CHEMICAL SAFETY AWARENESS AMONG SCIENCE STUDENTS IN UMK JELI CAMPUS

By

MUHAMMAD AMINUR NAZIF BIN MOHD NAYAN

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THESIS DECLARATION

I hereby declare that the work embodied in this Report is the result of the original research and has not been submitted for a higher degrees to any universities or institutions.

……..

Student

Name: Muhammad Aminur Nazif Bin Mohd Nayan

DATE: 5/2/2021

I certify that the Report of this final year project entitled Chemical Safety Awareness among Science Students in UMK Jeli Campus by Muhammad Aminur Nazif Bin Mohd Nayan, matric number E17A0085 has been examined and all correction recommended by examiners have been done for the degree of Bachelor of Applied Science (Sustainable Science) with Honors Faculty of Earth Science, University Malaysia of Kelantan.

Approved by,

…….

Supervisor

Name: Dr Noor Syuhadah binti Subki

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Chemical Safety Awareness among Science Students in UMK Jeli Campus.

ABSTRACT

Chemical safety is the most important issue when working in the laboratories. Recently, the increasing number of accident cases reported involving universities laboratories shows the importance of safety issues in the education sector. Safety awareness among students is crucial in order to find out the method to prevent the accident occurred in future. This study was conducted to assess the level of chemical safety awareness among students in UMK Jeli Campus. Survey questionnaires were distributed among 238 of students from ten academic programmes in UMK Jeli Campus. Descriptive analysis shows that the understanding of safety and health practice when doing activities in the laboratory were good (mean values: x-x) but some of the students did not implement the safety practices in the laboratories especially when an unplanned event occur. Therefore, it is crucial for all students in universities that involved in laboratory activities to attend a chemical safety training in order to maintain and create a safe environment.

Kesedaran Keselamatan Kimia di Kalangan Pelajar Sains di Kampus UMK Jeli.

ABSTRAK

Keselamatan merupakan isu yang paling penting semasa bekerja di dalam makmal. Sejak kebelakangan ini, semakin banyak kes kemalangan yang dilaporkan melibatkan persekitaran universiti dan ini menunjukkan pentingnya isu keselamatan dalam sektor pendidikan. Kesedaran keselamatan di kalangan pelajar sangat penting untuk mengetahui kaedah bagi mengelakkan kemalangan berlaku pada masa akan datang. Kajian ini dilakukan untuk menilai tahap kesedaran keselamatan kimia di kalangan pelajar di UMK Kampus Jeli. Soal selidik diedarkan di antara 238 pelajar dari sepuluh program akademik di UMK Kampus Jeli. Analisis deskriptif menunjukkan bahawa pemahaman mengenai amalan keselamatan dan kesihatan adalah baik semasa melakukan beberapa aktiviti pekerjaan di makmal tetapi sebilangan pelajar tidak melaksanakan amalan keselamatan di makmal terutamanya ketika kejadian tidak dirancang. Oleh itu, adalah sangat penting bagi semua pelajar di universiti yang terlibat dalam aktiviti makmal untuk mengikuti latihan keselamatan kimia untuk menjaga dan mewujudkan persekitaran yang selamat.

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LIST OF ABREVIATION

PPE	Personal Protective Equipment
CHRA	Chemical Health Risk Assessment
DOSH	Department of Occupational Safety and Health
CLASS	Classification, Labelling and Safety Data Sheet of Hazardous Chemical
SDS	Safety Data Sheets
SPSS	Statistical Package for the Social Science
IDLH	Immediately Dangerous to Life and Health
MSDS	Material Safety Data Sheet
USECHH	Use and Standard of Exposure Chemical Hazardous to Health
OHS	Occupational Health and Safety

LIST OF SYMBOLS

n	sample size
E	margin error
N	population size
r	fraction of responses
c	confidence level
Z(c/100)	critical value

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Students pursuing science as part of their formal education are of necessity, to take part in laboratory sessions. These practical classes help students to examine the theory learned in greater detail; and can improve interest in the subject (Adane and Abeje, 2012). Universities have subjects that require practical laboratory sessions such as chemistry, biology. Chemistry is one of the subjects that often use hazardous chemicals during laboratory sessions. In these classes, students are introduced to, and use, chemicals of differing types and properties (Walter, 2017).

In laboratories, chemicals are almost used every day in a wide range of analytical work, however, they may be dangerous and pose threats to safety, physical, and the atmosphere (Ryder, 2014). Dangerous chemical includes those that are corrosive, volatile, readily oxidizing, flammable, poisonous, annoying, hazardous or toxic to humans and that may also pollute the

atmosphere (Adane and Abeje, 2012). Exposure to these chemicals may result in chemical burns, inflammation of the skin and eyes, infections, lungs, cancer and even death. Such symptoms may greatly impact the willingness of an individual to continue functioning, depending on the extent, and can reduce quality of life. It is not acceptable to underestimate the potential adverse effects triggered by unintended spills and improper management procedures, on the atmosphere and also the human community.

Although the chemical laboratories involve hazards, if appropriate procedure are in place to ensure proper handling and control, the potential hazard can be mitigated. The use of inappropriate procedures will contribute to injury in the laboratory (Draman et al, 2010).

Perhaps safety is an important prerequisite for education in science. Having a safe and secure laboratory environment is a prime concern while doing practical science work and research. Laboratory health is a prerequisite to set down guidelines for successful learning in research. That is why appropriate protection skills are required to be established in the students and safety protocols found in laboratory classes (Olajumoke, 2018). Chemical safety procedures usually require personal protective equipment (PPE), such as safety glasses, goggles, face shields, gloves, lab coats, aprons, ear plugs, and respirators. Health protection equipment should be carefully constructed to accept the products used and the technique used. It will help in protecting against pollutants, electrical interference or other dangers.

Awareness is crucial for developing chemical safety awareness among universities' students. Students must be subjected to this knowledge or awareness regarding the chemical safety and health protocols to face the threat. With true experience of the potential hazards, it can one of the easiest approaches to enforce to do the correct things that ought to be done as it was really occurring. That could help to reduce the laboratory risk. In order to alert the students and also staff, skills and training must be provided if possible risk occurred. The chemical protection protocol is accountable and warning also to students, employees and teachers as well (Olewski, 2017).

1.2 Problem Statement

Individuals who regularly deal with chemicals, for example, are at risk especially students and people employed in laboratory. If structures are in place to ensure secure handling and control, the possible danger can be mitigated. A total of 17 students were recently hurt in 2019 during a chemical leakage and explosion incident at a school in Bayan Lepas, Pulau Pinang, with another 70 affected by the resulting vapors (Sekaran 2019). Chairman of the State Environment Committee Phee Boon Poh said that for now, there was not much detail available other than the fact that chemical suits were needed for anyone going into the area. This may be occurred because the carelessness of students when handling the chemical substances. Another incident is 49 percent of injuries at university campuses in Taiwan had to do

with inappropriate usage of chemicals in normal laboratory experiments in three years (Su and Hsu, 2008).

It is important to understand the importance of laboratory safety and render it a top priority in industry or the laboratory. The knowledge of the chemical danger was overlooked, and this leaves the student more vulnerable to the harm.

Therefore, the aim of the study is thus to assess the awareness of chemical safety in the laboratory so that unwanted accidents that can avoided and thus provide better understanding. Hopefully, it can also increase the awareness among students about the importance of chemical safety in laboratories.

1.3 Objectives

The objectives of this study are as follows:

1) To assess the level of chemical safety awareness among students in UMK Jeli Campus.
2) To suggest the standard good laboratory practice for students and staffs.

1.4 Scope of Study

The study is focused on the level of chemical safety awareness among students in laboratories. The scopes of study are identifying knowledge, skills, practice and perception of respondent towards chemical safety in laboratories. This study involved students in UMK Jeli Campus that are

exposed to chemicals during lab session. A set of questionnaires will be used for data collection.

1.5 Significance of Study

According to Vince Mcleod (2011), running a research laboratory is a challenge. In all the hustle of loading the auto sampler, pipetting, pouring, and mixing for research experiments, health and safety can be overlooked, inadvertently pushed aside or forgotten sometimes with dire consequences. So, this study will explain that the incidents can be controlled if proper safety procedure implemented in each laboratory. In a meantime, the major risk factor can be identified and mitigated effectively in the laboratory. The attitude of the person also influences the chemical safety. The best way is to be well prepared in unexpected situation by gaining knowledge and understanding the possible risk to make the right decision.

This study will provide information about the knowledge, practice, skills and perception on chemical safety that will be conducted in laboratories. Through this study it is hoped that any parties involved will be extra alerted about the chemical safety.

CHAPTER 2

LITERATURE REVIEW

2.1 Chemical

A chemical is any pure substance or a mixture of substances (compound), in any form of solid, liquid or gas. It covers all chemicals, both natural and manufactured, and the full range of situations of exposure from the natural presence of chemicals in the environment to their extraction or synthesis, industrial production, transport use and disposal. Basically, the daily routines in laboratory are chemicals handling. Some chemicals can cause discomfort or even present health hazards if they are inhaled, ingested or come into contact with the skin or eyes. Many hazardous substances are irritants, mutagens, carcinogens or teratogens that cause cancer deficiencies, damage to the genes and birth defects. Hence the body should be exposed to such chemical substances as little as possible (Ray, 1999).

2.2 Chemical safety

Chemical safety is the product of a mixture of mindset and good activities beyond rigid operational observance (Karapantsios et al., 2008).

Primary chemical health elements include hazard detection and risk evaluation, emergency response, waste control, and monitoring and review of accidents.

Chemical safety can be achieved by undertaking all activities involving chemicals in such a way that human health and the environment are protected whether in laboratories or at worksites.

The DOSH aims to build and operate a strong chemical control and health program to avoid industrial injuries and occupational illnesses. The department of Chemical Management plays an important role in handling broadly expanding chemical management issues. For example, environmental quality risk evaluation, dosage level identification, drug regulation, disclosure of risks, and international agreements on hazardous substances control, protection and quality (DOSH, 2019).

The level of chemical safety levels are generally grouped as minimal, low, moderate and high in chemical or physical hazards. There are no concentrated acids or bases, toxics, carcinogens, or teratogens in the first level which is minimum. It also uses flammable liquids smaller than 4 liters. No fume hood is required, and there is no specified general ventilation rate. The second stage of distilled reagent intensity acids or bases, which is weak in usage minimal

quantities, contains no or restricted levels of hazardous or high danger products and requires fewer than 1 liter was contained fewer than 40 liters of flammable liquids. Specific activities may require fume hoods (American Chemical Society, 2003). The third moderate level involves laboratory work involving concentrated acids, bases, toxic substances, other high hazard chemicals, or cryogenic liquids. It deals with carcinogens or reproductive toxins. In cabinets or fume hoods, corrosive, flammable, or toxic compressed gases occur (American Chemical Society, 2003). Volume larger than 40 liters of flame retardant liquids are stored in the laboratory. Chemicals such as hydrofluoric acid, pyrophoric chemicals, or cyanides, may pose high hazards in small amounts throughout the laboratory. Laboratories are fume hoods, or intensive local exhaust. Uses of a glove for air or water reactive chemicals are required (American Chemical Society, 2003).

The fourth high-level level involves working with explosives or potentially explosive compounds, or using larger quantities of pyrophoric chemicals frequently. The use of glove boxes for pyrophoric or air or water reactive chemicals is compulsory because, in the event of uncontrolled release or predictable incident, large quantities or high-risk materials with significant potential for Immediately Dangerous to Life and Health (IDLH) conditions.

2.3 Department Occupational Safety and Health

In Malaysia, the chemicals are managed under the Department of Occupational Safety and Health (DOSH). Under the Ministry of Human Resources, the Department of Workplace Safety and Health (DOSH) is a branch.

As a federal body, it is the organization that is responsible for implementing and executing the country's workplace safety and health laws. It is a policy of the Department of Occupational Safety and Health to continuously improve the quality of the employees' products, services and performance in safety and health alongside the relevant persons. In year of 2016 till early 2007, according to report, there are 16 cases of accidents in school involving chemical spill such as mercury in laboratories. That is why both management and staff will work together to prevent potential product and service non-conformity and potential injury from workplace incidents (DOSH, 2019).

2.3.1 Chemical Management Division

Any workplace safety and health problems associated with chemicals can be greatly minimized through proper chemical management and use. In addition, the Division of Chemical Management under DOSH is responsible for dealing with chemicals issues. The Division serves as the department's think tank to monitor the current problems and integrate fresh creative concepts into established legal framework to ensure systematic strategy and effective occupational chemicals control is practiced.

In addition, state offices related to legislation and issuing guidelines to ensure safe use of chemicals at any place of work (DOSH, 2019).

2.3.2 Occupational Safety and Health Act

Occupational health and safety (OHS) is about workplace health, safety and welfare issues. OHS includes the laws, standards and programs aimed at improving the workplace for workers as well as co-workers, family members, customers and other stakeholders. Improving the occupational health and safety standards of a company ensures good business, a better brand image and a greater morale of employees (OHS, 2018).

The 1994 Occupational Safety and Health Act is enforced by the Department of Occupational Safety and Health (DOSH), which is a government department under Malaysia's Ministry of Human Resources. The Act was issued in gazette on 24 February 1994 and can be referred as the 1994 Workplace Safety and Health Act. This Act is a functional instrument superimposed to current laws related to protection and health. Via compliance and promotional activities DOSH must ensure that workers, self-employed individuals, producers, designers, importers, retailers and employees always follow a culture of healthy and secure work and always comply with current regulations, guidelines and codes of practices (Lawyerment, 2001).

2.3.3 Classification, Labelling and Safety Data Sheet of Hazardous Chemicals (CLASS) Regulations

The Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013 (CLASS Regulations), promulgated in compliance with the Occupational Safety and Health Act 1994 (Act 514) replaced the Occupational Security and Health (Classification,

Packaging and Labeling of Dangerous Chemicals) Regulations 1997 (CPL Regulations). The primary purpose of the CLASS Regulations is to ensure the manufacturers of hazardous chemicals have sufficient details about the dangers of chemicals they provide in order to minimize the dangers of chemicals they import.

Suppliers' duties as specified in the CLASS Regulation are to do the submission of details on the classification, marking, preparation of Protection Data Sheet, packaging and chemical inventory. Suppliers are described in the legislation as individuals that provide hazardous chemicals that involve major suppliers which are suppliers that design, produce, import, recycle or reformulate hazardous chemicals. The secondary suppliers which are suppliers who repack, sell or market hazardous chemicals. The school should provide the MSDS for proper chemical handling and waste management more efficiently. It will help in reducing the issues in the laboratory.

2.3.4 Use and Standard of Exposure Chemical Hazardous to Health (USECHH Regulations)

The Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulations 2000 (USECHH Regulations 2000) is the sixth set of regulations made under the Occupational Safety and Health Act 1994 (OSHA 1994) (OSH, 2018).

The purpose of the USECHH Regulations is to provide a legal framework for the employer to control chemicals hazardous to health with respect to their usage and to set workplace exposure standards so as to protect the health of employees and other persons at the place of work (Any, 2000). The Regulations clearly stipulates the responsibility of the employer (including self-employed person), in respect of his employees and any other person, so far as is practicable to protect their safety and health from being affected by chemicals hazardous to health.

Thus, this regulation should be followed by the staffs and lecturers to setup a safe laboratory. When a chemical hazardous to health is used in any manner that is affecting the health of any person who may be at risk by the chemical hazardous to health, the person in charge in laboratory such as laboratory assistance shall ensure that warning signs are posted at conspicuous locations at every entrance of the area to warn the person. Other relevant information should be given to the person entering the laboratory such as poster to ensure the laboratory is a safe workplace.

2.4 Chemical Safety Awareness

Awareness of chemical protection will be measured on the grounds of the students and staff's awareness, experience, behavior and expectations of chemical health. Knowing and following Standard Operating Procedure (SOP) at the laboratory is important. SOP should be implemented which addresses the use of correct personal protective equipment, safe handling, safe use and proper

disposal and can cover all chemicals in a laboratory. Flip charts, signs, or other literature may then be used to recall specific chemical hazards to the workers. Laboratory should have safety rules which each individual will obey while handling experiments or chemical substances**.** Teachers should know what types of chemical used when handling the experiments. Laboratory assistant should be prepared for any hazard and teach a proper technique in handling the apparatus.

The use of improper techniques can lead to accidents in the lab environment (Draman et al., 2010). Adane and Abeje (2012) also concluded that accidents involving chemicals can be expected to occur in cases of inexperience, and lack of awareness about the risks associated with different substances and techniques in the lab.

CHAPTER 3

MATERIALS AND METHODS

3.1 Sampling sites

All survey and study were conducted in UMK Jeli Campus. The main reason in selecting Jeli Campus for the study is because of only Jeli Campus is offering Applied Sciences courses. It would be most appropriate as Applied Science courses in handling and expose to chemicals when conducting experiment in the laboratories.

3.2 Target population

The target respondents compromise a total of 238 student from all ten courses in UMK Jeli Campus. The total population of the student of UMK Jeli Campus from first year to fourth year is 1941(N) students. Hence, the sample size of students in UMK Jeli Campus were 238 with 90% of confidence level (Z), 5% of margin error (E) and 50% of sample proportion (p). The equations to calculate the sample size (n) as stated in Eq. (3.1.1) – (3.1.2). The sample size of the study was calculated by using Raosoft calculator from International Statistical Service as follows:

$$n = \frac{s}{1+\frac{(s-1)}{N}} \quad (3.1.1)$$

Where,

$$s = \frac{z\ 2p\ (1-p)}{E2} \quad (3.1.2)$$

3.3 Study Instrument

The study was conducted using a set of questionnaires (Appendix 1) as a data collection that were distributed to target respondent. The questionnaire is adopted from previous research related to chemical safety and its analysis. The questionnaire covered several topics to analyze the chemical safety awareness among the students. The questionnaire is divided into five main sections which are demographic, knowledge, attitude, skills and perception to measure the awareness of students.

Section one is demographic profile that have four questions function as describing the characteristic of people who are surveyed. In this section, respondent ask on the gender, race, academic programme and year of study.

Section two have twelve questions that ask on knowledge on chemical safety to determine the level of knowledge of respondent toward chemical safety. Understanding chemical hazard management, safety measure was evaluated in this part.

Section three have eleven questions ask on attitude of chemical safety in laboratories. Besides, the behavior that they practiced in laboratory were evaluated in this part.

Section four have twelve questions ask on skills of students on chemical safety in laboratories. The risk concern on surrounding were measured. This part will analyze on how they handling the chemical and unexpected accident.

Section five have one questions ask on the perception on chemical safety awareness in UMK Jeli Campus. This part will analyze their opinion on level of awareness of chemical safety in laboratories.

3.4 Sample Analysis

All the data were collected through field survey and analyzed by using Statistical Package for the Social Sciences (SPSS) which included descriptive approaches. Description helps in understanding the data provided by summarize the data. The detailed statistics used involved the mean score, standard deviations, percentages and frequency which were displayed using frequency tables (Walters et al., 2017).

In addition, the study uses Likert scale method to measure the agreement of respondent toward chemical safety applications (Saul, 2019). Five-point scale was used to represent the opinion of the respondent and measured.

3.5 Pilot study

A pilot study can be described as a 'small trial' in preparation for a larger study to evaluate testing procedures, data collection equipment, sample recruiting strategies and other research techniques. A pilot study is one of the important stages of a research project and is conducted to identify potential problem areas and deficiencies in the research instruments and protocol prior to implementation (Abu Hassan et al., 2006).

To test the validity the questionnaire were analyzed using Cronbach's Alpha in SPSS software. Cronbach's Alpha in SPSS software is one of the most popular statistics on reliability in use today (Cronbach, 1951). In order to test its reliability, Cronbach's alpha specifies the internal accuracy or average selection of objects in a survey instrument (Santos 1999).

According to Garth (2008) the questions are accurate and found appropriate by utilizing Cronbach's Alpha when the coefficient is 0.70 or higher.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

The data in this study was obtained from the survey through questionnaire distribution. The questionnaire was then processed and presented in table. The number of respondents is based on the sample size calculated. Based on the research objectives, a descriptive statistic was used to analyze the data using SPSS computer software version 20.

4.2 Pilot study

The pilot study is needed before start the online survey which is through the Google form. The pilot study tested 40 questions using SPSS 20 to analyze the validity and the reliability of the built questionnaires. The result shows Cronbach Alpha value is 0.7 where indicate this study is reliable and consider acceptable.

4.3 Demographic analysis

The background of the respondent is required in order to commence the questionnaire studies. This section views respondent sex, race, academic programme and year of study. Table 4.1 shows the frequency of gender that answered the questionnaire.

Table 4.1: Distribution of gender

GENDER	FREQUENCY	PERCENT (%)
Male	110	46.2
Female	128	53.8
Total	238	100.0

The number of respondents according to gender is shown in the Table 4.1 where it revealed that 53.8% as whole respondent was female students based on the result of the frequency. In contrast, for male respondent is 46.2%.

Based on the finding of this study, on table 4.2, the races that answer the survey dominated by Malay respondent 92.0% which is the biggest number followed by Indian (4.6%), Chinese (2.5%) and other races which is Dusun from Sabah (0.8%).

Table 4.2: Distribution of race

RACE	FREQUENCY	PERCENT (%)
Malay	219	92.0
Indian	11	4.6
Chinese	6	2.5
Others (Dusun)	2	0.8
Total	238	100

Demographic profile also measure the academic programme and the year of study of each respondent. There are ten academic programme in UMK Jeli Campus that involved in the survey. This study managed to get respondent from all the courses. Table 4.3 shows the frequency of academic programme that answered the questionnaire, where Sustainable Science programme (SEL) dominated with 26.9 %. This shows that the survey are well distributed to the SEL students.

The least programme that answer the survey is Material Technology programme (SEB) which is 1.3%. This shows that the survey are not well distributed to the SEB students.

Table 4.3: Distribution of academic programme

FACULTY	ACADEMIC PROGRAMME	FREQUENCY	PERCENT (%)
FSB	SEN	34	14.2
	SEG	40	16.8
	SEL	64	26.9
FIAT	SBL	24	10.1
	SBH	21	8.8
	SBF	20	8.4
	SBP	5	2.1
FBKT	SEB	3	1.3
	SEH	8	3.4
	SBT	19	7.1
	Total	238	100

Table 4.4 shows the frequency of year of study of the respondents that answered the questionnaire. Fourth year students dominated the result with 46.2% followed by third year and second year students (33.6% and 11.3% respectively), and the least is first year students (8.8%). The reason why the first year is the least respondent because it cannot be distributed well and lack of communication with the first-year students.

Table 4.4: Distribution of year of study

YEAR OF STUDY	FREQUENCY	PERCENT (%)
Year 1	21	8.8
Year 2	27	11.3
Year 3	80	33.6
Year 4	110	46.2
Total	238	100

4.4 Status of knowledge, attitude and skills towards chemical safety in UMK Jeli Campus

For questionnaire from Section B - D were analyzed by using index method due to respondent responding differently for each category of statements. The choices of opinion are narrowed down to Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree.

4.4.1 Knowledge on chemical safety

In this study, knowledge of respondent related to chemical safety was investigated by the response of 12 questions. It can be observed from Table 4.5 that the mean score regarded to the respondent's knowledge on chemical safety.

Table 4.5 : Descriptive Statistics of knowledge

QUESTIONS	N	MEAN	STD. DEVIATION
1) All chemicals are hazardous to human health.	238	3.866	1.0387
2) Laboratories should have good ventilation	238	4.714	.5379
3) Each laboratory should have their own spill kit and first aid kit.	238	4.815	.4203
4) All chemicals should be labeled according to the law requirement	238	4.874	.3571
5) Emergency Response Plan is important in the laboratories.	238	4.836	.3709
6) Personal Protective Equipment (PPE) is compulsory to wear in the laboratories.	238	4.727	.5997
7) Safety Data Sheet (SDS) provides information about chemicals used in the laboratory.	238	4.718	.4867
8) Chemical Waste cannot be disposed in the drainage system.	238	4.647	.6242
9) All chemicals need to be registered with the Department of Occupational Safety and Health (DOSH)	238	4.752	.4790
10) Chemical Health Risk Assessment (CHRA) should be conducted to selected chemicals only.	238	4.391	.8634
11) Chemical exposure may lead to chronic effect.	238	4.672	.5452
12) All accidents happened in the laboratory have to be reported to the laboratory's staffs.	238	4.874	.3571

The mean score for each question is between 4 and 5, indicating that respondents agree with the questions in term of those aspects and have good knowledge about chemical safety (Table 4.1). This practice shows good behavior for create safety environment in laboratory. They can establish a positive work culture and always concern about safety and health in any work done (Fazreen, 2013).

Respondent received the knowledge by training, courses, reading material or social media and other sources. This happens because most of the respondents come from science courses and familiar with the knowledge on chemical safety in the laboratory.

Table 4 shows the result related to all chemical is hazardous to human health shows that most respondents are agree than disagree. This shows that they have knowledge regarding chemical. Based on the result, there is least respondent that disagree that all chemical is hazardous to human health (mean value: 3.87). This shows that even with the students that came from science background are lack of knowledge regarding chemical effect. This statement is supported by Taber (1997) proposed that many students have not grasped the knowledge of chemicals in chemistry because they have problems in understanding the concept of chemicals.

For the other knowledge related to chemical safety like safety data sheets (SDS), personal protective equipment, waste disposal and emergency plan shows that generally the students know and agree about it (mean value: 18.93: Table 4.1). SDS are the primary chemical safety information including hazard identification, chemical handling & storage, first aid, exposure control/personal protection, physical & chemical properties, stability & reactivity, and waste disposal (Kemsley, 2016). This based on more than half respondents agreed that they have knowledge about chemical safety.

The respondent mostly agreed that all accident that happened have to be reported to the staff (mean value: 4.874; Table 4.1). This shows that the students have common sense to not take action recklessly. They know that it is important to ensure safe environment for all academic activities especially in laboratory. Appropriate supervisory practice can help to control the situations in the laboratory in order to keep the environment safe and sound. (Chima, 2016).

4.4.2 Attitude on chemical safety

For section C attitude of respondent on chemical safety was investigated by the responses of 11 questions. It can be observed from Table 4.6 below, that the mean score regarded to the respondent's attitude on chemical safety is tabulated.

Table 4.6: Descriptive statistic of attitude

QUESTIONS	N	MEAN	STD. DEVIATION
1) I read labels on chemicals before using it	238	4.437	.6578
2) I read safety rules and regulations before start working with chemicals in the laboratories.	238	4.450	.6589
3) I practice safe operating procedure (SOP) in the laboratory	238	4.643	.5760
4) I wear Personal Protective Equipment (PPE) while using chemicals in the laboratory	238	4.555	.7256
5) I know how to use fire extinguisher in the laboratory	238	4.189	.8126
6) I read safety data sheets (SDS) before using any chemicals	238	4.202	.7803
7) I know the location of safety shower in the laboratory	238	4.567	.6948

Table 4.6 (Continued)

8) I practiced the correct chemical safety procedure in the laboratory as trained.	238	4.597	.5856
9) I ensure my workspace is organized and cleaned before and after working in the laboratories.	238	4.748	.4447
10) I know how to use the safety shower	238	4.105	.9241
11) I used an appropriate container in the laboratory to dispose chemical waste.	238	4.639	.6194

Regarding the attitude, Table 4.6 shows that the respondents had more manners towards safety measure that need to be taken while working in the laboratories.

The minimum mean score of each question is 4.0, indicating the respondents generally had good attitude towards chemical safety. So, this can lead to decreased possibilities that incidents can be occurred in the laboratory. According to researcher stated that, the factors that led to the accident is caused by the individual attitude on matters related to the safety and health (Husna, 2017).

Majority of the respondents agreed that reading labels of chemicals and also read the safety and regulation before working on the chemicals in the laboratory is important (mean value: 4.44). The highest awareness was regarding the safety environment and surrounding in laboratory indicating the students showing good attitude in the laboratory. Importance of Safe operating procedure (SOP) in laboratory are agreed by the respondents. They know and realize that, the surrounding in laboratory need to be free and safe from any obstacle or hazard that could contribute accidents (Kamarudin, 2011).

More than half of the respondents agreed that they need to use an appropriate container in the laboratory to dispose the chemical waste (mean value: 4.64). Instead of dispose into the drainage system, it is better to dispose the chemical waste in the prepared container to avoid contamination of the groundwater and also pump damage.

4.4.3 Skills on chemical safety

Skills on chemical safety in UMK was investigated by the responses of 12 questions (Table 4.7). The mean score of all questions is between 3 and 4 which indicating that the skills of the students on chemical safety are good.

Table 4.7: Descriptive Statistic of skills

QUESTIONS	N	MEAN	STD. DEVIATION
1) I used to join training related to chemical safety such as chemical hazardous management and chemical handing	238	4.109	.9747
2) I know proper evacuation routes if accident occurs	238	4.244	.7899
3) I know how to control chemical spills in the laboratory.	238	3.996	.9300
4) I know how to control fire in the laboratory.	238	3.866	.8852
5) I know how to treat major bleeding with first aid procedure.	238	3.840	.8215
6) I know how to treat chemical splashes on arm, hands or face	238	3.807	.9527

Table 4.7 (continued)

7) I know emergency call number or person in charge in the laboratory if accident occurs	238	4.193	.8596
8) I know how to transport hazardous chemical outside of the laboratory	238	3.924	1.0118
9) I know how to control electrical hazards in the laboratory	238	3.702	.9274
10) I know how to treat person with electric shock in the laboratory	238	3.550	1.0124
11) I know how to handle scheduled waste (store and dispose)	238	4.017	.8762
12) I know how to notify people when accident occurs in the laboratory.	238	4.361	.8033

Based on agree and strongly disagree respondent it indicated that most respondent used to join training that related to chemical safety such as chemical hazardous management and chemical handling. Therefore, it shows that they have skills on chemical safety. Besides, based on the result, it shows that the students know the proper evacuation routes if accident occurs. This skill is for their preparation for an emergency's response in laboratories (Chamberlain, 2003).

However, most of the respondent have the low mean score on how to treat chemical spills (mean value: 3.99), how to control fire (3.86), how to control chemical hazard (3.70) and how to treat major bleeding (3.84). This shows that the students lack of knowledge on how to treat injuries in the laboratory and need to be guided on how to treat properly. When the time comes, the respondents are well prepared to deal with this kind of situation. Besides, the respondents shows that they lack of skills in controlling hazard such as electrical hazard, fire and also chemical spills. This may lead to poor in handling situation when the hazard happened in the laboratory. The respondent should be exposed with this

kind of scenario and learn to come out with best solution in solving the problems at that time. Thus, respondent should attend the chemical safety training and know how to react while emergency happen (Nurul, 2017).

Furthermore, most students know the emergency call number on person in charge in the laboratory. If accident occurs, the students know who to call and avoid reckless action. As stated by Kenneth (1976) laboratory accident happens because of someone's carelessness. Carelessness may result from someone's lack knowledge, rushed feeling, or other reasons.

Besides, lowest mean score on how to treat the person with electric shock in the laboratory shows that the respondents are lack of courage and knowledge to handle the situations. The respondent can join training that involved simulation to help in better understanding in handling the situation. Moreover, most respondents know how to notify people when accident occurs in the laboratory. So, the others can be extra cautious and calm on the accident. These skills are important because to avoid the people from panicking and thus start doing reckless action. Poor behavior regarding safety practice will affect smooth operation in laboratories (S.U, 2016).

4.5 Perception on chemical safety

This is the last section of the survey where there is only one question which is the perception of the students about the level of chemical safety awareness in UMK Jeli Campus. The level of awareness is divided into 4 scales which are excellent, good, moderate and poor. The level of awareness on chemical safety in UMK Jeli Campus were investigated.

The overall mean score can be observed from Table 4.8. It shows that mostly respondents agreed that the level of awareness on chemical safety in UMK Jeli Campus is good.

These results give an assumption that the respondents can follow the safety rules and have fewer possibilities on incidents occurrence which indicate in good practicing chemical safety in the laboratory. These assumptions can be accepted based on the outcome as discussed in the analysis above.

Table 4.8: Descriptive statistic of perceptions

QUESTIONS	N	MEAN	STD. DEVIATION
1) What is your opinion about level of chemical safety awareness among students in UMK?	238	3.874	.7637

CHAPTER 5

CONCLUSION

5.1 Conclusion

The implementation of chemical safety in the academic laboratory environment is an important step for the student to be safe in the laboratory. Chemicals had a variety of beneficial uses, while it can also be extremely harmful to human and environment if they misused. Therefore, the awareness on chemical safety is very crucial, especially to those that involved in laboratories' activities.

This study focused on the chemical safety awareness among the students in UMK Jeli Campus. Information about the knowledge, attitude and skills on chemical safety were analysed. The knowledge, attitude and practice are identified by descriptive statistic which display the frequency of respondent and mean score of each question.

The outcome from the data collected revealed that UMK Jeli Campus students generally have good knowledge, attitude and skills on chemical safety. Besides, this study also shows that the lack on skills of treatment on accidents related chemical safety. Based

on the result, it can be concluded that they need to join more training related to chemical safety. So, the first objectives of the study have been achieved.

However, the second objectives which is suggesting the good laboratory practice in the laboratory are not to be achieved due to limitations of time. But, from the observation in all laboratories in UMK Jeli Campus, each faculty already have rules and regulations that need to follow by all staffs and students that working in the laboratories. This safety rules and regulations, will give knowledge and help to increase awareness on chemical safety.

Using this information, various safety measure can be taken to improve and enhance the chemical safety awareness where indirectly can help avoid accident form occur.

Nevertheless, the key factor in ensuring chemical safety awareness is the people themselves. Hence, parties involve in the handling chemical such as students and staffs need to be extra alert about the importance of chemical safety.

5.2 Recommendation

Chemical safety in the laboratory is everyone's responsibility. It requires proper safety attire and equipment, knowledge on chemicals we are handling with, and proper laboratory procedure and skills. Based on the finding in the survey conducted, there are several recommendations that may needed to improve understanding on importance of chemical safety.

The first thing that should be improvised is the survey form should be distributed to three campus which are Pengkalan Chepa, Bachok and also Jeli. Thus, the result of chemical safety practices among all the students in UMK can be obtained. Staff should be

involved in answering the survey form. With the result, the level of chemical safety awareness and practices can be assessed among all the science students and also staff in UMK laboratories.

Another improvement is students must be provided with Laboratory Risk Assessment to provide information and identify problems related to the hazards present in their laboratory. This can help in mitigating the hazards including potential exposure situations. Knowledge regarding safety practice is very important while working in laboratory to prevent or minimize accidents and also can be reduced with the good safety practice of students in the laboratory. Thus, they can create safe environment in laboratory.

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APPENDIX 1

FACULTY OF EARTH SCIENCE

BACHELOR DEGREE OF APPLIED SCIENCE

(SUSTAINABLE SCIENCE)

QUESTIONNAIRE ON CHEMICAL SAFETY AWARENESS AMONG STUDENTS IN LABORATORIES IN UMK JELI CAMPUS

Disclaimer:

I am the student of Universiti Malaysia Kelantan (UMK) and presently doing a research on 'Chemical Safety Awareness in Secondary School Laboratories'. Your responses will be anonymous and will never be linked to the university or to you personally. I will not use your name or any information that would allow you to be identified in any presentation or published work related to the research. Kindly fill in the questionnaire below and assure that the data you generated shall be kept confidential and for research purpose only. I appreciate your time and generosity. Thank you for your cooperation.

SECTION A: DEMOGRAPHIC

Instructions: Please tick (√) the answer.

Arahan: Sila tandakan jawapan dengan (√).

1) Gender:
Jantina:

Male		Female	

2) Race:
Bangsa:

Malay	
Indian	
Chinese	
Others	

3) Academic Programme:
Program Akademik:

SEN	
SEG	
SEL	
SBL	
SBH	
SBF	
SBP	
SEB	
SEH	
SBT	

4) Academic Year of Study:
Tahun Akademik:

Year 1	
Year 2	
Year 3	
Year 4	

SECTION B: KNOWLEDGE ON CHEMICAL SAFETY

Instructions: For each of the following statement below, please indicate the extent of your agreement or disagreement based on the given scale by placing a tick (√) in the appropriate box.

Arahan: Sila tandakan (√) sama ada setuju atau tidak setuju dalam kotak berkenaan bagi setiap pernyataan berikut.

1 = strongly disagree 2 = disagree 3 = neutral 4 = agree 5 = strongly agree

		1	2	3	4	5
1	All chemicals are hazardous to human health. *Semua bahan kimia adalah berbahaya kepada kesihatan manusia.*					
2	Laboratories should have good ventilation. *Makmal harus mempunyai pengudaraan yang baik*					
3	Each laboratory should have their own spill kit and first aid kit. *Makmal harus mempunyai peti tumpahan dan peti kecemasan.*					
4.	All chemicals should be labeled according to the law requirement. *Bahan kimia harus dilabel berdasarkan kehendak undang-undang.*					
5	Emergency Response Plan is important in the laboratories. *Pelan tindak balas kecemasan adalah penting di dalam makmal.*					
6	Personal Protective Equipment (PPE) is compulsory to wear in the laboratories. *Alat pelindung diri adalah tidak wajib untuk dipakai di dalam makmal.*					
7	Safety Data Sheet (SDS) provides information about chemicals used in the laboratory. *Lembaran Data Keselamatan (SDS) memberikan maklumat mengenai bahan kimia yang digunakan di makmal.*					
8	Chemical Waste cannot be disposed in the drainage system. *Sisa kimia boleh dibuang dalam system saliran..*					
9	All chemicals need to be registered with the Department of Occupational Safety and Health (DOSH) *Semua bahan kimia perlu didaftarkan di Jabatan Keselamatan dan Kesihatan Pekerjaan (JKKP).*					

10	Chemical Health Risk Assessment (CHRA) should be conducted to selected chemicals only. *Penilaian Risiko Kesihatan Kimia (CHRA) harus dilakukan kepada bahan kimia terpilih sahaja.*					
11	Chemical exposure may lead to chronic effect. *Pendedahan kepada bahan kimia boleh menyebabkan kesan yang kronik.*					
12	All accidents happened in the laboratory have to be reported to the laboratory's staffs *Semua kemalangan yang berlaku di makmal perlu dilaporkan kepada staff makmal.*					

SECTION C: ATTITUDE OF CHEMICAL SAFETY

Instructions: For each of the following statement below, please indicate the extent of your agreement or disagreement based on the given scale by placing a tick (√) in the appropriate box.

Arahan: Sila tandakan (√) sama ada setuju atau tidak setuju dalam kotak berkenaan bagi setiap pernyataan berikut.

1 = strongly disagree 2 = disagree 3 = neutral 4 = agree

5 = strongly agree

		1	2	3	4	5
1	I read labels on chemicals before using it. *Saya membaca label mengenai bahan kimia sebelum menggunakannya.*					
2	I read safety rules and regulations before start working with chemicals in the laboratories. *Saya membaca peraturan keselamtan sebelum mengendalikan bahan kimia di makmal.*					
3	I practice safe operating procedure (SOP) in the laboratory. *Saya mengamalkan prosedur operasi yang selamat dalam makmal.*					
4	I wear Personal Protective Equipment (PPE) while using chemicals in the laboratory. *Saya memakai Peralatan Perlindungan Diri (PPE) semasa menggunakan bahan kimia di makmal.*					
5	I know how to use fire extinguisher in the laboratory. *Saya tahu cara menggunakan alat pemadam api di makmal.*					
6	I read safety data sheets (SDS) before using any chemicals. *Saya membaca lembaran data keselamatan sebelum menggunakan bahan kimia.*					
7	I know the location of safety shower in the laboratory. *Saya mengetahui lokasi mandi keselamatan di dalam makmal.*					
8.	I practiced the correct chemical safety procedure in the laboratory as trained.					

	Saya mempraktikkan prosedur keselamatan kimia yang betul di makmal seperti yang telah dilatih.					
9	I ensure my workspace is organized and cleaned before and after working in the laboratories. . *Saya memastikan tempat kerja saya teratur dan bersih sebelum dan selepas bekerja di makmal.*					
10	I know how to use the safety shower *Saya mengetahui cara menggunakan tempat mandi keselamatan*					
11	I used an appropriate container in the laboratory to dispose chemical waste. *Saya menggunakan bekas yang sesuai di makmal untuk membuang sisa kimia.*					

SECTION D: SKILLS ON CHEMICAL SAFETY

Instructions: For each of the following statement below, please indicate the extent of your agreement or disagreement based on the given scale by placing a tick (√) in the appropriate box.

Arahan: Sila tandakan (√) sama ada setuju atau tidak setuju dalam kotak berkenaan bagi setiap pernyataan berikut.

1 = strongly disagree 2 = disagree 3 = neutral 4 = agree 5 = strongly agree

		1	2	3	4	5
1	I used to join training related to chemical safety such as chemical hazardous management and chemical handing. *Saya pernah mengikuti latihan berkaitan keselamatan kimia seperti pengurusan bahan kimia berbahaya dan pengalian bahan kimia.*					
2	I know proper evacuation routes if accident occurs. *Saya mengetahui jalan keluar yang betul jika kemalangan berlaku.*					
3	I know how to control chemical spills in the laboratory. *Saya mengetahui cara untuk mengawal tumpahan bahan kima di makmal.*					
4	I know how to control fire in the laboratory. *Saya menyedari bagaimana untuk mengawal kebakaran di makmal.*					
5	I know how to treat major bleeding with first aid procedure. *Saya mengetahui cara untuk merawat pendarahan utama dengan prosedur pertolongan cemas.*					
6	I know how to treat chemical splashes on arm, hands or face. *Saya mengetahui cara untuk merawat percikan bahan kimia di tangan, lengan dan muka.*					
7	I know emergency call number or person in charge in the laboratory if accident occurs. *Saya mengetahui nombor telefon kecemasan atau orang yang bertanggungjawab di makmal jika kemalangan berlaku.*					

8	I know how to transport hazardous chemical outside of the laboratory. *Saya menyedari tentang cara untuk memindahkan bahan kimia berbahaya keluar daripada makmal*					
9	I know how to control electrical hazards in the laboratory. *Saya menyedari tentang cara untuk mengawal bahaya elektrik di makmal*.					
10	I know how to treat person with electric shock in the laboratory. *Saya mengethaui cara untuk merawat orang yang terkena kejutan elektrik.*					
11	I know how to handle scheduled waste (store and dispose) *Saya mengetahui cara untuk mengendalikan bahan terbuang yang berjadual (menyimpan dan membuang).*					
12	I know how to notify people when accident occurs in the laboratory. *Saya mengetahui cara untuk memberitahu orang apabila kemalangan berlaku*.					

SECTION E: PERCEPTION IN CHEMICAL SAFETY

Answer the following questions in your opinion.
Sila jawab soalan berikut mengikut pandangan anda

1) What is your opinion about level of chemical safety awareness among staffs and students in UMK?
   Apakah pendapat anda tentang tahap kesedaran keselamatan kimia dalam kalangan staf dan pelajar di UMK?

Excellent	
Good	
Moderate	
Poor	

-Thank you for your cooperation-