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TRAINING SCIENCE STUDENTS FOR LABORATORY SAFETY

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Abstract

Experiments play an important role in the progress of science as a large number of inventions and path breaking discoveries have been possible through investigations that are usually carried out in laboratories. If precautions are not taken however, a worthwhile undertaking such as this could constitute hazard. This paper argues for the need to train science students on safety measures to guard against potential hazards while working in the science laboratory. Using documentary sources, the paper highlights certain hazards, and explores measures to guard against them. Recommendations are also made to save students from the likely consequences of laboratory accidents.

Key words: Laboratory, Safety, Science Students, Training

Introduction

When God enjoined man to go into the world and subdue the earth, there is no doubt, He was providing for man, limitless possibilities to tackle the problems and challenges of his environment. This, perhaps, is the origin of science. Science is a process of discovering and exploring the natural world. From the Palaeolithic age to the present, man has been able to transform his physical environment through scientific discoveries and inventions. Experiments play an important role in the progress of science as a large number of inventions and path

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breaking discoveries have been possible through investigations that are usually carried out in laboratories (Shrivastatva, 2017). A science laboratory is a place where basic experimental skills are learnt by performing a set of prescribed experiments.

The laboratory environment could be risky if proper safety measures are not put in place. Science students may encounter daily hazards which include: physical, biological, and chemical (Nixon, Lanz, Manapragada, Bruk-Lee, Schantz & Rodriguez, 2015). Physical hazards range from environmental conditions that may result to falls, cuts or electrical shocks. Biological hazards on the other hand, range from exposure to blood-borne pathogens such as bacteria, hepatitis, and tuberculosis among others as a result of interactions with specimen (Perry, Parker & Jagger, 2003). Chemical hazards include contact with hazardous agents ranging from carcinogens, corrosives and toxic (Ford & Wiggins, 2012). Thus, teaching science students some safety measures to overcome these hazards is not only healthy, but sustainable as well. Mashia, Subramaniama, and Joharia (2016) stated that safety training involves the acquisition of knowledge and skills and attitude that improve safe behaviour in a potentially hazardous environment. According to Shrivastatva (2017), safety is a learned behaviour that must be incorporated into the instructional plans.

The paper attempts an advocacy for laboratory safety training for our future scientist. In this attempt, the paper has been organized under the following sub-headings: Justification for safety training, Laboratory safety rules for science students, recommendations and conclusion.

Justification for Safety Training

Training refers to instruction and practice for acquiring skills and knowledge of rules, concepts, or attitudes necessary to function effectively in specified task situations (Cohen, Colligan, Sinclair, Newman & Schuler, 1998). Safety training is defined as instruction in hazard recognition and control measures, learning safe work practices and proper use of personal protective equipment, and acquiring knowledge of emergency procedures and preventive actions (Cohen, 1998 in Mashia, Subramaniama & Joharia, 2016). Safety training is an important risk prevention and control strategies to guarantee every student is safe in a good

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laboratory conditions (Mashia *et al*, 2016). Safety training has been recognized as an important organizational characteristic distinguishing organization with successful safety programme, and is an effective means for students to enhance their skills and knowledge of safety in the laboratory (Shea *et al*., 2016).

The rationale behind safety training include as follows:

- Students interact with hazardous chemicals that may have adverse effect on them if precautionary measures are not put in place;
- The human resource should not be sacrificed in the process of investigations and discoveries;
- It has been found that science students exhibit poor attitude to safety in science (Ezeugbor, 1990).

Based on these and some others, it becomes imperative to train students on best safety practices especially while working in the laboratory.

Laboratory Safety Rules for Science Students

The National Science Teachers Association (not dated) provided some rules and regulations for safe laboratory practices. These are standards for students' conduct in the laboratory and in the field. These rules are organized under four categories: standards for students' conduct, personal safety, safety involving chemicals and laboratory equipment.

Standards for students' conduct

Students are enjoined to conduct themselves in a responsible manner at all times in the laboratory. Frivolous activities, mischievous behaviour, throwing items, and conducting pranks are prohibited (Aluko, Adebayo, Adebisi, Ewegbemi, Abidoye, & Popoola, 2016). Laboratory and safety information and procedures must be read to students ahead of time. All verbal and written instructions shall be followed in carrying out the activity or investigation.

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Students are to avoid eating, drinking, gum chewing, applying cosmetics, manipulating contact lenses, and other unsafe activities in the laboratory. It is in that vein that working in the laboratory without the instructor present is prohibited (Aluko, *et al*, 2016). Likewise, unauthorized activities or investigations are prohibited. Unsupervised work also is not permitted. Entering preparation or chemical storage areas is prohibited at all times. Removing chemicals or equipment from the laboratory is prohibited unless authorized by the instructor.

Personal safety

Certain precautionary measures for personal safety should be taken by students for personal safety. Chemical splash goggles or safety glasses, as appropriate or directed by your instructor, shall be worn at all times in the laboratory or field, including pre-laboratory work and clean-up, unless the instructor specifically states that the activity does not require the use of chemical splash goggles or safety glasses (Mashi, 2014). Goggles are to be worn during the activity or investigation, clean up, and through hand washing. When an activity or investigation requires the use of laboratory gloves for hand protection, the gloves shall be appropriate for the hazard and worn throughout the activity.

When an activity requires the use of laboratory aprons, the apron shall be appropriate to the size of the student and the hazard associated with the activity or investigation. The apron shall remain tied throughout the activity or investigation. All accidents, chemical spills, and injuries must be reported immediately to the instructor, no matter how trivial they may seem at the time. Follow your instructor's directions for immediate treatment (Aluko *et al*, 2016).

Students should dress appropriately for laboratory work by protecting their body with clothing and shoes. This means that they should use hair ties to tie back long hair and tuck into the collar. They should not wear loose or baggy clothing or dangling jewellery on laboratory days. Acrylic nails are also a safety hazard near heat sources and should not be used. Sandals or open-toed shoes are not to be worn during any laboratory activities (Mashi, 2014). Students should know the location of all safety equipment in the room. This includes eye wash stations,

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the deluge shower, fire extinguishers, the fume hood, and the safety blanket. They should know also the location of emergency master electric and gas shut offs and exits.

Certain classrooms may have living organisms including plants in aquaria or other containers. Students must not handle organisms without specific instructor authorization (Aluko *et al*, 2016). Students should wash their hands with soap and water after handling organisms and plants.

Science specific safety precautions involving chemicals and laboratory equipment

1. Avoid inhaling in fumes that may be generated during an activity or investigation.
2. Never fill pipettes by mouth suction. Always use the suction bulbs or pumps.
3. Do not force glass tubing into rubber stoppers. Use glycerine as a lubricant and hold the tubing with a towel as you ease the glass into the stopper.
4. Proper procedures shall be followed when using any heating or flame producing device especially gas burners. Never leave a flame unattended.
5. Remember that hot glass looks the same as cold glass. After heating, glass remains hot for a very long time. Determine if an object is hot by placing your hand close to the object but do not touch it.
6. Should a fire drill or other evacuation emergency occur during an investigation or activity, make sure you turn off all gas burners and electrical equipment and exit the room as directed.
7. Always read the reagent bottle labels twice before you use the reagent. Be certain the chemical you use is the correct one.
8. Replace the top on any reagent bottle as soon as you have finished using it and return the reagent to the designated location.
9. Do not return unused chemicals to the reagent container. Follow the instructor's directions for the storage or disposal of these materials.

Standards for maintaining a safer laboratory environment

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1. Backpacks and books are to remain in an area designated by the instructor and shall not be brought into the laboratory area.
2. Never sit on laboratory tables.
3. Work areas should be kept clean and neat at all times. Work surfaces are to be cleaned at the end of each laboratory or activity.
4. Solid chemicals, metals, matches, filter papers, broken glass, and other materials designated by the instructor are to be deposited in the proper waste containers, not in the sink. Follow your instructor's directions for disposal of waste.
5. Sinks are to be used for the disposal of water and those solutions designated by the instructor. Other solutions must be placed in the designated waste disposal containers.
6. Glassware is to be washed with hot, soapy water and scrubbed with the appropriate type and sized brush, rinsed, dried, and returned to its original location. Never use glassware that is cracked or chipped (even if it does not leak). When using a blade, never use a dull blade and always cut downward and away from your body. If a cut is received, immediately wash the cut, apply pressure to stop the bleeding, and notify your instructor. Always dispose of broken glass in a glass disposal box and notify your instructor.

Chemical and biological safety

Students interact with hazardous chemical agents in the laboratory and as such should take certain precautions while working with these agents. They should know the location and proper use of the eye-wash, sinks, and chemical showers; the location of sand or vermiculite in case of acid spills. When diluting, students should always pour acids into water and not pour water into acid (Aluko, *et al*, 2016). If a chemical is spilled on the body, immediately flush the area with water and notify the instructor. Moreover, chemicals should be disposed of only as instructed in marked containers.

On biological safety, students should wear protective gloves when handling biological specimens. If the student comes into direct contact with biological specimens or fluids, he/she should immediately notify the instructor. Again, all biological cultures or materials containing live cultures should be disposed of properly in the proper biohazard bags (Mashi, 2014).

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Recommendations

The following are recommended for students' safety in the science laboratory:

1. Laboratory science rules and regulations should be displayed copiously on the entrance and inside the laboratory in order to keep students abreast of them.
2. Science students should be allowed inside the laboratory only when they have signed a declaration that they understand the rules and regulations guiding the use of the laboratory.
3. Science instructors should take safety very serious and take measures to keep their students safe.
4. Schools should provide ant-reactionary agents to assist students during emergency situations.

Conclusion.

Everyone in the laboratory is responsible for their own safety and the safety of others. Advance planning coupled with knowledge is the best antidote against harm in the laboratory. The laboratory accidents are caused by unsafe conditions such as improperly guarded or unguarded equipment; defective equipment; slippery, weak or uneven floor surfaces, hazardous arrangement, improper ventilation and illumination. Laboratory accidents are also caused by unsafe acts such as making safety devices inoperative, using unsafe equipment, unsafe position, horseplay, failure of safe clothing, using unsafe dress or apparel etc. Unsafe acts are due to the human elements which includes; physical and mental characteristics, knowledge, skill and attitudes of the individuals. Students should be made aware of the link between their actions and inactions and likely occurrence of hazards in the laboratory.

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