Safety Behaviours Assessment in Academic Institution: A Case Study in Unit Laboratory

By

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the requirements for the

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(Chemical Engineering)

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CERTIFICATION OF APPROVAL

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Approved by,

_____

(MR. AZIZUL BIN BUANG)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2013

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that original work contained herein have not been undertaken or done by unspecified sources or persons.

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MOHD FATHULLAH BIN MOHD SAM

ABSTRACT

The purpose of this research is to discover the unsafe acts or behaviours of the students that might lead to accidents or injuries in UTP laboratories. Hence, a safety behaviours assessment should be conducted to assess the unsafe acts or any behaviour in unsafe condition. Mostly, the technique used is based on observation system whereby safety observation will be piloted in during the students conduct their experiments which is including equipment and chemical handling and safety behaviours in the laboratories. Safety interventions will be applied in order to assist the students and as guidance to reduce or prevent any accidents or injuries. It is estimated that after a certain period of time, the statistic of unsafe behaviours will decrease even after without safety interventions.

At the end of the research, this safety training model using behaviours-based safety training program should be applicable for young adults especially during their tertiary education. In addition, the school or college should also be able to develop and integrate this safety program as part of compulsory method as it will be helpful before the students are exposed to the real-life working situations. This is because most of the accident and injury case in work-place are due to improper safety training and lack of experiences by the newbies or the fresh graduated students. Therefore, this research will help them to gain some knowledge and experiences before getting to work after graduated from college or school.

ACKNOWLEDGEMENT

I would like to express my deepest appreciation to all those who provided the possibility to complete this report. A special gratitude I give to my FYP supervisor, MR. AZIZUL BIN BUANG, whose contribution in stimulating suggestions and encouragement, helped me to coordinate my project especially in writing this report.

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CHAPTER 1
INTRODUCTION

1.1. Background of Study

In recent research, the behaviours of workers are identified as the main root causes of occupational accidents, in which the behaviours are described as acts or how people do it. Many cases related to accidents and injuries are due to improper training, lack of knowledge and experiences as well as lack of safety approach during the beginning of real work life. As a fact, companies only provide proper safety training to the hired employees and most of the hired employees are graduated college students or at least has attended the school.

However, in school or colleges, the implementation of safety conducts and proper training are still ineffective and exposure to the occupational safety and health are still under level of study. These ineffectiveness and lack of exposure might influence the safety behaviour of a person, which could lead to accidents and injuries. In other words, the probability of accidents and injuries to occur when they work in the real company, plant or factory is high. Therefore, this project focuses on introducing/identifying about the safety behaviours that could lead to improper acts and investigating the application of proper safety methods, approaches, training, and application on changing these unsafe acts to safe acts behaviours as well as maintaining the good changes.

1.2. Problem Statement

Generally, students in the schools or colleges are not exposed enough with the proper safety training and most of the learning is through subject of study, but lack of safety implementation in real life. Due to the education policy, which is to provide a safe environment for the students to learn, grow and develop as well as government acknowledgement on school safety is a fundamental prerequisite for student success and academic achievement, a deep study such as accidents and injuries and advance safety training might be limited for the students.

1.3. Objectives

I. To identify the safety behaviours that might lead to unsafe acts and apply safety interventions;
II. To provide safety methods or approaches that suit with students as safety interventions;
III. To study and investigate how to maintain the safe environment with or without safety interventions;
IV. To determine whether behaviour-based safety training programme is more effective compare to standards-based safety programmes that only focus on teaching safety skills and safety educations;
V. To integrate and develop the behaviour-based safety training and approaches in the school or college.

1.4. Scope of Study

This safety behaviours assessment will be conducted in one of the laboratory in UTP and the chosen laboratory should be under chemical department, which is related to major programme and mostly equip with lab equipment, chemical apparatus, hazard signs, emergency fire system, and injury aids and more important is near to lab technicians and assistants places. The assessment will be piloted/performed/tested/ on the various groups of students who conducted their experiments and the unsafe acts will be observed and stated during that time. Further actions related to unsafe behaviours that could cause accidents or injury will be discussed through proper methodology and data analysis.

1.5. The Relevancy of the Project

This project depends on the lab schedule of the students and the laboratory room, where the students will conduct their experiment. The time and places must be consistent or at least less varies during period of assessment. The subjects of study, which is the students, must be the same person or the same groups in order to receive accurate data of unsafe acts and to observe their safety behaviour patterns from times to times before safety interventions are implemented.

1.6. Feasibility of the Project

Due to UTP's three semesters per year of study, in which one semester is four months long, that period length is enough to conduct this safety behaviour assessment. With the help of manual books on how to conduct the experiments as well as safety precautions provided by UTP and helps from lab technicians or assistants, this project is under safe environment as well as can be conducted properly.

CHAPTER 2
LITERATURE REVIEW AND THEORY

2.1. Factors of Unsafe Behaviours or Acts that Lead to Accidents or Injuries

Articles **2.1.1 – 2.1.4** discusses the various factors regarding the unsafe acts and behaviours that might lead to injuries. Most of them discussed about the factors that conceded human to allow it happen accidentally or due to environment factors in the factories, construction site or other places.

2.1.1. At-risk Behaviours and Unsafe Conditions Lead to Accidents and Injuries

In securing the effectiveness of safety management system, objective prevention system is developed to observe and foresee the occurrence of at-risk behaviors and unsafe conditions as well as to promote environmental monitoring of these fundamental safety aspects. These at-risk behaviors and unsafe conditions could lead to numbers of accident with severe injuries. Therefore, eliminating these two factors from working environments can prevent the occurrence of any incidental events [1]. Along the way, an enriched safety culture can also be implemented through training, improving participation and motivation by example. Thereby, some case studies try to demonstrate that these at-risk behaviors and unsafe conditions can be anticipated, thus, preventing any incidental event to occur through a safety management system based on efficient safety management tools for the behavior-based monitoring of working areas for construction sites and mechanical industries [2].

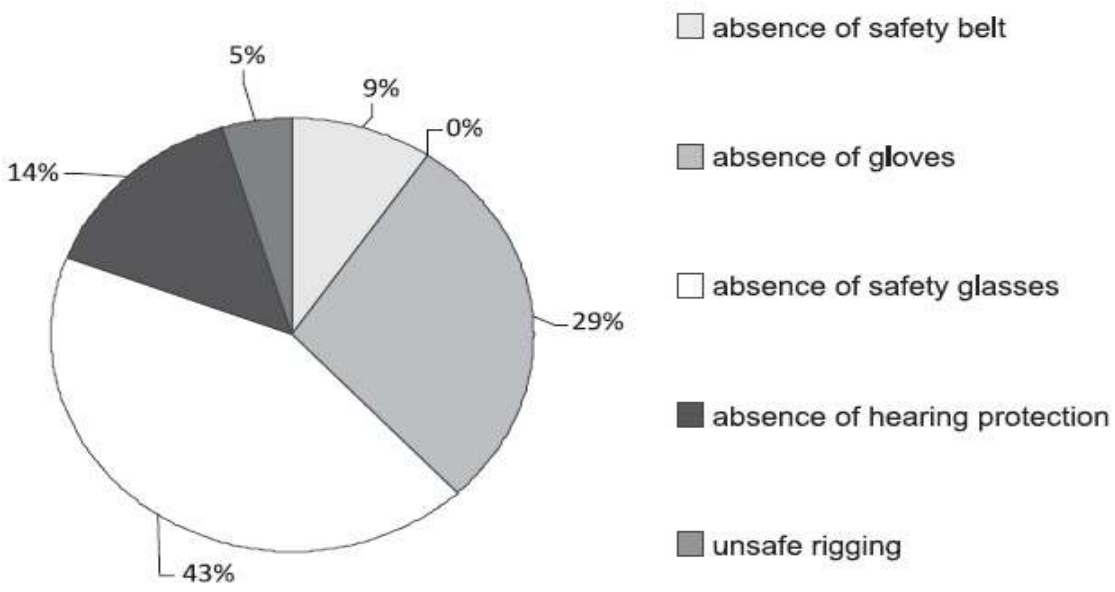


Figure 1: Example of At-risk Behaviours and Unsafe Acts That Cause Accident or Injuries

2.1.2. Lack of Knowledge, Inappropriate Attitude and Behaviours Lead to Unsafe Acts

According to Heinrich's theory, the most important factor in industrial accidents is unsafe behavior, in which proposition for every 330 unsafe acts, 29 will result in minor injuries and one in a major or lost time accident. Other studies also concluded that this theory is the causing agent of accidents considering that the workplace is safe. However, all health and safety measures might fail if workers (employees) have insufficient knowledge or do not have the proper attitude and behaviour toward health and safety of the workplace [3-4].

Besides that, a study also showed, although the workers have high knowledge [78% - 100%], only a few of them [29-31%] used personal protection equipment to prevent any accidents or hazards that might occur [5]. In addition, industrial countries also made some studies and reveal that 90% of workplace accidents is caused by human errors and only 10% of those belong to incompatible workplace and equipment [6]. In this case,

human errors are considered as having negative attitude, unsafe behaviours, lack of knowledge and interest and unskillfulness. Necessary education needs to be planned to change the behavior of the workers from unsafe to safe in order for them to observe safety regulations for safety development [7-8].

2.1.3. Relation of Organizational Factors and Safety Climate

The awareness and experience of the workers toward occupational health and safety are barely considered in programmes for the prevention of work related injuries and diseases. Healthy behaviours and environment play important role in determining good occupational health, but organizational threats are becoming more significant in many workplaces. Organizational factors such as design concern, management and organization of work are the major factors that contribute to occupational health and safety. These factors also related to safety and health issues at work and it have been shown that they can affect the implementation of workers' safety training [9].

There is hypothesis that linking both organizational factors and safety climate (the perception of employees toward organizational culture and practices concerning safety at their companies or companies' safety culture). In 1980, Zohar identified two main prominent climate dimensions in determining safety climate levels, which describes the relevance of safety job behaviour and also workers' perceived attitude of the management towards safety [10]. Thus, a correct intervention must be planned through proper and effective management.

2.1.4 More Accidents Caused by Young Adult due to Less Safety Approach

According to Social Security Organisation of Malaysia's (SOCSO) 2008 annual report, the highest accident rate is among the age group between 20 – 24 years old, with total of cases 203 in 2007 as compared in 2006, which are only 177 cases. Based on these increasing figures, it is identified that most of the young workers are more vulnerable to

the accident and injuries compared to the employees who has been working for a long period of time [11].

An international review conducted by Salminen in 2004 states that young workers have a higher injury rate compared to their older counterparts. Young workers are identified as workers under 24 and 25 years old. Less safety approaches and experiences might be the reason why young workers do not know much about the safety, chemical hazards and proper work without getting injuries or accidents [12-14].

2.2. Accident Cases Caused By the Unsafe Acts and Behaviours

2.2.1. Laboratory Accident in University of California, Los Angeles

It is reported that a technician died due to the fire accident in the lab. A person named Sheharbano Sheri Sangji, a 23-year-old technician made her task as her last one in her lifetime whereby at that time, she worked on a liquid called T-Butyl Lithium. This event happened at late December afternoon in 2008, where during working, she only wore sweatshirt and no lab coat. She tried to handle the chemical, but it caused fire when it was exposed to air. This chemical has a pyrophoric characteristic, which means that it is easy to ignite. During that time, this equipment failed to work and the chemical spilled on her cloth (made from synthetic fiber), which later, set her up ablaze. Two postdocs (person who engaged in postdoctoral researches) rushed to help, but they failed to locate nearby shower. Meanwhile, emergency personnel arrived too late and caused her to spend 18 days in hospital burn unit before she died.

According to the California Division of Occupational Safety Health (Cal/OSHA), the accident is not a mere catastrophe, because it happened due to safety violation conducts of life threatening. In other words, lack of proper training and protective clothing [15].

Figure 2: Emergency Eyes Wash and Shower should be place nearby to hazardous working area for high safety management

2.2.2. Massachusetts's Student Died due to Asphyxia

At 5.30 p.m. on Wednesday, a campus wide email that described the death information about the student named Michele Dufault '11 has been confirmed by Richard Levin, a University President. Through investigation, the Connecticut Office of Chief Medical Examiner in Farmington concluded that, Dufault died because of asphyxia. Asphyxia refers to the neck compression in which Michele's hair got caught in one of the shop's wood lathes during her working in Laboratory's machine shop. According to Levin, that lathe machine is large and used for woodworking and metalworking that casts objects through rotating mechanism use.

Through chemistry department website, the machine is located in the building's basement and only a certain students and faculties that completed the shop course (construct or modify research instrumentation) can access the room. Thus, some reviews have been made. One of it is, the use of power equipment will be restricted to certain hours when monitors are present. This accident is referred as an unsafe care of personnel belongings and not only focuses on basic protective personnel equipment, which is vital to follow during entering the lab [16].

Figure 3: Lathe is used in woodturning, metalworking, metal spinning, and thermal spraying/parts reclamation, and glass-working

2.2.3. A Flash Fire Sparked in Princeton University's Frick Laboratory

A sparked flash fire caused the chemical to be sent to air and three people were sent to the hospital. It is reported that a female post-doctoral student, a student and a security guard were treated for slight chemical irritations after unintended chemical reaction sent to a cloud of vapors into the lab they were occupying. Captain Michael Oakley from Trenton Fire Department said that this accident happened because a solvent had been added at some point to nitric acid and causes it to spark, produced smoke, and splashed the chemical into air as the chemicals incompatible with each other's. In addition, the fire is contained to the lab and almost of the chemicals has been sucked into the hood, where they conducted their experiment. This accident is caused by unsafe acts through unplanned experiment [17].

Figure 4: Part of the nuclear magnetic resonance lab in the B level of the Frick Chemistry Laboratory at Princeton University in Princeton, N.J.

CHAPTER 3
METHODOLOGY AND PROJECT WORK

3.1. Methodology

3.1.1. 1st Phase: Preliminary Procedures

- Acquire the locations of project research which are located at Block 3 and Block 4 and the information of student lab and grouping sessions from UTP e-learning or lecturers;
- Arrange and synchronize the behavior-based assessment to conduct with this semester studies' timeline;
- Acquire the permission and authority to use lab (s) from UTP's supervisor and also from the authorized department;
- Self-study and practices about the occupational safety and health that related to safety conducts behaviours, safety hazards and laboratory assessments.
- Do preliminary observation on unsafe acts and behaviours in the lab;
- List down every unsafe acts that might exist or not or prepare a blank list to describe the unsafe acts that might occur or under prediction.
- The chosen labs are from Unit Operation Lab I & II and also Organic Chemistry Lab
- Below shown the tables of chosen groups that are suitable or synchronized with this semester timetable including the dates of conducting this project.

Unit Operation Lab I & II (Block 3 GF, 2F & Block 4)

Table 1: Synchronizing the groups with BBS stages (periods of assessments) for Group Unit Ops Lab I & II

		Groups							
		4-Jun	11-Jun	18-Jun	25-Jun	2-Jul	9-Jul	16-Jul	23-Jul
Location	Type of Experiments								
Block 3, GF	1. Packed Column Distillation	G8	G5	G2	G16	G13	G10	G7	G4
	2. Climbing Film Evaporator	G9	G6	G3	G17	G14	G11	G8	G5
	3. Mixed-Settler	G10	G7	G4	G1	G15	G12	G9	G6
Periods	BBS Stages	Observations			Obs-With-Interventions			Obs-Without-Interventions	

		Groups							
		4-Jun	11-Jun	18-Jun	25-Jun	2-Jul	9-Jul	16-Jul	23-Jul
Location	Type of Experiments								
Block 3, L2	1. RTD Tubular Flow Reactor	G11	G8	G5	G2	G16	G13	G10	G7
	2. CSTR Dynamic	G12	G9	G6	G3	G17	G14	G11	G8
Periods	BBS Stages	Observations			Obs-With-Interventions			Obs-Without-Interventions	

		Groups							
		4-Jun	11-Jun	18-Jun	25-Jun	2-Jul	9-Jul	16-Jul	23-Jul
Location	Type of Experiments								
Block 4, GF	1. Tray Dryer	G13	G10	G7	G4	G1	G15	G12	G9
	2. Spray Dryer	G14	G11	G8	G5	G2	G16	G13	G10
Periods	BBS Stages	Observations			Obs-With-Interventions			Obs-Without-Interventions	

Table 2: Synchronized groups of Unit Ops Lab I & II with dates of BBS assessments

	Dates of BBS Assessment		
BBS Stages	**G4**	**G5**	**G13**
Observations	18-Jun	11-Jun	4-Jun
Obs-with-Intv.	25-Jun	25-Jun	2-Jul
Obs-without-Intv.	23-Jul	23-Jul	16-Jul

Organic Chemistry Lab (Block 4)

Table 3: Synchronizing the groups with BBS stages (periods of assessments) for Group Ochem Lab

Group 3A, Thursday (8.00 A.M - 11.00 A.M)	
BBS Assessment Stages	**Dates of Assessment**
Observations	6-Jun
Obs-WITH-Interventions	20-Jun
	18-Jul
Obs-WITHOUT-Interventions	1-Aug

3.1.2. 2nd Phase: Conducting Safety Behaviours Assessment with Immediate Responses

- Observe the behaviours of the students during conducting experiments or handling equipment;
- "Tick" or "Check" or write down the unsafe acts by individuals and by groups, take pictures;
- Immediately give advises or guidance to correct the unsafe acts in order to prevent further misconducts of experiment and to avoid any accidents or injuries that might occur;
- Assessment will be conducted approximately within 3 or 4 weeks.
- Do collect data and analysis.

3.1.3. 3rd Phase: Conduct Observation without Safety Interventions

- Conduct observation without providing any safety interventions;
- Do collect data and analysis;
- Compare with the result in 2nd phase;
- Do discussion. If the result is negative, repeat with 2nd phase and do 3rd phase again, if the result still give a negative, precede with alternative safety interventions.

3.1.4. 4th Phase: *Alternative Safety Interventions

- Deliver talks about safety in the beginning and at the end of the experiment;
- Ask the students to show how to do a specific safety practices from the experiment. If unsatisfied, ask them to do it again. If they fail, teach them again;
- Further planning and consultation with safety management team (if have) or supervisor.

SAFETY BEHAVIOUR SAMPLING

WORKSHEET

Department: Type of Activity:
Work Center:

UNSAFE ACTS							
1. Handling Hot Parts with Unprotected Hands 2. Failure to wear proper safety glass 3. Improper Lifting 4. Carrying heavy load --- --- --- Total Unsafe Acts							

Date:
Time:

Figure 5: Example of Sampling Worksheet for Safety Behaviours Assessment. *Notes* - the sampling worksheets in this project might be varied and should outfit with the use in laboratories.

3.2. Methodology in Simple Flow Charts

3.2.1. 1st Phase: Preliminary Procedures

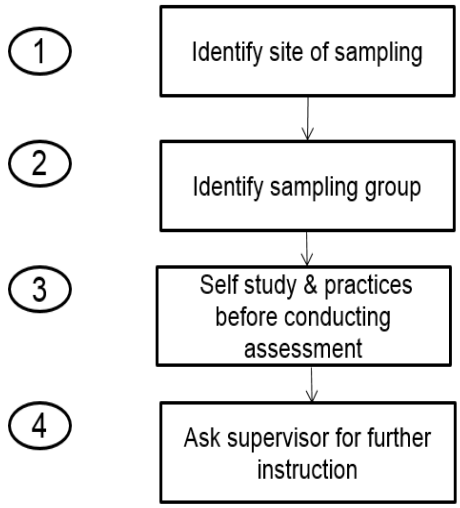


Figure 6: 1st Phase: Preliminary Steps

3.2.2. 2nd Phase: Conducting Safety Behaviours Assessment with Immediate Responses

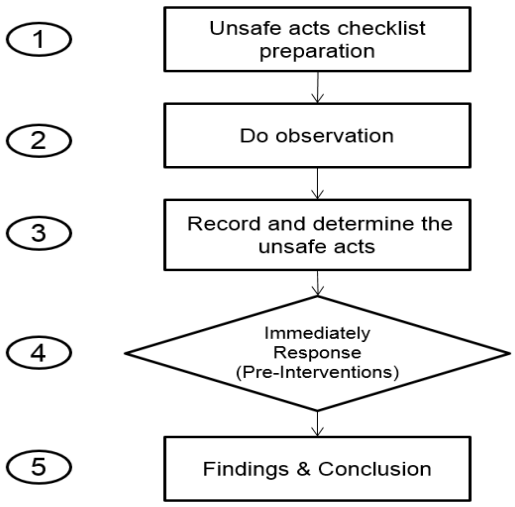


Figure 7: 2nd Phase: Conducting Observation and Providing Safety Interventions

3.2.3. 3rd Phase: Conduct Observation without Safety Interventions

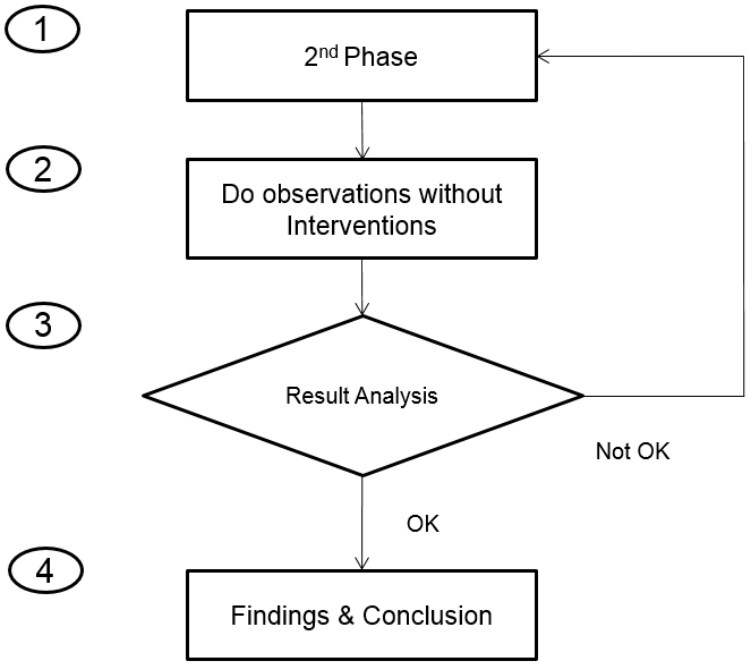
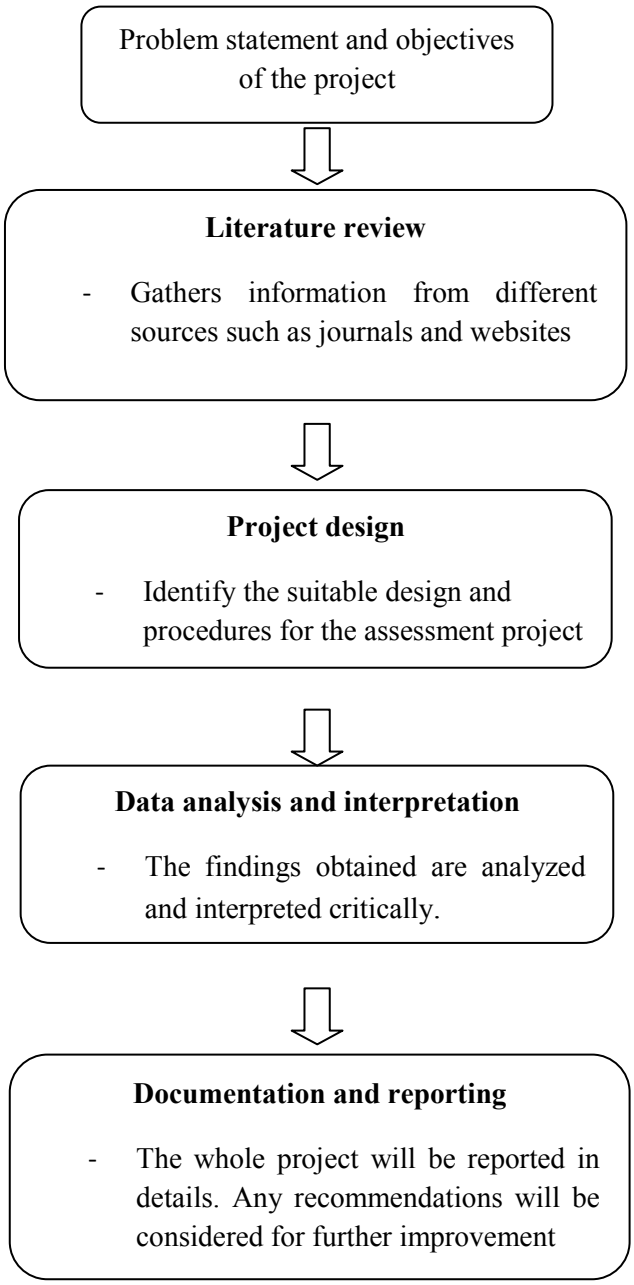


Figure 8: 3rd Phase: Conducting Observation without providing safety intervention

3.3. Key Milestones



3.4. Gantt Chart

NO	DETAILS / WEEKS	1	2	3	4	5	6	7		8	9	10	11	12	13	14
1	Project Work Continues	■	■	■	■	■	■	■								
2	Submission of Progress Report							●								
3	Project Work Continues									■	■	■	■	■		
4	Pre-SEDEX											●				
5	Submission of Draft Report												●			
6	Submission of Dissertation (soft bound)													●		
7	Submission of Technical Report													●		
8	Oral Presentation														●	
9	Submission of Project Dissertation (Hard Bound)															●

● Suggested milestone

■ Process

CHAPTER 4
RESULTS AND DISCUSSION

4.1. Results

From this project, the results are shown in the **Table 4.0, 5.0, 6.0 and 7.0**. The results are taken from the observation through THREE GROUPS from Unit Ops Lab I & II (On Tuesday from 2.00 P.M to 5.00 P.M) and also from ONE GROUP from Organic Chemistry (On Thursday from 8.00 A.M to 11.00 P.M) for TWO stages (OBS & OBS-W-INT):

- *Unit Ops Lab Groups consist of three groups which are G4, G5 and G13 and each group consist of FIVE students;*
- *Ochem Lab consist of one group only which is group 3A and consist of 18 students;*
- *OBS refers to the Observation stage;*
- *OBS-W-INT refers to Observation with Interventions;*
- *OBS-WT-INT refers to Observation without Interventions.*

Results of G4

Table 4: Total of student who at-risk behaviours for OBS and OBS-W-INT for G4

Group 4 (T = 5 Students)							
Total student at risk behaviours, N and % of N/T							
No.	BBS Assessment Stages / Types of At Risk Behaviours	OBS		OBS-W-INT		OBS-WT-INT	
		N	%	N	%	N	%
1	Wear NON fully-covered shoes	1	20	0	0	0	0
2	NOT wearing safety gloves	2	40	0	0	0	0
3	NOT wearing safety glassess	5	100	3	60	2	40
4	NOT buttoned lab coats	1	20	0	0	0	0
5	NOT wearing safety helmet	2	40	0	0	0	0
6	NOT tied back long hair	0	0	0	0	0	0
7	Working area not clean & tidy	2	40	0	0	0	0
8	Chemical Handling	1	20	1	20	0	0
9	Horseplay	2	40	1	20	1	20

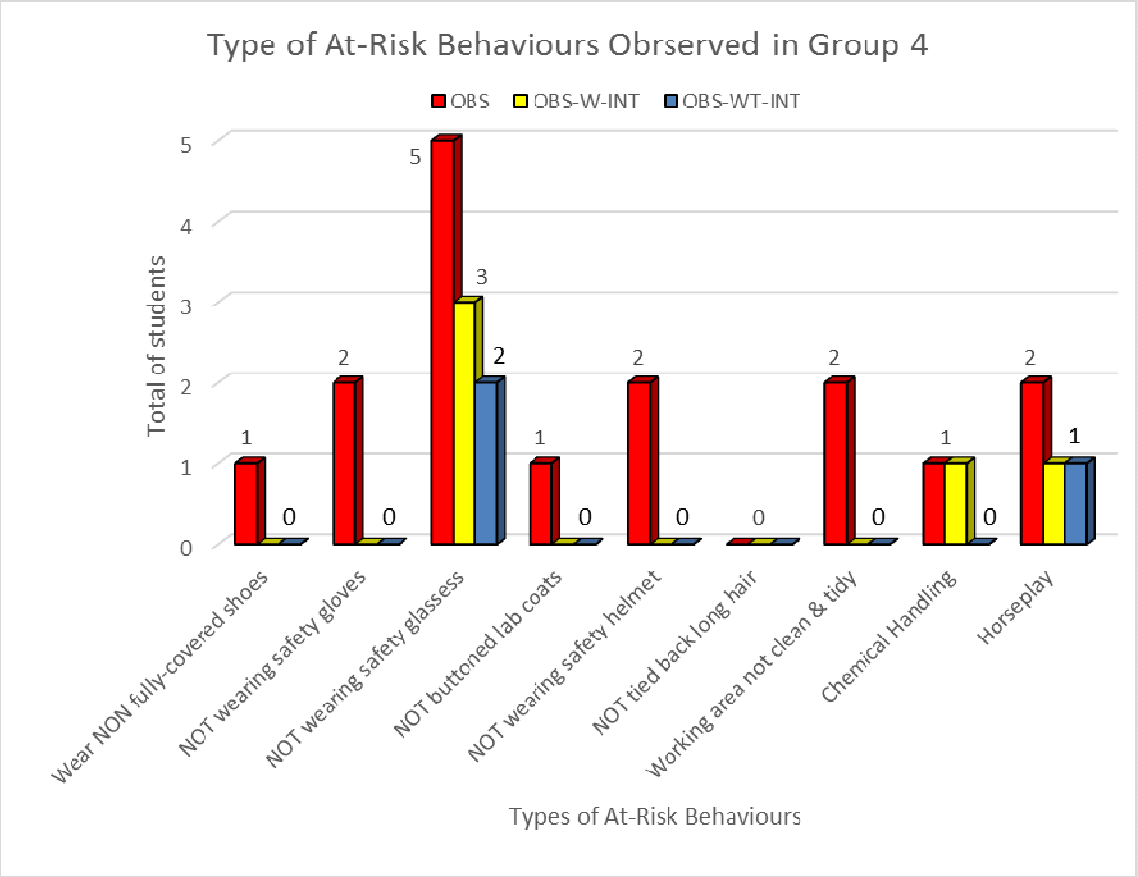


Figure 9: Comparison of type at-risk behaviours observed in G4 by the number of students

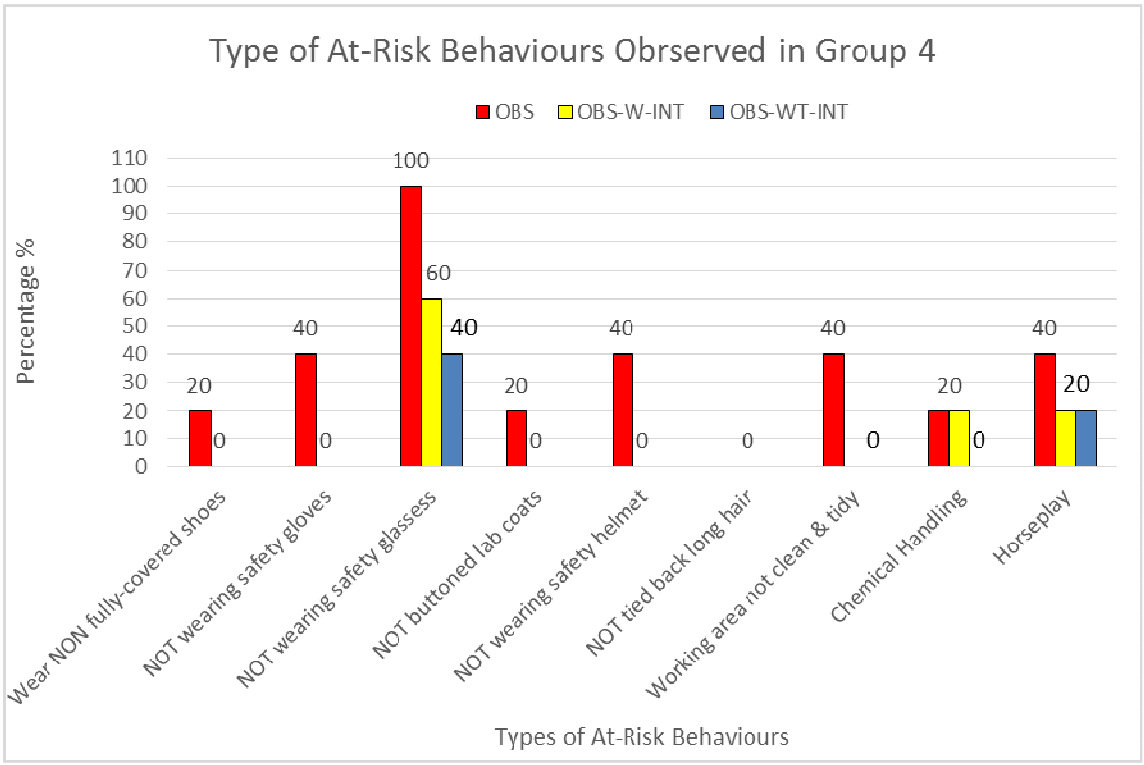


Figure 10: Comparison of type at-risk behaviours observed in G4 by percentage

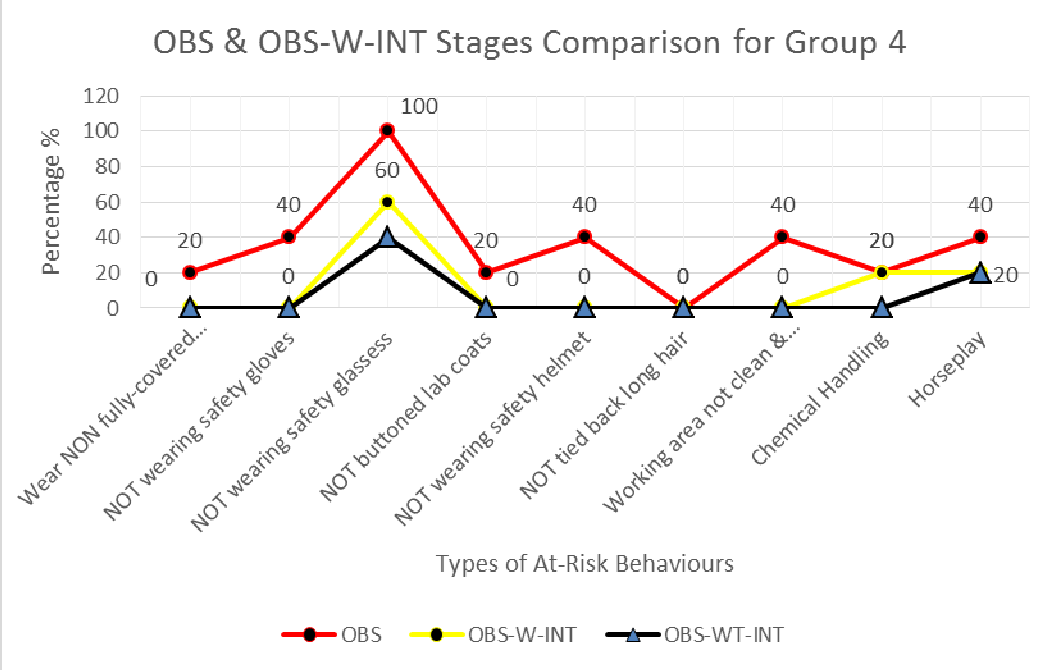


Figure 11: Comparison of type at-risk behaviours observed in G4 by BBS Stages

Results of G5

Table 5: Total of student at-risk behaviours for OBS and OBS-W-INT for G5

Group 5 (T = 5 Students)							
Total student at risk behaviours, N and % of N/T							
No.	BBS Assessment Stages / Types of At Risk Behaviours	OBS		OBS-W-INT		OBS-WT-INT	
		N	%	N	%	N	%
1	Wear NON fully-covered shoes	1	20	0	0	0	0
2	NOT wearing safety gloves	1	20	0	0	1	20
3	NOT wearing safety glassess	5	100	3	60	2	40
4	NOT buttoned lab coats	1	20	1	20	0	0
5	NOT wearing safety helmet	2	40	0	0	0	0
6	NOT tied back long hair	0	0	0	0	1	20
7	Working area not clean & tidy	1	20	0	0	0	0
8	Chemical Handling	2	40	1	20	1	20
9	Horseplay	3	60	2	40	1	20

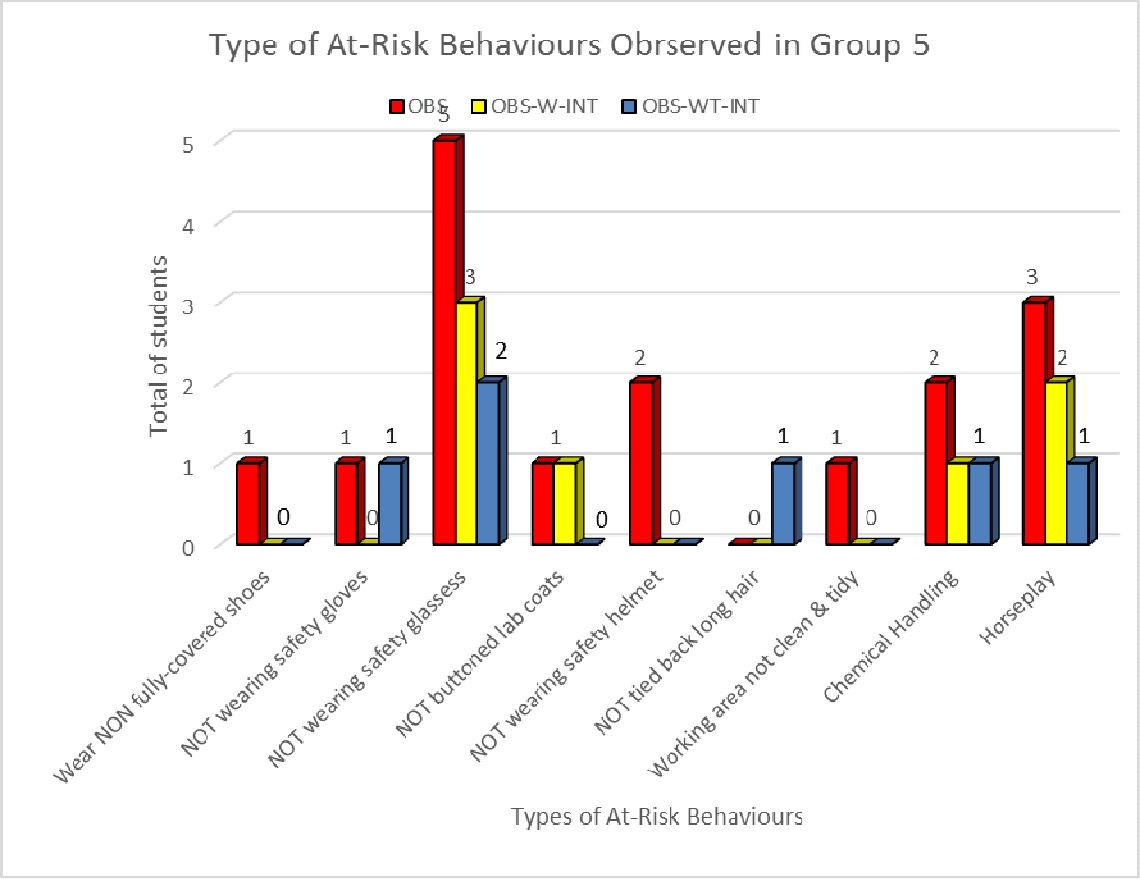


Figure 12: Comparison of type at-risk behaviours observed in G5 by the number of students

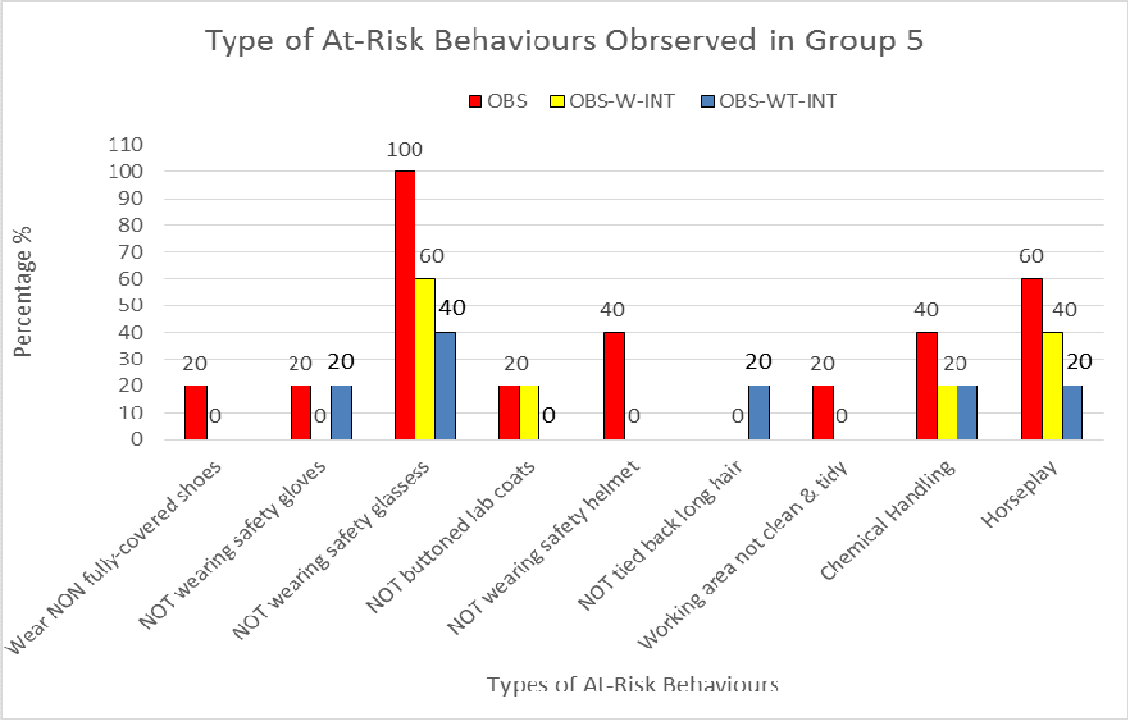


Figure 13: Comparison of type at-risk behaviours observed in G5 by percentage

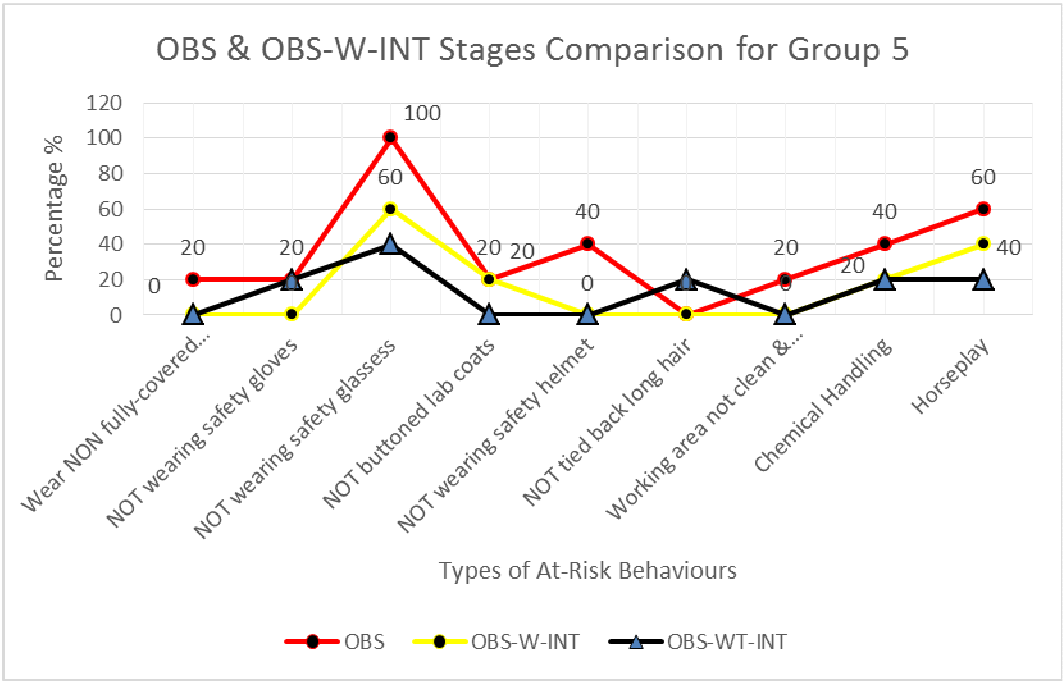


Figure 14: Comparison of type at-risk behaviours observed in G5 by BBS Stages

Results of G13

Table 6: Total of student at-risk behaviours for OBS and OBS-W-INT for G13

Group 13 (T = 5 Students)							
Total student at risk behaviours, N and % of N/T							
No.	BBS Assessment Stages / Types of At Risk Behaviours	OBS		OBS-W-INT		OBS-WT-INT	
		N	%	N	%	N	%
1	Wear NON fully-covered shoes	1	20	0	0	0	0
2	NOT wearing safety gloves	1	20	1	20	0	0
3	NOT wearing safety glassess	4	80	2	40	2	40
4	NOT buttoned lab coats	1	20	0	0	0	0
5	NOT wearing safety helmet	1	20	0	0	0	0
6	NOT tied back long hair	1	20	0	0	0	0
7	Working area not clean & tidy	1	20	0	0	0	0
8	Chemical Handling	1	20	1	20	0	0
9	Horseplay	2	40	1	20	1	20

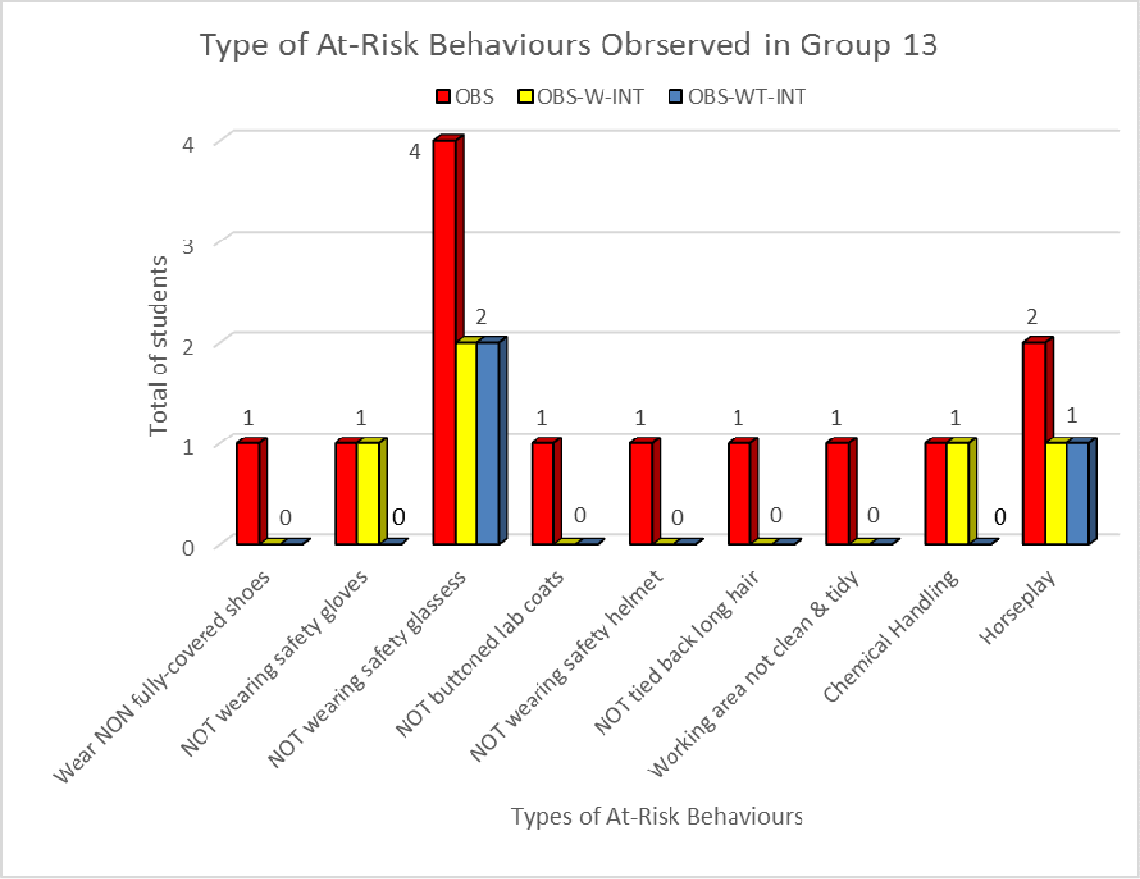


Figure 15: Comparison of type at-risk behaviours observed in G13 by the number of students

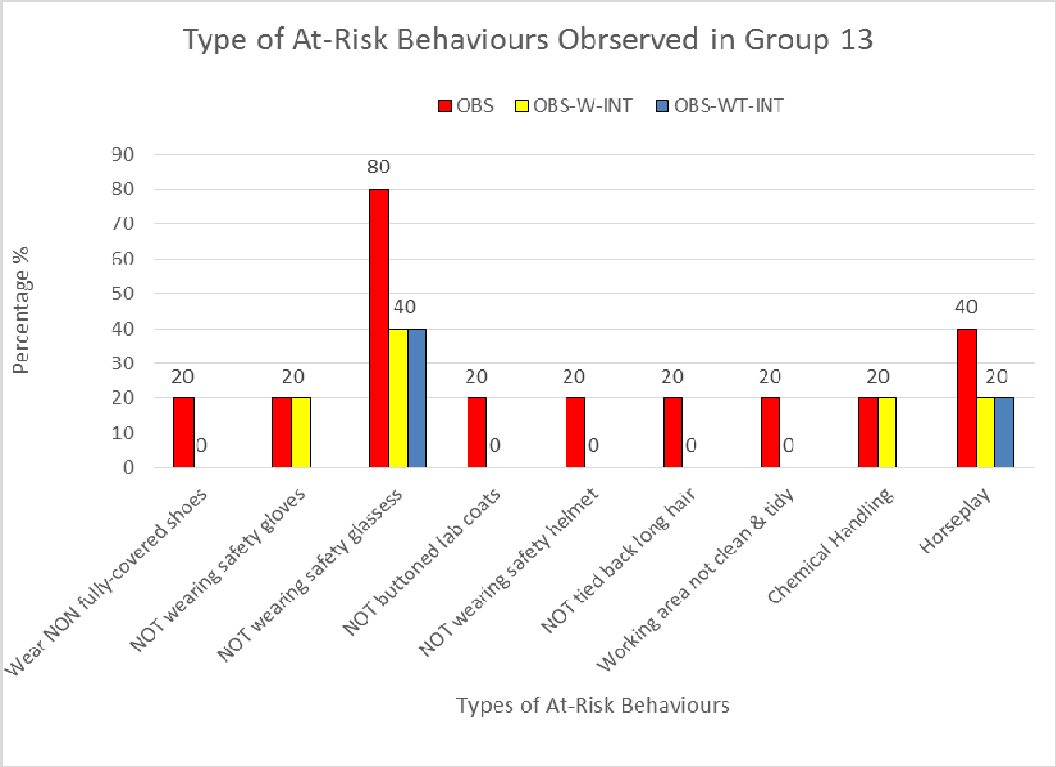


Figure 16: Comparison of type at-risk behaviours observed in G13 by percentage

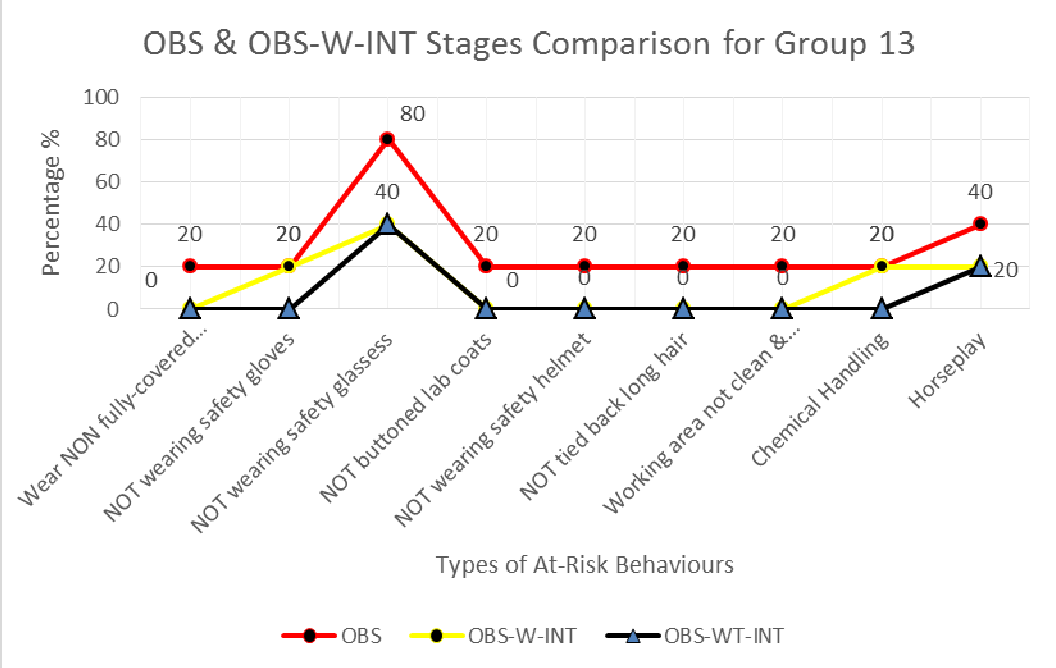


Figure 17: Comparison of type at-risk behaviours observed in G13 by BBS Stages

Results of G3A

Table 7: Total of student at-risk behaviours for OBS and OBS-W-INT for G3A

Group 3A (T = 18 students)							
Total student at risk behaviours, N and % of N/T							
No.	BBS Assessment Stages / Types of At Risk Behaviours	OBS		OBS-W-INT		OBS-WT-INT	
		N	%	N	%	N	%
1	Wear NON fully-covered shoes	2	11.1	1	5.6	0	0.0
2	Not wearing safety gloves	5	27.8	2	11.1	1	5.6
3	NOT wearing safety glassess	8	44.4	3	16.7	2	11.1
4	NOT buttoned lab coats	4	22.2	2	11.1	0	0.0
5	NOT tied back long hair	2	11.1	1	5.6	0	0.0
6	Working area not clean & tidy	4	22.2	2	11.1	2	11.1
7	Chemical Handling	6	33.3	3	16.7	4	22.2
8	Horseplay	6	33.3	4	22.2	3	16.7

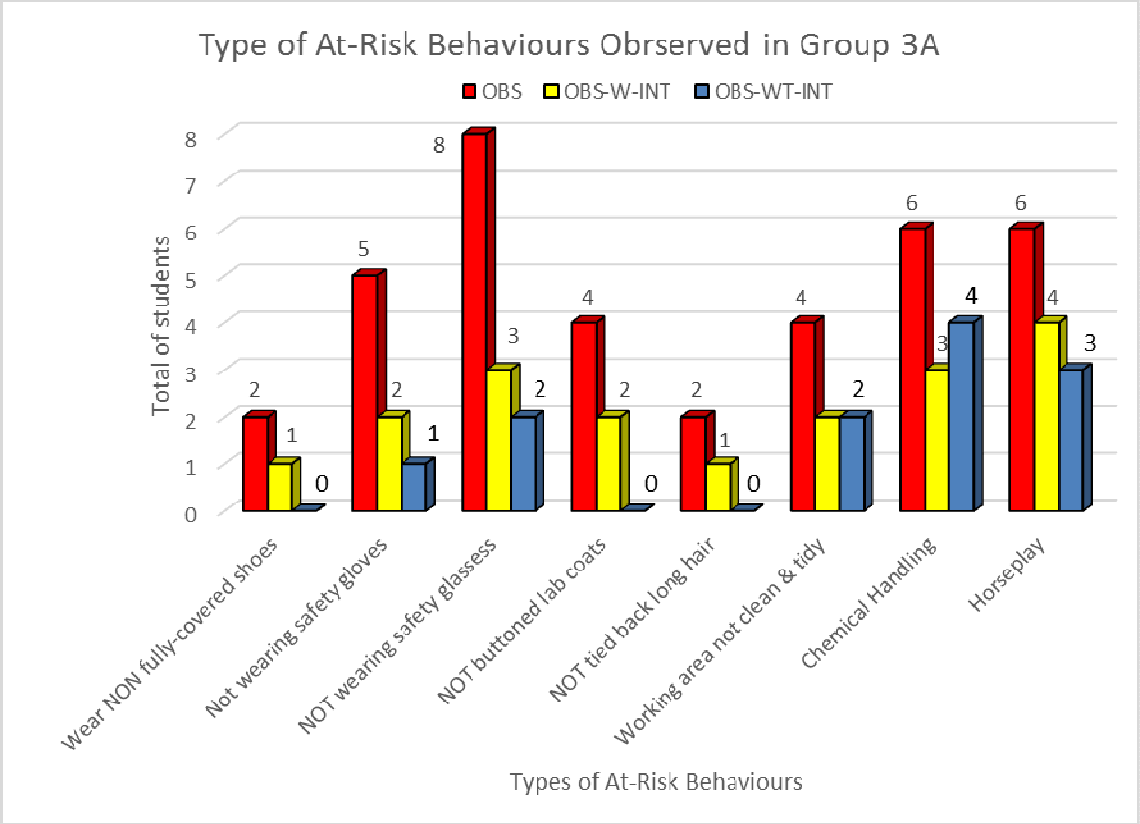


Figure 18: Comparison of type at-risk behaviours observed in G3A by the number of students

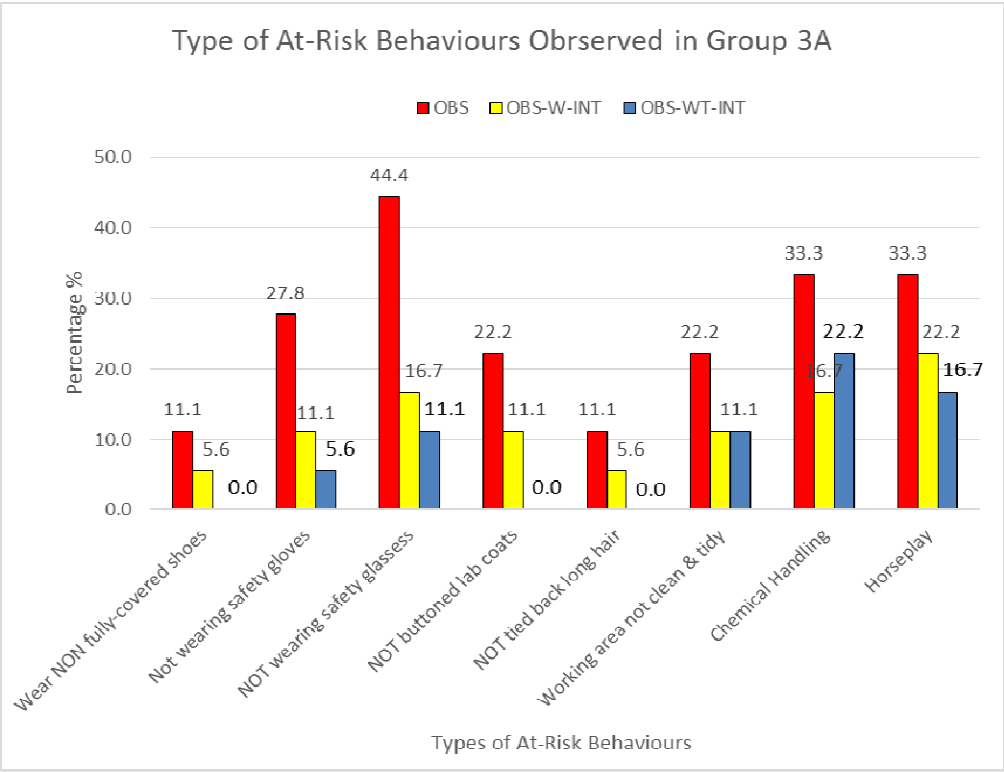


Figure 19: Comparison of type at-risk behaviours observed in G3A by percentage

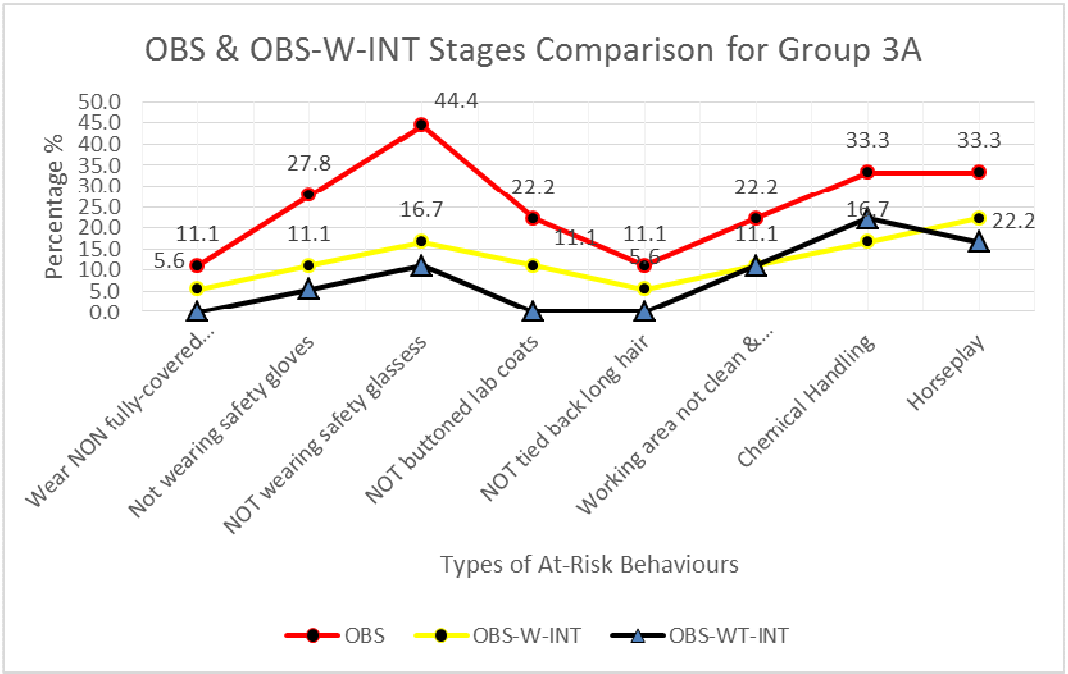


Figure 20: Comparison of type at-risk behaviours observed in G3A by BBS stages

4.2. Discussion

Observation Stage

Through observation in Unit Ops Lab I & II, from G4, the highest unsafe act is 'NOT wearing safety glasses' and the second highest are 'NOT wearing safety gloves', 'NOT wearing safety helmet', 'Working area not clean and tidy' and 'Horseplay'. Others below 40%. In G5, the highest unsafe act is 'NOT wearing safety glasses' and the second highest is 'Horseplay' which is 60% (3 out 5 students). 40% for 'NOT wearing safety helmet' and 'Chemical Handling', whereas others are 20% and below. In G13, the highest unsafe act is the same as G4 and G5 which is 'NOT wearing safety glasses' but less one student (-20%) compare to both. Second highest are 'Horseplay' which is 40% (2 out of 5 students), however, others contributed to 20% with zero safe acts.

Observation also has been made in Organic Chemistry Lab and the chosen group is Group 3A which is consisting of 18 students. The highest unsafe act through observation is 'NOT wearing safety glasses', second highest is 'Chemical Handling' and 'Horseplay' which is about 33.3% (6 out of 18 students) followed by third highest which is 'NOT wearing safety gloves' at 27.8 % (5 out 18 students) and others are 22.2% and 11.1%.

As overall comparison between G4, G5, G13 and G3A, most dangerous common act is not wearing safety glasses, horseplay and chemical handling. Any student which not wearing safety glasses has a tendency to be exposed by the spilling of chemical during chemical handling or disposing and also horseplay also can cause incident during work progress especially during conducting the equipment, chemicals and so on.

Observation with Intervention Stage

These second stage is conducted by providing immediate safety interventions and other interventions such as giving them safety talks, handling safety sheets, immediate responses and explain about the safety to those who are committed errors (type of unsafe acts). By the way, labeling each equipment or put the hazard labels (chemicals, items and tools) or reminders about the hazards on the table or wall might help students to read, aware and understand about the safety in the lab. So, from the result shown, the overall unsafe acts or behaviours decrease after apply some interventions which are more likely to speech, communication and reactions. G4, G5, G13 and G3A show some improvements whereby some of the unsafe acts have been reduced tremendously through constant observation and also from the lab instructor's effort of reminding student to seriously obey the safety rules and regulations.

A few of them is likely not so adore to wearing safety glasses because some of them already wore spectacles and UTP lab safety glasses are not suitable or comfortable for those who has short or long-sightness. So in this case, to force them to wear is not appropriate and then just can assume that they wear spectacles which provide some protection rather than full protection. However, is it recommended to wear safety glasses in order to protect the eyes and the face from any danger during working in the lab. Besides, playing with phone for a very long time is consider as horseplay because this might cause experiment errors due to ignorance and unawareness which then might lead to accidents in the lab caused by damage tools, equipment failure, chemical spills or explode and so on. Hence, overall, some applicable interventions that have been applied are useful and show some enhancement by reducing unsafe acts to less occur then before.

Observation without Intervention Stage

At the end of this project, it is predictable that, in early August until Sept, the unsafe acts will turn to safe acts and be maintained for the next month and remaining months without any interventions. If the unsafe acts and behaviours for the next month or remaining months start to increase again, then second stage should be conducted again. If all the processes stages are not working, then it can be concluded the safety interventions should be conducted continuously for every lab sessions and experiments.

Hence, from G4, G5, G13 and G3A we can see that after giving them some safety interventions, some of their unsafe acts and behaviours start to decrease rapidly because of some reasons which are:

- Students aware of the safety observers at the location where they do the experiments;
- Students remember about safety precautions and safety lab rules and regulation;
- Students do not want technicians or lab instructors get into trouble caused by their mistakes or errors;
- Students really care about safety which in the previous sessions, students might not need to know about their own safety, full of self-ignorance or fail to recall about it.

Trending and Symptoms

Mostly at-risk behaviours can be classified as trending or symptoms. Some of the students believe the acts of unsafe become one of the student's normal behaviours or trending. 'Familiarization' is the best word to describe this kind of trending or symptoms. This BBS method might change the perspective of that word to more positive ways by making the students familiarize and live with this kind of environment. Through observation and researches, other factors that cause these trending or symptoms are the easiness or stress-free in the lab, ignorance or used to behaviours, lack of or

uninterested to know about lab safety rules and regulations due to only learn through subjects of study. However, BBS method used in this project cannot be truly 100% reliable but can reach the greatest achievement if been carried out frequently with more observations and safety interventions. Best way to apply this method is by throughout 'all and in' an organization with full support from the top management. Nevertheless, this project is a successful one due to the occurrence of observers, technicians and instructors whereby the students become more aware of safety in the lab and more apprehension the presence of hazards or dangers. Students are likely to seriously take about the safety behaviours during experiment.

Nonetheless due to the time constraint and only can be conducted about four to five months, hence this project is expected to give the result from June to August only. If this project is insufficient or not enough to be implemented in the school or college, this project should be continued by other members from UTP or other persons from other colleges or schools. This project 'MUST' be carried out frequently for every session of experiments in order to obtain high achievement of success and to prove that this method is 100% reliable.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This project is very suitable to be conducted in the laboratory at the schools, colleges or universities. This project is a preliminary training or basic training to train and educate students to rely more on real understanding and practical rather than only learning through subjects or manuals. Besides, this project will implement the safe acts and behaviours in laboratories and promote students to be more aware of hazards and dangerous situations that can cause accidents or injuries.

By the way, there are side benefits in long term which are very important after student graduated from schools or colleges whereby the students are already know and exposed to the safety behaviours when they trying to work in plants, factories or in the lab of the companies, by the way, their safe behaviours and actions will lead to a lot of improvement in working environment or life-living. At the end, in the future, hopefully the statistic of accidents or injuries are expected to be diminished and this can help the industries to maintain or reduce the work lost time due to absence of labor workers and employees. By the way, it will help to improve in economic as all works are expected to be done in well and smooth without so much loss of workers.

5.2. Recommendations

5.2.1. Personal Protective Equipment

- Wear NON fully-covered shoes
  - ✓ Shoes must be worn all the times in the laboratory. Wear shoes that adequately cover the foot, enclosing the whole top of the foot. Low-heeled shoes with non-slip soles are preferable. No sandals, open-toed shoes, open-backed shoes, or high-heeled shoes in the laboratory.

- NOT wearing safety gloves
  - ✓ When dealing with chemicals, safety gloves such as latex and nitrile gloves must always be worn in order to provide protection for the skin.

- NOT wearing safety glasses
  - ✓ Safety glasses must be worn at all times in the laboratory even if wearing prescription glasses and safety glasses with side shields are preferable.

- NOT buttoned lab coats
  - ✓ Long sleeved, fully buttoned up lab coats must be worn when working in the lab especially when the lab work involves hazardous materials. The lab coats help to prevent contamination of regular clothes from splashes and toxic material.

- NOT wearing safety helmet
  - ✓ Always wearing helmet when working at high places, required to handle with load, machines, large and dangerous equipment in order to protect the head.

5.2.2. Behaviours in the Lab

- NOT tied back long hair
  - ✓ Long hair must be tied back in order to avoid from falling into flames or chemicals.

- Working area not clean & tidy
  - ✓ Keep working area including fume hoods clean and tidy at all times. Eating, smoking and drinking are not allowed in a laboratory. Dispose of all chemical waste properly.

- Chemical Handling
  - ✓ The MSDS for an individual substance should always be consulted before a chemical is used for any reason.

- Horseplay
  - ✓ Never fool around in the laboratory. Horseplay, practical jokes and pranks are dangerous and prohibited in the laboratory.

5.2.3. Lab Instructors, Technicians or Any Person Involved in the Lab

- Always observe and take note when other do the experiments including the person in and out of the lab;
- Lab instructors or technicians always explain about safety in the lab instead of only instruct about the how to do the experiment;
- Lab instructors or technician always be around the lab or keep the eyes often around the lab;
- Others, students also should take care about each other instead of being selfish.

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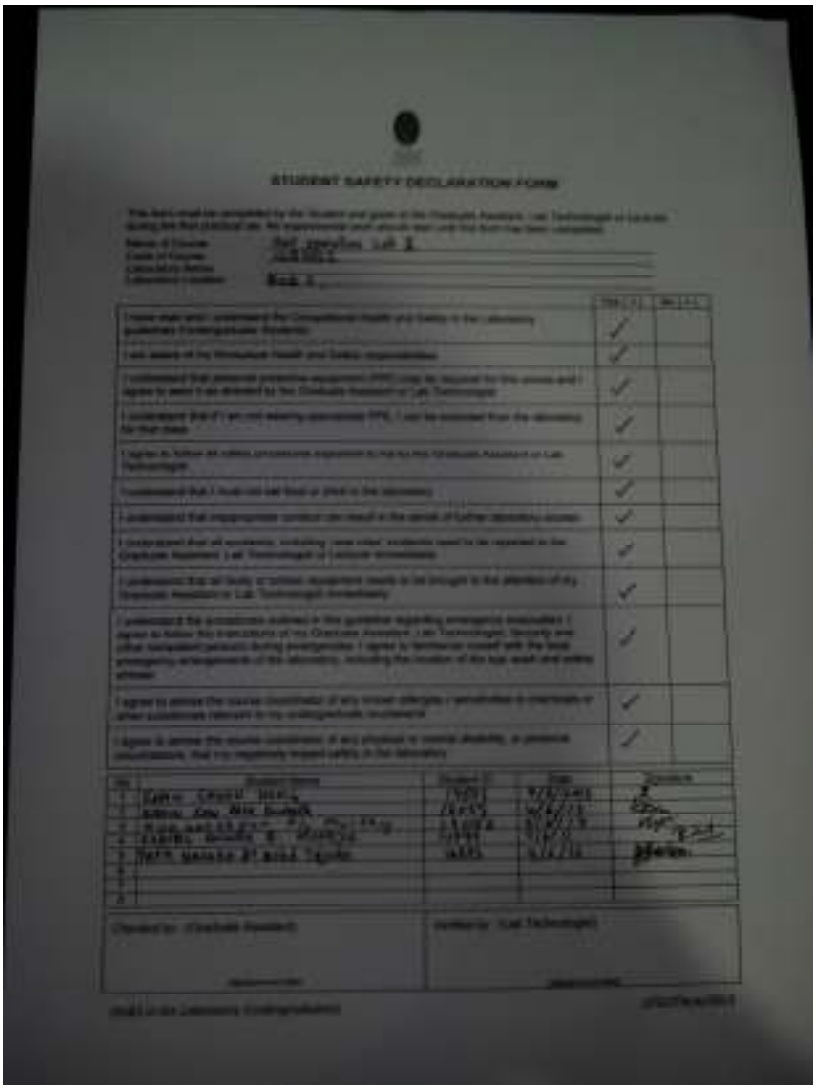
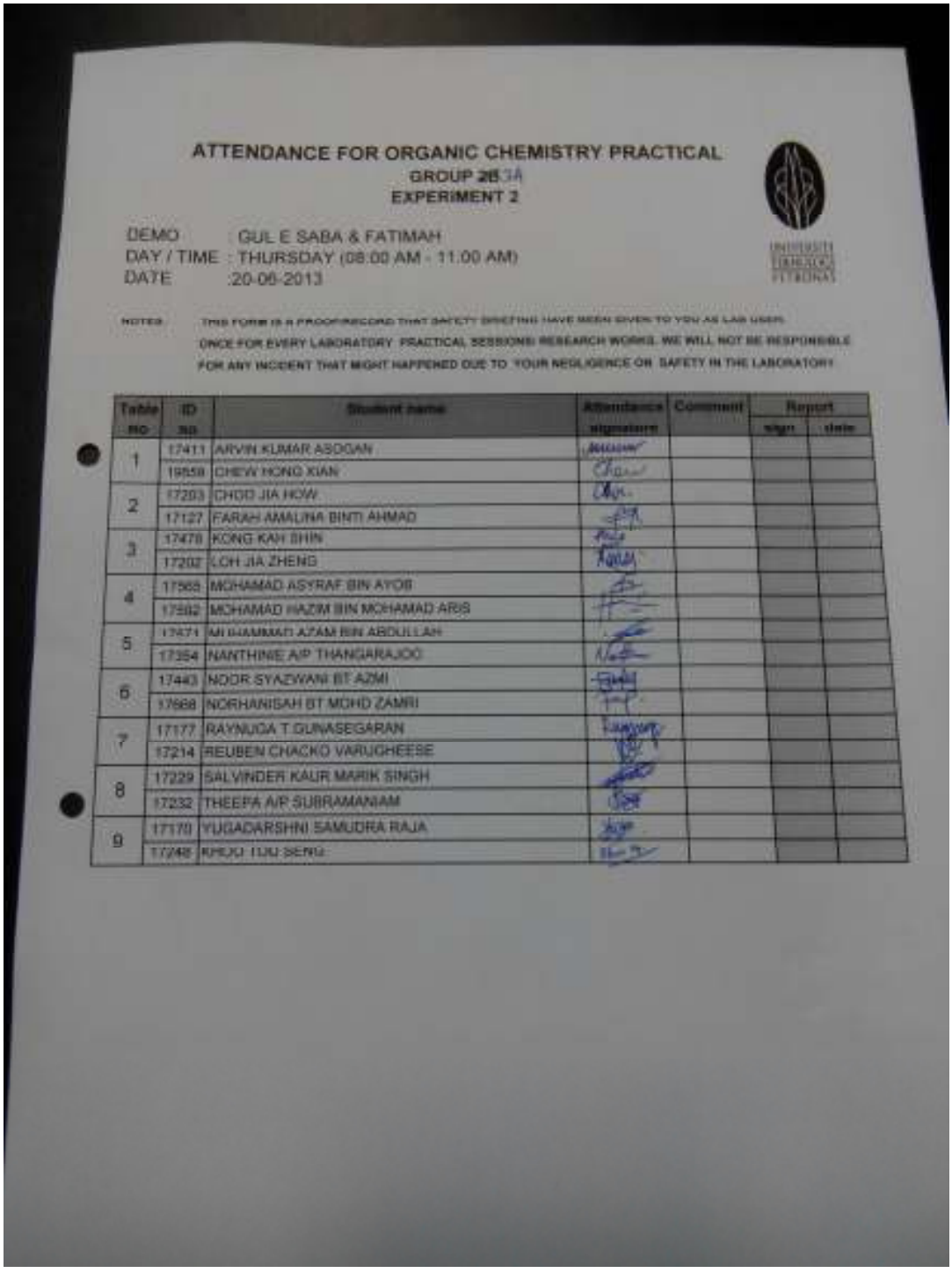
APPENDICES

APPENDIX A - PRELIMINARY



STUDENT SAFETY DECLARATION FORM

Figure A.1: Sample Unit Ops Lab I & II Declaration Form



ATTENDANCE FOR ORGANIC CHEMISTRY PRACTICAL

GROUP 2B 3A

EXPERIMENT 2

DEMO : GUL E SABA & FATIMAH

DAY / TIME : THURSDAY (08.00 AM - 11.00 AM)

DATE :20-06-2013

NOTES: THIS FORM IS A PROOF/RECORD THAT SAFETY BRIEFING HAVE BEEN GIVEN TO YOU AS LAB USER. ONCE FOR EVERY LABORATORY PRACTICAL SESSIONS/ RESEARCH WORKS. WE WILL NOT BE RESPONSIBLE FOR ANY INCIDENT THAT MIGHT HAPPENED DUE TO YOUR NEGLIGENCE OR SAFETY IN THE LABORATORY!

Table no	ID no	Student name	Attendance signature	Comment	Report	
					sign	date
1	17411	ARVIN KUMAR ASOGAN				
	19559	CHEW HONG XIAN				
2	17203	CHOO JIA HOW				
	17127	FARAH AMALINA BINTI AHMAD				
3	17478	KONG KAH SHIN				
	17202	LOH JIA ZHENG				
4	17565	MOHAMAD ASYRAF BIN AYOB				
	17592	MOHAMAD HAZIM BIN MOHAMAD ARIS				
5	17471	MUHAMMAD AZAM BIN ABDULLAH				
	17354	NANTHINIE A/P THANGARAJOO				
6	17443	NOOR SYAZWANI BT AZMI				
	17668	NORHANISAH BT MOHD ZAMRI				
7	17177	RAYNUGA T.GUNASEGARAN				
	17214	REUBEN CHACKO VARUGHEESE				
8	17229	SALVINDER KAUR MARIK SINGH				
	17232	THEEPA A/P SUBRAMANIAM				
9	17170	YUGADARSHNI SAMUDRA RAJA				
	17248	KHOO TZU SENG				

Figure A.2: Sample Ochem Lab Attendance List

APPENDIX B – OBSERVATIONS STAGE

Figure B.1: Sample 1 of student not wearing safety helmet in Unit Ops Lab I & II

Figure B.2: Sample 2 of student not wearing safety helmet in Unit Ops Lab I & II

Figure B.3: Sample of student not tie her long hair Unit Ops Lab I & II

Figure B.4: Sample of student not buttoned up lab coat in Unit Ops Lab I & II

Figure B.5: Critical sample of student whereby the students not wearing safety glasses and also safety helmet in Unit Ops Lab I & II

Figure B.6: Sample of student not wearing safety glasses in Ochem Lab

Figure B.7: Sample of incorrect chemical or tool handling in Ochem Lab. This beaker might falls and be broken.

Figure B.8: Sample of table which is not clean and tidy in Ochem Lab

APPENDIX C – OBSERVATION WITH SAFETY INTERVENTION STAGE

Figure C.1: Sample of Safety Lab Boards that the student should read in Unit Ops Lab I & II

Figure C.2: Sample of PPE that the student should know and use in Unit Ops Lab I & II

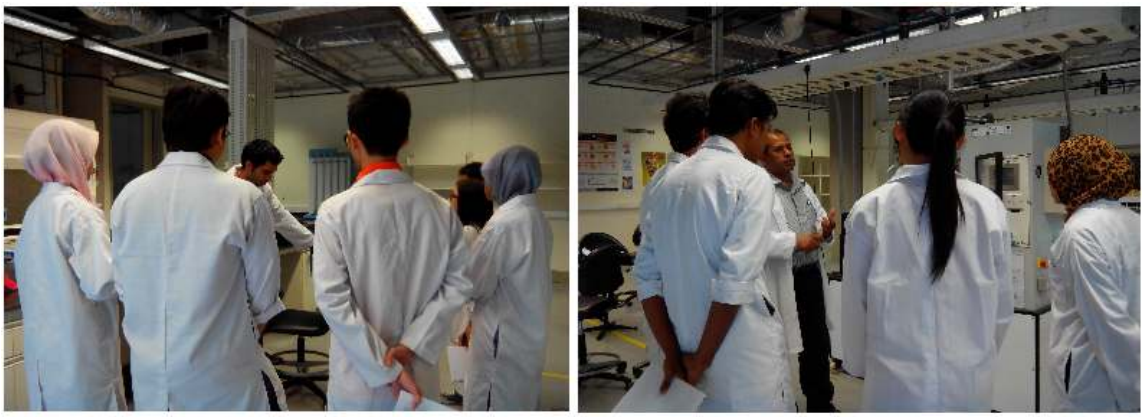
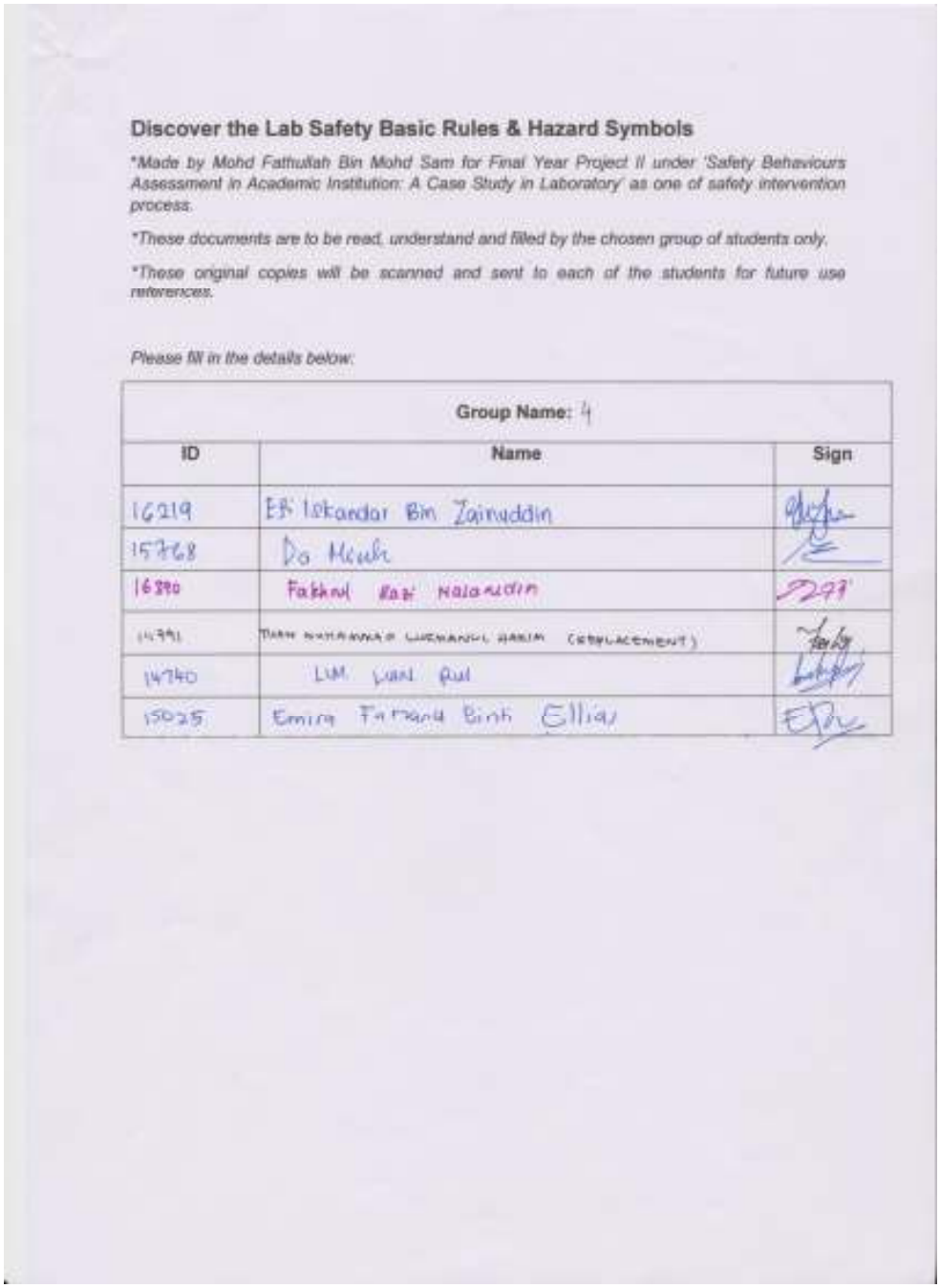


Figure C.3: Sample of safety briefing before doing experiment in Unit Ops Lab I & II

Figure C.4: Sample of safety briefing after doing experiment in Unit Ops Lab I & II



Discover the Lab Safety Basic Rules & Hazard Symbols

**Made by Mohd Fathullah Bin Mohd Sam for Final Year Project II under 'Safety Behaviours Assessment in Academic Institution: A Case Study in Laboratory' as one of safety intervention process.*

**These documents are to be read, understand and filled by the chosen group of students only.*

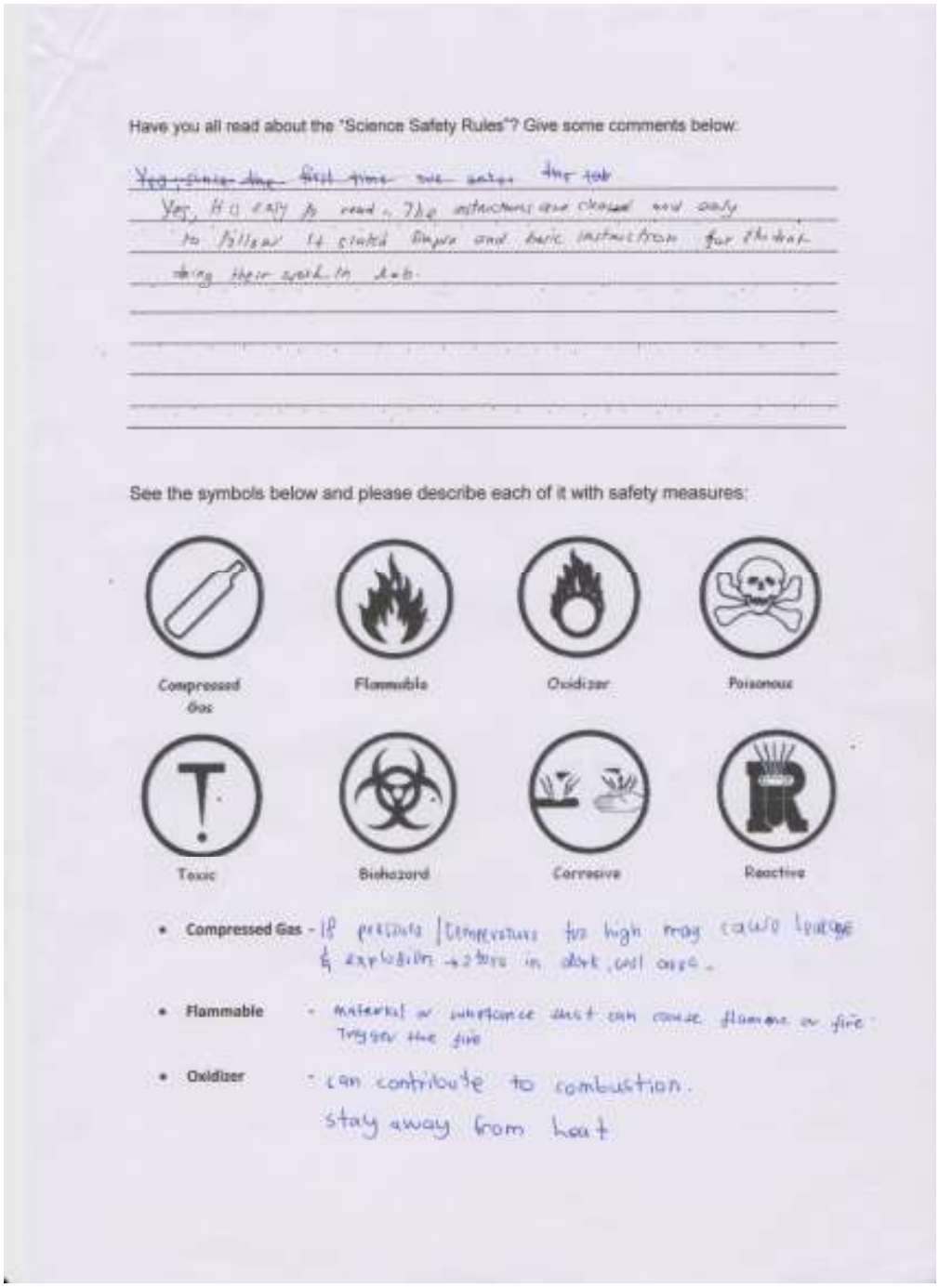
**These original copies will be scanned and sent to each of the students for future use references.*

Please fill in the details below:

Group Name: 4		
ID	**Name**	**Sign**
16219	Ef Iskandar Bin Zainuddin	
15768	Da Hanh	
16890	Fakhrul Razi Halauddin	
14991	[illegible] (REPLACEMENT)	
14740	LIM Wan Rui	
15025	Emira Farhana Binti Elliaz	

Figure C.5: One of the safety interventions to fill up by Group 4

Figure C.6: One of the safety interventions to be read by the students (included with Figure C.5)



Have you all read about the "Science Safety Rules"? Give some comments below:

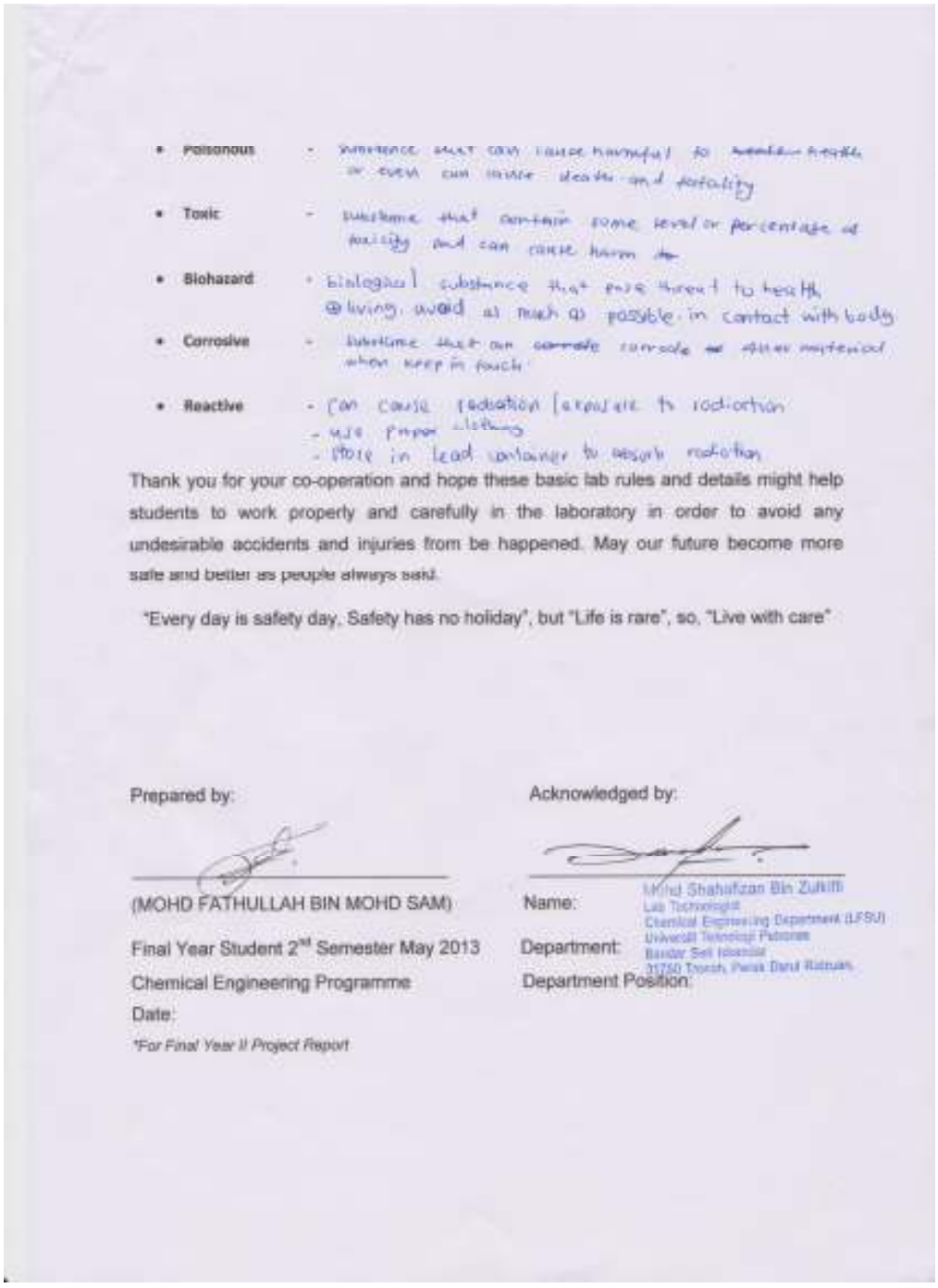
Yes, since the first time we enter the lab

Yes, it is easy to read. The instructions are clear and easy to follow. It stated simple and basic instructions for the students doing their work in lab.

See the symbols below and please describe each of it with safety measures:

- **Compressed Gas** - If pressure | temperature too high may cause leakage & explosion → store in dark, cool area.
- **Flammable** - material or substance that can cause flames or fire. Trigger the fire
- **Oxidizer** - can contribute to combustion. stay away from heat

Figure C.7: One of the safety interventions to fill up by Group 4 (included with Figure C.5)



- **Poisonous** - substance that can cause harmful to human health or even can cause death and fatality
- **Toxic** - substance that contain some level or percentage of toxicity and can cause harm to
- **Biohazard** - biological substance that pose threat to health @ living. avoid as much as possible in contact with body
- **Corrosive** - substance that can corrode corrode or other material when keep in touch
- **Reactive** - can cause radiation [exposure to radiation
  - use proper clothing
  - store in lead container to absorb radiation

Thank you for your co-operation and hope these basic lab rules and details might help students to work properly and carefully in the laboratory in order to avoid any undesirable accidents and injuries from be happened. May our future become more safe and better as people always said.

"Every day is safety day, Safety has no holiday", but "Life is rare", so, "Live with care"

Prepared by:

(MOHD FATHULLAH BIN MOHD SAM)

Final Year Student 2nd Semester May 2013

Chemical Engineering Programme

Date:

*For Final Year II Project Report

Acknowledged by:

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Department:

Department Position:

Figure C.8: One of the safety interventions to fill up by Group 4 and to be approved by authorized person (included with Figure C.5)

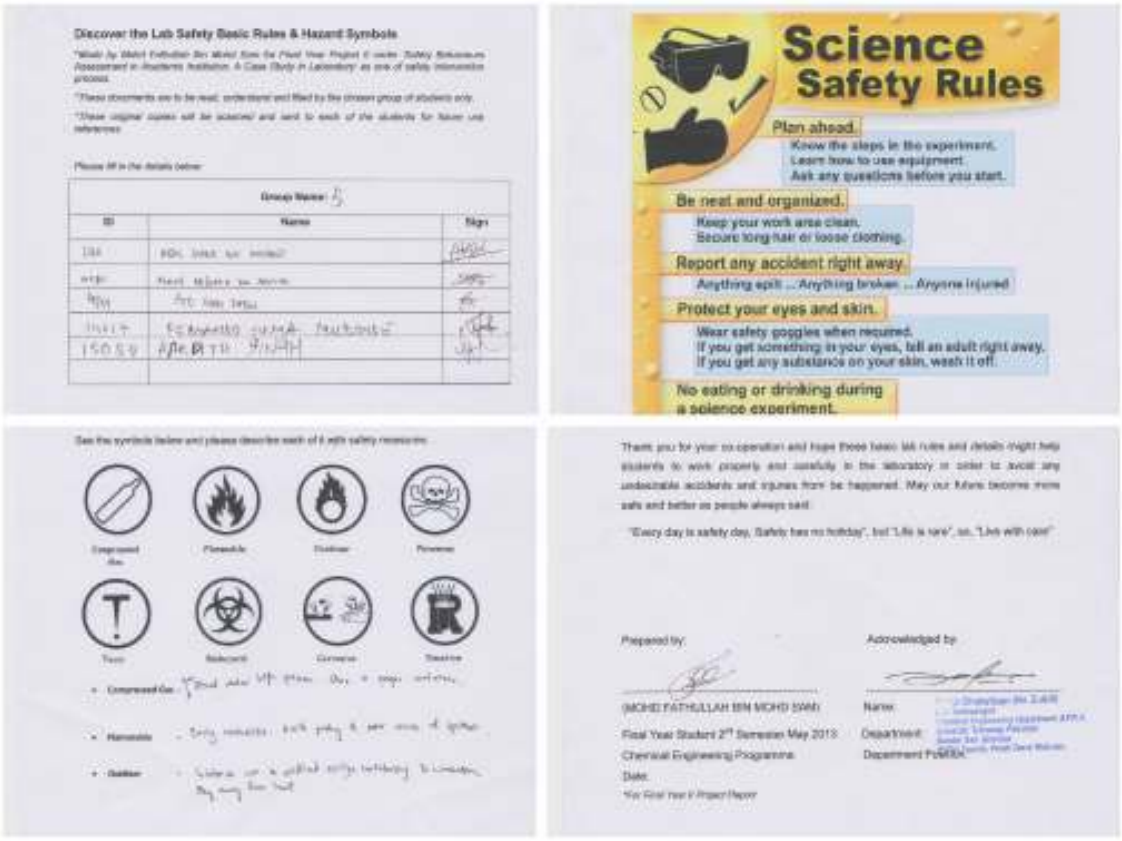

Figure C.9: Discover the Lab Safety Basic Rules & Hazard symbol that needed to fill up by Group 5

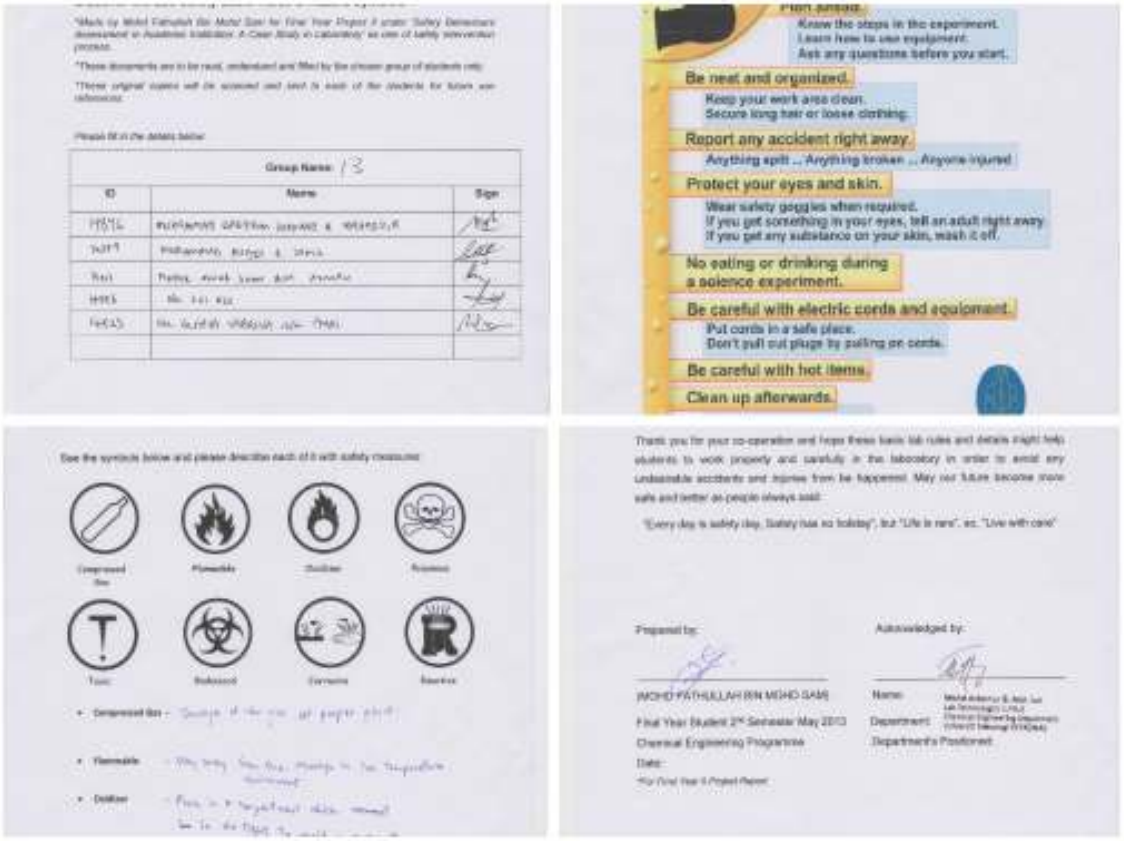

Figure C.10: Discover the Lab Safety Basic Rules & Hazard symbol that needed to fill up by Group 13

APPENDIX D – OBSERVATIONS WITHOUT INTERVENTION STAGE

Figure D.1: Students now try to get familiar by wearing safety glasses in Unit Ops Lab I & II

Figure D.2: Students now try to get familiar by wearing safety glasses in Unit Ops Lab I & II during chemical handling

Figure D.3: Students now try to get familiar by wearing safety glasses in Unit Ops Lab I & II during experiment

Figure D.4: Students now try to get familiar by wearing safety glasses in Unit Ops Lab I & II during conducting the equipment

Figure D.5: Students now try to get familiar by wearing heat safety gloves in Unit Ops Lab I & II eventhough doing nothing

Figure D.6: Students now try to get familiar by wearing safety gloves in Unit Ops Lab I & II during chemical handling