Enhancing students laboratory safety rule awareness: The case of biology students in Dilla College of Teachers Education, Dilla, Ethiopia.

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Abstract

Laboratory safety involves the prevention of and response to laboratory emergencies. Good prevention is far better than someone getting hurt. Hazard codes, chemical labels, and material safety data sheets are the first sources of information that help us prepare to work safely in the laboratory. The laboratory can be but not necessarily a dangerous place. When intelligent precautions and a proper understanding of techniques are employed, the laboratory is no more dangerous than any other classroom. The chemistry laboratory can be a place of discovery and learning. However, by the very nature of laboratory work, it can be a place of danger if proper common-sense precautions aren't taken. Before the action plan, this study shows that some students have a misunderstanding about laboratory safety rules. After the action plan implementation and evaluation from the feedback of the students I can speak that the problem is almost resolved. The students' laboratory safety rule awareness is better than the previous. That is they know about laboratory safety rule and its importance. The students also perform the laboratory safety rule what they know and learned in the laboratory properly. Therefore, the result of this research shows that the students' laboratory safety rule awareness is improved and changed.

Keywords: Laboratory safety rule, Laboratory emergencies, Misunderstanding, Action plan, Feedback, Implementation.

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Introduction

Laboratory safety

Laboratory safety involves the development of skills and responsibility and must be an integral part of every chemistry curriculum. This means that safety awareness must be integrated into each laboratory course including research with increasingly broader scope at more advanced levels. The creation of a culture of laboratory safety requires a broad commitment from all levels of the educational institution. At the department level, faculty need to assume responsibility for continuing review of safety issues with students in teaching and research laboratories, especially the persons responsible for undergraduate instruction, often graduate students or instructors. Faculty must lead by example in a coordinated departmental safety effort. At the administrative level, this will involve implementation of a chemical hygiene plan that is in agreement with any campus chemical hygiene/safety efforts and must address the safe handling, storage, and disposal of chemicals. Eye wash and showers must be in operating condition, and fume hoods with proper sashes are essential. Anyone working or visiting in the lab must be wearing goggles, and consumption of food or drinks must not be permitted. A clean, uncluttered laboratory is more likely to encourage careful work. Development of safety skills may be divided into four emphasis areas [1].

Recognize hazards: A hazard is a potential source of danger or harm and can result from working with chemicals, equipment, and instrumentation. Introduction to this topic can start with an understanding of the terms describing chemical hazards, such as "toxic", "flammable", or "corrosive", and how to obtain information from chemical labels, Safety Data Sheets (SDS), and other reference sources.

Chemical hazards encountered in early undergraduate laboratories should be explained in more detail– for example, acids, bases, flammables, and toxic compounds. At more advanced levels, more details of chemical and physical hazards should be explained so that students are able to identify hazards themselves in experiments– for example, types of toxic compounds, compressed gases, cryogenics, pressurized systems, peroxides, reactives, unstable compounds, pyrophorics, explosives, and water-reactives. Other topics might include toxicology, nanomaterials, biohazards, and radiological hazards, which become relevant when the chemistry curriculum becomes broader in scope [2].

Assess risks: Once a hazard(s) is recognized, laboratory safety necessarily requires an assessment or evaluation of risk from potential exposure to the hazard. Identifying potential routes of exposure is followed by judging the relative risk posed by the hazards of the experiment.

Minimize risks: Based on a risk assessment, experiments should be designed to minimize potential risks. These steps may involve carrying out experiments in a fume hood with a protective shield and wearing protective gloves and goggles. The handling and storage of wastes is a critical component. It is often useful to consider case histories of incidents that have resulted in injury or damage.

Prepare for emergencies: Since it is essential to react promptly and deliberately to emergencies, students should learn what to do in various emergencies and be prepared to act accordingly– for example, fires, injuries, and spills. Safety devices such as showers, eye washes, fire extinguishers, and spill kits, must be clearly labeled and their use and location known to all those working in a laboratory. Emergency phone numbers, alarms, and escape routes should be clear to everyone.

The Culture of laboratory safety

Faculty and staff must be leaders in safety: Teaching safety to students, continuously promoting safety, demonstrating the importance of safety through their actions, and accepting responsibility for safety. At some institutions the graduate students teach the undergraduate labs, in which case the graduate students TAs must be champions of safety ethics. The Safety Ethic is, above all, a value, stated as: I value safety, work safely, prevent any risk-behavior, promote safety, and accept responsibility for safety [3,4]. It emphasizes personal responsibility of each person involved. In order for this culture to thrive, everyone must be promoting it. It is, of course, necessary to be familiar with Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), Department of Transportation (DOT), and Department of Energy (DOE) regulations, but responsibility goes beyond simply complying with federal, state and local regulations–it is about caring for the safety of fellow students, faculty, and staff. There are several chemical and laboratory safety resources that can be very useful in building a strong culture of safety [5-8].

Curricular approaches

Laboratory safety education and training is an ongoing process and therefore must be integrated into every laboratory course. In research laboratories, the responsibility for necessary instruction will lie with the research director. Because of time and resource constraints, presentation and discussion may be limited in lab lectures prior to the start of a laboratory or pre-lab assignments.

Objectives of the study

General objective: To enhance second year Biology students laboratory safety rule awareness.

Specific objectives:

- To teach the students laboratory safety rule awareness.
- To change the students awareness about laboratory safety rule.
- To guide the students to perform the safety rules in the laboratory.

Significance of the study

This study will have the following major significances:

- It can maximize the students' awareness about laboratory safety rule.
- It protects the students from laboratory emergencies.
- It also prevents the property of the laboratory from damage.

Action Research Methodology

Study approach

This study used both quantitative and qualitative or mixed approach. Quantitative approach deals with describing data using percentiles and frequency tables, to increase the objectivity and accuracy of the study. Whereas the qualitative study relies on the skill and abilities of the researcher to describe something about the topic in order to increase the validity of the study.

Sampling Techniques and sample size

In Dilla College of Teacher Education there are 52 second year Biology students. From these students, 8 are females and 44 are males. This study was used simple random sampling techniques. As a result, only 26 students were selected as a sample, and from the selected samples 4 (15.4%) were females and 22 (84.6%) were males.

Data collection instruments

The study's primary data was collected from selected students from Dilla College of Teacher Education institution by distributing questionnaires and personal interview. The questionnaires that consist closed and open ended items. The questionnaires are prepared in English language.

Method of data analysis and presentation

The collected data was organized and tabulated. The result was converted and analyzed in to percentage and frequency. The information found from open ended questionnaires and interviews was analyzed by using narrations.

Reconnaissance

This chapter deals with the data presentation, discussion, interpretation and conclusions which were gathered through open and closed ended questionnaire and the information which were collected through interview from selected respondents (Table 1).

Table 1. *Sex of the respondents.*

Sex	Frequency	Percentage
Male	22	84.6
Female	4	15.4
Total	26	100

According to the above Table 1 result 22 (84.6%) were males and the remaining 4 (15.4%) were females. Therefore, majority

of the respondents were males and very few respondents are females (Source: survey 2017).

Table 2. *Distribution of respondents based on understanding of lab safety rule.*

Lab safety rule	Frequency	Percentage
Poor	1	4
Medium	11	42
Good	14	54
Total	26	100

The result of the above Table 2 shows that 1 (4%) of the respondents were poor in laboratory safety rule understanding, 11 (42%) were medium in laboratory safety rule understanding and 14 (54%) were good in laboratory safety rule understanding.

Therefore, the above table results shows that majority of the respondents' have good laboratory safety rule understanding and some students have poor and medium laboratory safety rule understanding (Source: survey 2017).

Table 3. *Distribution of respondents based on lab safety rule importance.*

Is important knowing lab safety rule?	No of respondents	Percentage
Yes	26	100
No	-	
Total	26	100

According to the finding of the study (Table 3) result shows all of the respondents know the importance of laboratory safety rule. This indicates that the students have an idea about the importance of laboratory safety rule (Source: survey 2017).

Table 4. *Distribution of respondents based on awareness in the lab regarding safety rules.*

Lab safety rule	Frequency	Percentage
Poor	1	4
Medium	6	23
Good	19	73
Total	26	100

The result of the above Table 4 shows that 1 (4%) of the respondents were poor in laboratory safety rule awareness, 6 (23%) were medium in laboratory safety rule awareness and 19 (73%) were good in laboratory safety rule understanding.

Therefore, the above table results shows that majority of the respondents' have good laboratory safety rule awareness and some students have poor and medium laboratory safety rule understanding (Source: survey 2017).

Table 5. *Distribution of respondents based on where lab safety rules performed.*

Lab safety rule	Frequency	Percentage
Home	-	-
Class Room	2	8
Laboratory	24	92
Total	26	100

According to the above Table 5, 2 (8%) respondents taught lab safety rule performed in the class room and 24 (92%) were think lab safety rule performed in the lab.

Generally, the majority of the respondents know where the lab safety rules are performed. But some students did not know where the lab safety rules were performed. That is they think the lab safety rules performed in the class room. So this is wrong assumption (Source: survey 2017).

Table 6. *Distribution of respondents based on type of shoes wear in the lab.*

Type of shoes	Frequency	Percentage
Open	14	54
Closed	12	46
Total	26	100

The result of the above Table 6 shows that 14 (54%) of the students were wear open shoes in the laboratory and the rest 12 (46%) of the students wear closed shoes in the laboratory.

Therefore, the above table results shows that majority of the students wear open shoes in the laboratory and some students wear closed shoes in the laboratory. Thus the majority of the student's shoes are wrong. That is the types of shoes which must be worn in the lab are closed shoes. This is because closed shoes protect us from spilled chemicals, broken glasses and sharp materials (Source: survey 2017).

Table 7. *Distribution of respondents based on play during the conduct of experiment.*

Would you play?	Frequency	Percentage
Never	19	73
Sometimes	6	23
Always	1	4
Total	26	100

The result of the above Table 7 shows that 19 (73%) of the students were never play, 6(23%) of the students were sometimes play and 1 (4%) of the students were always play in the laboratory during the conduct of experiment. Generally, the

majority of the respondents know playing in the laboratory is unnecessary. But some students play sometimes and a few students play always in the lab when they are doing an experiment. So this is wrong! Because playing in the lab during the conduct of experiment may result accidents to happen in lab and also to the students.

From the feedback of the students there are problems on the understanding of laboratory safety rule. There are some students who have poor and medium understanding about laboratory safety rule. Also there are some students who have poor and medium awareness in the laboratory safety rule. Some students did not know where the laboratory safety rule is performed. That is some of them think laboratory safety rule is performed at home. This is wrong assumption because as the name indicates that laboratory safety rule must be performed in the laboratory.

Majority of the students assumed that the type of shoes wear in the laboratory were open shoes. This is wrong assumption; because in the laboratory it is a must to wear closed shoes. Wearing closed shoes is important to minimize accidents in the laboratory.

Finally, there are some students who played in the laboratory some times and a few students who played always with their friends during the conduct of experiment. Playing in the laboratory during the conduct of experiment is totally forbidden. Because it causes accident and which can occurs in the laboratory.

Designing Action Strategies, Action Implementation and Action Evaluation

Action planning

To minimize or prevent the problem I would teach the students in the laboratory about laboratory safety rule. Knowing laboratory safety rule is important to minimize or prevent accidents that occur in the laboratory. Thus I taught the students about laboratory safety rules like:

- Closed shoes should be worn in the laboratory.
- Eating, drinking and smoking in the laboratory are forbidden.
- Playing in the laboratory during the conduct of experiment is totally forbidden.
- Follow up the procedures on the manuals when performing an experiment in the laboratory.
- Do not perform unauthorized experiments in the laboratory.
- Always add acid to water (not the reverse!) etc.

Action Implementation

I allowed the students to perform what they have learned about laboratory safety rule in the laboratory during their laboratory class. To check their understanding I distributed questionnaire and interview for them.

Evaluation/Observation of the intervention

Table 8. *Distribution of respondents based on understanding of lab safety rule.*

Lab safety rule	Frequency	Percentage
Poor	-	-
Medium	-	-
Good	26	100
Total	26	100

The result of the above Table 8 shows that 26 (100%) of the respondents were good in laboratory safety rule understanding.

Therefore, the above table results show that all of the respondents' have good laboratory safety rule understanding (Source: survey 2017).

Table 9. *Distribution of respondents based on lab safety rule importance.*

Is important knowing lab safety rule?	No of respondents	Percentage
Yes	26	100
No	-	
Total	26	100

According to the finding of the study Table 9 result shows all of the respondents know the importance of laboratory safety rule. This indicates that the students have an idea about the importance of laboratory safety rule (Source: survey 2017).

Table 10. *Distribution of respondents based on awareness in the lab regarding safety rules.*

Lab safety rule	Frequency	Percentage
Poor	-	-
Medium	2	8
Good	24	92
Total	26	100

The result of the above Table 10 shows that 2 (8%) of the respondents were medium in laboratory safety rule awareness and 24 (92%) were good in laboratory safety rule understanding.

Therefore, the above table results shows that majority of the respondents' have good laboratory safety rule awareness and a few students have medium laboratory safety rule understanding (Source: survey 2017).

Table 11. *Distribution of respondents based on where lab safety rules performed.*

Lab safety rule performed in	Frequency	Percentage
Home	-	-
Class Room	-	-
Laboratory	26	100
Total	26	100

According to the above Table 11, 26 (100%) respondents taught lab safety rule performed in the laboratory. So, the majority of the respondents know where the lab safety rules are performed (Source: survey 2017).

Table 12. *Distribution of respondents based on type of shoes wear in the lab.*

Type of shoes	Frequency	Percentage
Open	-	-
Closed	26	100
Total	26	100

The result of the above Table 12 shows that 26 (100%) of the students were wear closed shoes in the laboratory.

Therefore, the above table results show that all of the students wear closed shoes in the laboratory. This is because closed shoes protect us from spilled chemicals, broken glasses and sharp materials (Source: survey 2017).

Table 13. *Distribution of respondents based on play during the conduct of experiment.*

Would you play?	Frequency	Percentage
Never	24	92
Sometimes	2	8
Always	-	-
Total	26	100

The result of the above Table 13 shows that 24 (92%) of the students were never play, 2 (8%) of the students were sometimes play in the laboratory during the conduct of experiment.

Generally, the majority of the respondents know playing in the laboratory is unnecessary. But some students play sometimes in the lab when they are conducting experiment. So this is wrong! Because playing in the lab during the conduct of experiment may cause accidents to happen in lab and also to the students (Source: survey 2017).

Reflection/ Conclusion

After the action plan implementation and evaluation from the feedback of the students I can speak that the problem is almost resolved. The students' laboratory safety rule awareness is better than the previous. That is they know about laboratory safety rule and its importance. The students also perform the laboratory safety rule what they know and learned in the laboratory properly. Therefore, the result of this research shows that the students' laboratory safety rule awareness is improved and hanged.

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