired by the principles of peer-to-peer collaboration, open-source software development, and social learning. The principles of peeragogy include self-determined roles, coteaching, coworking, colearning, and self-determined questions. Teaching HIRARC using peeragogy may increase students' level of understanding by allowing them to explore every part of HIRARC through discussions, collaborations, and presentations, compared to sitting in class and listening to a lecturer. Peeragogy is a collaborative and peer-driven learning approach that can be beneficial in teaching HIRARC in several ways.

1. **Self-Directed Learning:** Peeragogy promotes self-directed learning in which participants take ownership of their learning journeys. In the HIRARC, individuals must take responsibility for identifying and addressing risks. Peeragogy helps students develop the initiative and self-discipline required to excel.

2. **Active Engagement:** Peeragogy promotes active participation and engagement. Students are not passive recipients of information but active contributors to the learning process. In the context of HIRARC, this can lead

to thorough risk assessments, as students can actively discuss, analyse, and question the information and scenarios presented to them.

3. **Collaborative Learning:** HIRARC often involves teamwork and collaboration in real-world situations. Peeragogy mirrors this involvement by fostering collaborative learning environments. Students work together, share knowledge, and solve problems that align with the collaborative nature of risk assessment and control in professional settings.

4. **Problem-Solving Skills:** Hazard identification and risk assessment require strong problem-solving skills. Peeragogy encourages participants to collaboratively solve problems and make decisions, thus honing their critical thinking and decision-making abilities, which are directly transferable to HIRARC.

5. **Feedback and Peer Review:** In peeragogy, participants often provide feedback to their peers. This feedback can be invaluable in the context of HIRARC as it mimics the real-world practice of reviewing risk assessments and control measures. Peer reviews help students refine their skills and identify potential blind spots or areas for improvement.

Incorporating peeragogy into the teaching of HIRARC can create a dynamic and effective learning environment that not only imparts knowledge but also fosters the skills, attitudes, and collaborative abilities needed to excel in risk assessment and management.

The main objective of this short study is to provide a sample of industrial case-based studies for TVET students to develop HIRARC using the peeragogy learning method (2.0) and teaching lesson plan (3.0) as guidance for a TVET lecturer to conduct the peeragogy classes.

2.0 INDUSTRIAL CASE-BASED STUDY

The health and safety of employees are key concerns for most businesses. Although numerous countermeasures have been implemented, workplace accidents, injuries, and deaths continue to occur at alarming rates. The total number of workplace accidents that occurred in 2022 was 6,719, a slight increase from the number of cases in 2021 (6,686 cases), based on data provided by the DOSH. Table 1 lists the number of cases reported in each state of Malaysia. The impact of workplace accidents can be significant, affecting the individuals involved and the organisation. Workplace accidents can have various consequences affecting both human well-being and business operations. The following are some key aspects of the impact of workplace accidents:

1. Healthcare Costs;
2. Loss of Productivity;
3. Legal and Regulatory Consequences;
4. Reputation Damage;
5. Operational Disruption; and
6. Increased Insurance Costs.

Table 1 Statistics of Occupational Accidents by State from January to November 2022 (Reported to DOSH Only)

STATE	NPD	PD	DEATH	TOTAL
JOHOR	1082	59	24	1165
KEDAH	396	3	7	406
KELANTAN	115	4	5	124
MELAKA	362	7	2	371
N SEMBILAN	382	13	6	401
PAHANG	366	9	19	394
PERAK	747	26	20	793
PERLIS	12	0	2	14
PULAU PINANG	695	15	13	723
SABAH	227	22	9	258
SARAWAK	290	26	20	336
SELANGOR	1301	38	29	1368
TERENGGANU	135	3	11	149
WPKL	188	1	19	208
WP LABUAN	8	1	0	9
TOTAL	6306	227	186	6719

LEGEND:
PD - PERMANENT DISABILITY
NPD- NON PERMANENT DISABILITY

ISO 45001:2018 (Occupational Health and Safety Management Systems) provides the minimum standard set of practices for employee protection. ISO 45001:2018 is important for several reasons.

1. Enhances worker safety and reduces workplace accidents;
2. Ensures legal compliance in occupational health and safety;
3. Boosts employee morale and job satisfaction;
4. Reduces costs related to accidents and illnesses;
5. Enhances the reputation and competitiveness of an organisation;
6. Improves operational efficiency and productivity;
7. Provides a framework for risk management and continuous improvement; and
8. Enables global recognition and access to international markets.

To qualify for ISO 45001:2018 accreditation, HIRARC is an important element that must be complied with. The HIRARC is a compound word representing three consecutive activities. These activities include Hazard Identification, Risk Assessment, and Risk Control. Hazard identification refers to the act of recognising objects that may cause injury or harm to a person. Risk assessment focuses on the possibility of injury or harm to a person if they are exposed to a hazard. Introduction of measures to eliminate or reduce the risk of a person being exposed to a hazard is known as risk control. Table 2 presents the HIRARC forms according to the 2008 HIRARC guidelines.

Table 2 Hazard Identification, Risk Assessment & Risk Control Table (HIRARC) Form

TITLE :
DEPARTMENT:
LOCATION / EQUIPMENT:

HIRARC NUMBER :
PREPARED BY :
DATE :

1. HAZARD IDENTIFICATION					2. RISK ANALYSIS				3. RISK CONTROL		
NO	R/NR	WORK ACTIVITY	HAZARD	EFFECT	EXISTING CONTROL	L	S	RISK	RECOMMENDED CONTROL MEASURES	PIC	DUE DATE/ STATUS

LIKELIHOOD (L)	EXAMPLE	RATING
Most likely	The most likely result of the hazard / event being realized	5
Possible	Has a good chance of occurring and is not unusual	4
Conceivable	Might be occur at sometime in future	3
Remote	Has not been known to occur after many years	2
Inconceivable	Is practically impossible and has never occurred	1

SEVERITY (S)	EXAMPLE	RATING
Catastrophic	Numerous fatalities, irrecoverable property damage and productivity	5
Fatal	Approximately one single fatality major property damage if hazard is realized	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts, first aid type injury	1

	Severity (S)				
Likelihood (L)	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

RISK	DESCRIPTION	ACTION
15 - 25	HIGH	A HIGH risk requires **immediate** action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.
5 - 12	MEDIUM	A MEDIUM risk requires a planned approach to controlling the hazard and applies temporary measure if required. Actions taken must be documented on the risk assessment form including date for completion.
1 - 4	LOW	A risk identified as LOW may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded.

High
Medium
Low

Figure 1: Indications of Likelihood, Severity and Risk Level

HIRARC is applied mostly in technical industries. As a diploma holder in Process Engineering, the ideal job is that of an Assistant Engineer in the production team of the process and manufacturing industry. Chemical mixing processes are typically employed in industrial engineering. In these processes, two or more chemicals are combined in specific proportions to create new chemical mixtures or solutions. These processes are widely used in various industries such as manufacturing, pharmaceuticals, agriculture, food production, and cosmetics. The goal of chemical mixing is to achieve desired chemical reactions, physical properties, or end products by carefully controlling the composition and conditions of the mixture. The following hazards are common during chemical mixing.

1. Work environment (fire or hot temperature);
2. Mechanical (being caught between machines); and
3. Chemicals (flammable, corrosive, or toxic).

This study presents the development of HIRARC as a chemical mixing process. The HIRARC that is developed must follow DOSH guidelines and include the following activities.

Activity 1: Group Formation

To solve this industrial problem, a team of four (4) people needs to be formed.

Activity 2: Group Role Selection

In every group, participants are assigned the following roles:

1. SOP Developer;
2. Hazard Assessor;
3. Risk Assessor; and
4. Control Measure Person in Charge (PIC).

Activity 3: Group Discussion

Based on the roles listed above, a specific task for each team member was identified.

1. SOP Developer: Develops a detailed working procedure.
2. Hazard Accessor: Identifies the hazard based on the working procedure: chemical, physical, biological, etc.
3. Risk Accessor: Calculates the risk based on likelihood versus severity and determines the risk level.
4. Control Measure PIC: Suggests the appropriate control measure to reduce the risk level.

Then, according to the collected information, a complete HIRARC based on the 2008 HIRARC guidelines should be prepared.

Activity 4: Group Presentation
Present the HIRARC based on the role of each individual.

3.0 PEERAGOGY LESSON PLAN FOR LECTURER

Table 3 HIRARC Lesson Plan (Peeragogy)

Teaching plan	Description	Principle
Induction	To qualify for ISO 45001:2018 accreditation, HIRARC is an important element to be complied with. ISO 45001:2018 ensures safety and legal compliance, improves the efficiency of processes, and enhances the reputation of the company. As a production team in the chemical mixing process, they need to develop HIRARC in the process area to increase work safety. The HIRARC that will be developed needs to follow the 2008 HIRARC guidelines. Teachers need to perform the following: 1. Explain what ISO 45001:2018 entails in detail. 2. What is an example of a chemical mixing process in industry? 3. Provide real-world examples or case studies of the mixing process, such as chemical contact that can cause irritation or corrosiveness. 4. What is the guideline for HIRARC development?	PEERAGOGY
Activity	Activity 1: Group Formation Form a team of four persons to develop HIRARC in the chemical mixing process department. Activity 2: Group Role Selection To develop HIRARC in the mixing process department, several roles have been created. Discuss and self-appoint your group members according to these roles: 1. SOP Developer; 2. Hazard Assessor; 3. Risk Assessor; and 4. Control Measure Person in Charge (PIC). Activity 3: Group Discussion Based on the given role, collaboratively discuss your findings to obtain complete information to develop an HIRARC. 1. SOP Developer: develop detailed working procedures. List and identify all working procedures for the activities involved in the process area. Explain these working procedures to all team members in the chemical mixing process area. 2. Hazard Assessor: According to the list of working procedures, identify all chemical, physical, and biological hazards. Explain all hazard findings to the team members in the process area. 3. Risk Assessor: Calculate the risk level based on the likelihood and severity level. Establish a list of risk levels for each activity during the mixing process. Explain all risks to the team members in the process area. 4. Control Measure PIC: According to all gathered information, suggest appropriate control measures to reduce the risk level of every activity during the mixing process. Prepare a complete HIRARC based on DOSH	Self-determined roles Self-determined roles Co-teaching Co-working Co-learning

	guidelines. Explain to the team members every proposed control measure to reduce accident risks in the process area.	
	Activity 4: Group Presentation Present the generated HIRARC form to the class. Other groups need to share their feedback on the presented HIRARC form.	Co-teaching Co-working Co-learning Self-determined questions
Reflection / Assessment	Reflection will be done based on Peer Evaluation of the following activities: Activity 1–3: Evaluation will be done by each team member within the group. May refer to any suitable rubric for evaluation. Activity 4: Evaluation will be done by the class members during the presentation session. May refer to any suitable rubric for evaluation.	Co-learning

4.0 CONCLUSION

Currently, numerous teaching methods are available to ensure that students achieve their learning objectives, such as andragogy, peeragogy, heutagogy, and cybergogy. These learning methods are compatible with the current tech-savvy world and meet the needs of fast-paced industries. Previously, teachers or lecturers stood in front of the class and provided information to students during the learning and teaching processes. With the emerging and latest technology trends, TVET students need to adapt to the industrial revolution and become more proactive in gaining knowledge. When we talk about the use of peeragogy to learn about HIRARC, we think of it as teamwork. This is when everyone in a team offers ideas for solving a puzzle. HIRARC is practical, hands-on, and works together using peeragogy is essential. In this short study, the industrial case-based sample (2.0) and teaching plan (3.0) for the development of HIRARC have been provided as alternatives for lecturers and TVET students to explore and develop HIRARC using the peeragogical learning method. The teaching methods provided in this study were similar to those of a two-in-one tool. They can help students learn better while providing teachers with better ways to teach.

ACKNOWLEDGEMENT

The authors thank the National Institute of Occupational Safety and Health, Ministry of Human Resources, Malaysia.

REFERENCES

Amiruddin., Baharuddin,F. R., Takbir., Setialaksana, W., & Nurlaela (2023). Andragogy, Peeragogy, Heutagogy and Cybergogy Contribution on Self- Regulated Learning: A Structural Equation Model Approach. *International Journal of Instruction e-ISSN: 1308-1470.*

Department of Occupational Safety and Health (DOSH) website, https://www.dosh.gov.my/index.php

Guidelines for Hazard Identification, Risk Assessment and Risk Control (HIRARC), 2008.