Perception of safety intervention practices in the laboratory among students in higher education sector

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Abstract. Safety is one of the crucial elements in the educational sector. Safety intervention is one of the elements that must be highlighted to increase workplace safety. In general, safety intervention is the alteration of internal or external aspects that may minimize workplace accidents such as safety procedures, safety committees, safety expertise and others. Hence, this study aims to analyze the safety intervention in the laboratory among higher education students. A questionnaire survey was distributed to 338 students from three Universiti Malaysia Kelantan Jeli Campus faculties including the Science Foundation Program. Most of the respondents are Year 1 students with 31.7%. Most (45.9%) of students spend between four to six hours daily in the laboratory. Furthermore, 49.1% of students, participated in the laboratory three to four times per week. This study divided safety intervention practices into three components: management, technical and human. The results from the descriptive analysis show that management component practices are the highest intervention safety practices adopted by the students when working in the laboratory with an overall mean score of 4.64. Compared with the technical component (overall mean score of 4.61) and human component (overall mean score of 4.53). To prevent laboratory accidents in higher education, the human element in safety intervention practices should also be emphasized. The information obtained from this study could be used by the authorities in charge of occupational health and safety as well as by the stakeholders in higher education to reduce the accident rate in higher education institutions.

1 Introduction

This safety element always emphasizes the causes of accidents as well as safety intervention to reduce accidents in the workplace. Generally, an accident was defined as an unwelcome and unexpected event or object that could have been avoided if the cause of the accident had been identified and addressed prior to its occurrence [1]. Besides that, an accident was also defined as an unanticipated and uncontrollable occurrence resulting in personal injury or the possibility of it resulting from the action or reaction of a substance, person, object, or radiation [2]. Meanwhile, safety inventions are defined as interventions that require changes in external conditions to encourage safe behaviour over risky activity [3]. The National

Institute for Occupational Safety and Health Department also defined safety intervention as improving safety aspects in the workplace by implementing new policies, procedures or any initiative to enhance safety against workers and the workplace [4].

Any workplace accident in Malaysia is handled by the Department of Occupational Safety and Health Department (DOSH) under the Ministry of Human Resources. DOSH covers ten sectors including education which falls under Public Service and Statutory Authorities Utilities. Table 1, shows the statistical data of accidents that were reported and investigated by DOSH from the year 2018 until the year 2022. However, the statistical data show negligible accidents compared with other sectors such as manufacturing, construction, and transport, yet continues to raising public concern about the incidents and consequences.

Table 1. The statistical data of accidents reported in the public services and statutory authorities utility sector.

Year	The number of non-permanent disabilities	The number of permanent disabilities	Total death	Total
2018	21	0	3	24
2019	93	3	3	99
2020	73	1	3	77
2021	68	2	4	74
2022	74	3	0	77

Source: Department of Safety and Health, Malaysia (2023)

In addition, Table 2 shows explicitly the accident cases that occurred in education from the year 2018 until the year 2022 that were published in national newspapers. It was discovered that there were only eight accident cases in the education sector over the five years. Although the number of accident cases in the higher education sector is only one case over five years, is a wake-up call for those involved in the higher education sector to take this matter seriously. In the education sector, students or researchers who conducted research in laboratories were exposed to a variety of hazards such as musculoskeletal and chemical, biological, physical, and radioactive hazards [5] either directly or indirectly. Therefore, this study aimed to analyze the safety intervention practices in the laboratory among higher education students particularly students from UMK Jeli Campus.

Table 2. List of accident cases from the year 2018 to the year 2022.

No	Accident case	Types of Accident	Date	Source
1.	The thermometer broke at a laboratory science school in Sandakan, Sabah causing three students injured.	Broke	11 July 2018	[6]
2.	The chemical gas leak in the school's science laboratory in Bayan Lepas, Penang caused 17 students sick. A small fire and an explosion followed shortly.	Chemical leaking	6 May 2019	[7]
3.	One laboratory assistant sustained severe burns from an acid sulfuric spill with a concentration of acid sulfuric involving 98 percent in one of the schools at Kuching, Sarawak.	Chemical spill	11 Feb 2020	[8]

4.	A 50ml of acrylic acid liquid spilled in the public university laboratory in Penang.	Chemical spill	13 Mar 2021	[9]
5.	61 students from secondary school in Johor suffered nausea and sore throat after accidentally inhaling sulfuric acid.	Chemical spill	21 April 2022	[10]
6.	A gas leak while pupils conducting experiments in school in Subang Jaya, Selangor resulting in four pupils suffering dizziness and nausea.	Gas leaking	21 Jun 2022	[11]
7.	A student in Kota Kinabalu, Sabah experienced rashes on her hands due to the mercury spill.	Chemical spill	27 Sept 2022	[12]
8.	Thirteen students in Kulim, Kedah were hospitalized after exposure to a mercury spill in the school laboratory.	Chemical poisoning	15 Nov 2022	[13]

2 Methodology

This study used a quantitative approach to determine safety intervention practices among UMK students. The study sampling was conducted from September to November 2022 and was distributed using Google Forms. About 338 students from the Faculty of Earth Science, Faculty of Agro-Based Industry, Faculty of Bioengineering and Technology and UMK Science Foundation Program participated in this study. The survey questionnaire was divided into four sections. Section A focuses on socio-demographic information while Section B focuses on the management component of safety intervention practices, Section C focuses on the human component of safety intervention practices and Section D focuses on the technical component of safety intervention practices in the laboratory.

The safety intervention practices components were adapted from [14] and [15]. There were three major components in safety intervention: management, human and technical. In the management component, three safety intervention practices aspects are involved: communication and feedback, daily safety records, delivery safety communication mechanism. At the same time, the human component contains safety knowledge program, safety training, safety information. Lastly, the technical component contains the Personal Protection Equipment (PPE) program, control of the movement and use of hazardous substances and chemical, emergency responses preparedness.

Besides that, Section B until Section D used the Likert scale which contain 1 = never; 2 = rarely, 3 = sometimes; 4 = always; 5 = very always. The data collection was analysed using Statistical Package for the Social Science (SPSS). The reliability results for the 67 questions used in this study are shown in Table 3.

Table 3. The reliability results for questions used in this study.

Component	Cronbach's Alpha	Number of items
Management	0.975	22
Human	0.960	17
Technical	0.984	28

3 Results and Discussion

The socio–demographic information revealed that most respondents are female students with 52.1% while 47.9% are male students. The age range of the respondents is majority between 21 years old to 30 years old. The 31.7% of Year 1 students participated as respondents for this study. The majority (45.9%) of students spend about 4 to 6 hours daily in the laboratory. According to the findings, 49.1% of students, are involved and working in the laboratory three to four times per week as presented in Table 4.

Table 4. The socio-demographic information

			Frequency (n)	Percentage (%)
Gender	Male		162	47.9%
	Female		176	52.1%
		Total	**338**	**100.0**
Age	<20 years old		132	39.9%
	21-30 years old		190	56.2%
	31-40 years old		16	4.7%
		Total	**338**	**100**
Year of Study	Year 1		107	31.7%
	Year 2		82	24.3%
	Year 3		70	20.7%
	Year 4		60	17.8%
	Postgraduate		9	2.7%
	Foundation		10	3.0%
		Total	**338**	**100**
Time spent in the laboratory every day	1-3 hours		155	45.9%
	4-6 hours		156	46.2%
	7-9 hours		24	7.1%
	>10 hours		3	9.9%
		Total	**338**	**100**
Frequency of being in the laboratory in a week	1-2 times		138	40.8%
	3-4 times		166	49.1%
	5-6 times		28	8.3%
	>7 times		6	1.7%
		Total	**338**	**100**

Table 5 reveals the findings of the management component. There are three aspects in the management component which are communication and feedback, daily safety report, and delivery safety communication mechanism. This study indicated that the communication & feedback aspect and delivery safety communication mechanism aspect are the higher aspects of safety intervention practices among respondents with an overall mean score of 4.66. Overall, respondents answered between “always” and “very always” for all items in the management aspect with slightly different mean scores (4.57 to 4.68). This emphasizes that the effective communication is important to avoid mishaps in the laboratory [16].

Table 5. The mean score of the management component in safety intervention practices.

No	Item	Mean	Standard Deviation (SD)

Communication and feedbacks			
1.	I listen to the safety briefing by the lecturer or the laboratory staff prior to the practical	4.66	0.61
2.	I always play a role in reminding friends about personal safety while conducting practical work	4.62	0.62
3.	I always adhere to the Standard Operating Procedures (SOP) that implemented in the laboratory	4.67	0.56
4.	I interact well and smoothly with lecturers and laboratory staff when conducting practical work in the laboratory	4.66	0.57
5.	I am seeking permission from the lecturer or laboratory staff in order to operate certain machines in the laboratory	4.66	0.61
6.	I am supervised by lecturers or laboratory staff when handling high-risk laboratory equipment	4.65	0.60
7.	I understand the prohibition against distracting a friend who is running a machine while doing practical work	4.68	0.60
		4.66	
Daily safety record			
1.	I inform the laboratory staff if the apparatus is broken or damaged	4.63	0.64
2.	I notify the laboratory staff if the tools/chemicals are insufficient when performing practical work in the laboratory	4.62	0.66
3.	I am acquainted to handle scheduled waste (storage and disposal)	4.59	0.70
4.	I fill up the laboratory use log book that has been prepared every time I enter the laboratory	4.62	0.68
5.	I record the equipment/apparatus to be borrowed or returned in the laboratory equipment borrower record book	4.59	0.73
6.	I record the number of tools/apparatus that have been borrowed in the tool loan record book log	4.61	0.70
7.	I inform the laboratory staff if the tools/apparatus that I have borrowed have problems while using them (such as broken, lost, broken tools)	4.60	0.70
		4.61	
Deliver safety communication mechanisms			
1.	I read the practical manual before doing laboratory experiments	4.64	0.58
2.	I read the safety poster that was on display in the laboratory	4.67	0.54
3.	I call the emergency number or the person in charge of the laboratory if an accident occurs	4.61	0.67
4.	I am well aware that students are not permitted to operate alone in the laboratory without the supervision of the laboratory staff	4.66	0.60
5.	I always remind friends about personal safety when doing practical work in the laboratory/workshop	4.66	0.58
6.	I was always aware that any special laboratory safety instructions had to be followed	4.66	0.54
7.	I read the laboratory safety rules before undertaking practical work in the laboratory/workshop	4.65	0.56

8.	I clearly listened carefully to the explanation given by the laboratory staff about the use of dangerous equipment before using it in practical work	4.66	0.55
		4.66	

There are three aspects of human component in safety intervention practices which are safety knowledge program, safety training, and safety information. The results show the safety information aspect has the highest overall mean score with 4.63 in safety intervention practices among respondents in the human component, followed by the safety knowledge aspect (4.55) and safety training (4.14) as shown in Table 6. Overall, respondents answered between "always" and "very always" for all items in the safety knowledge program aspect and safety information aspect with slightly different mean scores (4.51 to 4.64). Unfortunately, for the safety training aspect, respondents preferred to answer "always" for this aspect, which revealed that the respondents lacked safety training in order to prevent laboratory accidents. Safety training and safety knowledge programs are vital in strengthening safety intervention practices in the laboratory [17][18].

Table 6. The mean score of the human component in safety intervention practices.

No	Item	Mean	Standard Deviation (SD)
Safety Knowledge Program			
1.	I joined training related to laboratory safety organized by my faculty	4.55	0.76
2.	I participated in a mock fire drill organized by the faculty	4.58	0.76
3.	I have joined an online webinar on occupational health safety organized by my faculty	4.55	0.77
4.	I get involved with any program related to health safety in the laboratory organized by outside UMK	4.56	0.79
5.	I attended a workshop related to laboratory safety organised by other faculty	4.55	0.80
6.	I have participated in any training in occupational safety and health organized by university	4.51	0.91
		4.55	
Safety training			
1.	I attended a lecture on fire hazards organized by the faculty	4.12	0.79
2.	I attended safety training to raise awareness of laboratory safety	4.15	0.89
3.	I participated in a first-aid program organized by a group outside of my university	4.14	0.85
4.	I always broaden my knowledge of laboratory safety by participating in safety programs organised by parties other than my university	4.12	0.84
5.	I always improve my knowledge about laboratory safety by following the safety program organized by my university	4.17	0.83
		4.14	
Safety information			
1.	I read and understand safety information in the laboratory located at the safety corner	4.60	0.63

2.	I read and understand the safety rules before conducting my experiment in the laboratory	4.63	0.56
3.	I read and understand the procedure prior to using specific equipment in the laboratory	4.64	0.59
4.	I understand the safety warning signs that posted in the laboratory	4.63	0.59
5.	I have always known that chemicals are hazardous to both human health and the environment	4.64	0.59
6.	I had always believed that all chemicals had to be registered with the Department of Occupational Safety and Health (JKKP) and have Safety Data Sheets (SDS)	4.63	0.59
		4.63	

There are four aspects involved in the technical component which are the Personal Protective Equipment (PPE) program, control of the movement and use of dangerous substances and chemicals, emergency response readiness, and safe work practices. According to Table 7 findings regarding the technical components in safety intervention practices among the respondents revealed the aspect of control of the movement and use of dangerous substances and chemicals had greatest overall mean score with 4.62 followed by the aspects of the Personal Protective Equipment (PPE) program and safe work practices with 4.61. The aspects of the emergency response readiness aspect has the lowest average mean score with 4.60. Overall, respondents answered between "always" and "very always" for all items in the technical aspect with slightly different mean score (4.57 to 4.64). Protective Equipment (PPE) is safety equipment gear that is compulsory to wear when conducting experiments in the laboratory. It is essential to know and understand how to use PPE in the proper way [19].

Table 7. The mean score of technical component in safety intervention practices.

No	Item	Mean	Standard Deviation (SD)
Personal Protective Equipment (PPE) Program			
1.	I adhere to the university-mandated dress code in the laboratory/workshop.	4.62	0.61
2.	I present myself if PPE training is provided for all students while in the laboratory/workshop	4.57	0.73
3.	I use first aid kit tools in the right way	4.60	0.68
4.	I am always aware of basic first aid procedures in case of an emergency in the laboratory/workshop	4.62	0.69
5.	I use a fire extinguisher properly in an emergency	4.61	0.66
6.	I wash my hands (and shower if necessary) after conducting experiments or laboratory analysis work.	4.64	0.63
		4.61	
Control of the movement and use of dangerous substances and chemicals			
1.	I know how to transport hazardous chemical outside of the laboratory	4.57	0.71
2.	I am not mixing the chemical hazardous waste into any containers other than the one designated for chemical hazardous waste in order to avoid any misuse.	4.62	0.66
3.	I read labels on chemical before using it	4.61	0.67

4.	I am not disposing any dangerous chemical waste in the laboratory sink	4.61	0.65
5.	I used an appropriate cointainer in the laboratory to dispose chemical	4.62	0.64
6.	I dispose of gloves before and after doing practical work in a bin labelled “gloves only”	4.61	0.66
7.	I promptly notify the laboratory staff on duty if dangerous substances and chemicals are spilled on the floor while conducting practical work in the laboratory/workshop	4.65	0.63
8.	I read safety data sheets (SDS) before using any chemicals	4.63	0.63
		4.62	
Emergency response readiness			
1.	I am well aware of the location of the fire extinguisher in the laboratory	4.57	0.66
2.	I am aware of the emergency exit door in the laboratory.	4.62	0.63
3.	I am aware with the location exit signboard in the laboratory	4.60	0.66
4.	I know how to utilise a safety shower correctly	4.60	0.67
5.	I know how to treat major bleeding with a first-aid procedure	4.58	0.70
6.	I know how to use first aid correctly	4.58	0.68
7.	I know how to treat someone who has received an electric shock in the laboratory	4.57	0.73
8.	I know how to notify people/emergency response team when accidents occur in the laboratory	4.61	0.68
		4.60	
Safe work practices			
1.	I practiced safe work practices while conducting practical in the laboratory/workshop	4.59	0.64
2.	I practice safe work procedures when it comes to dangerous practical work such as using a wood cutting machine	4.61	0.67
3.	I am supervised by the lecturer / laboratory staff when carrying out practical work in the laboratory	4.60	0.69
4.	I ensure that the equipment / chemicals are sufficient before starting the practical work	4.59	0.69
5.	I did the practical work according to the sequence as in the practical manual	4.63	0.65
6.	I practice proper safety procedures when using hazardous chemicals	4.60	0.66
7.	I make sure my workplace is organized and clean before and after doing practical work in the laboratory/workshop	4.64	0.63
		4.61	

4 Conclusion

This study shows how the management component highly been practiced in the safety intervention among students in the higher education sector compared with the technical and human components. The overall mean score as followed: management component (4.64) > technical component (4.61) > human component (4.53). Results shows, lack of practice in safety training aspect in the human component. In order to increase safety intervention at

workplace specifically in the laboratory at higher education, these three components should be balanced and will reduce workplace accidents in the future. The findings from this study are crucial for the authorities in charge of occupational health and safety including stakeholders in higher education to reduce the accident rate in higher education institutions.

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