

SECONDARY SCHOOL SCIENCE LABORATORY ACCIDENTS: WHO IS LIABLE?

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Abstract

School science laboratory accident is a common feature in most schools at all levels of our educational system. The accidents usually occur during science activities and it could be simple accidents, such as minor cuts or it could be very serious ones such as ingestion of dangerous chemicals, explosions, fire and electric shock. This study examined the various causes of laboratory accidents and who should be liable for such accidents. It also examined the position of the law as regards negligence on the part of both teachers and students. Reported cases that illustrate liability of science teachers due to their negligence during science activities were cited. Also, decided cases on contributory negligence of science students were reported. Finally, the implications of science laboratory accident liability were discussed and suggestions on how to make science laboratory safe for learning were made.

Key Words: Science laboratory, Laboratory accidents, Glassware, Negligence, Liability.

Introduction

Science is finding out about the world around us, generating information about living and non-living things and the various forms of energy through employment of our senses of perception and by engaging in certain types of mental activities. Science laboratory could be indoor or outdoor. Indoor laboratory is a spacious room equipped with facilities and furniture and it is used for carrying out scientific investigations. Outdoor laboratory, on the other hand, is any place outside the normal classroom where science activities can be studied.

This could be the school farm, football field, path, school garden, market and ponds.

The purpose of the school laboratory is to enable students carry out investigations about the nature and generation of knowledge about the world around us. In a school laboratory, whether indoor or outdoor, the processes of scientific investigations are carried out. Some of these processes include observation, experimentation, formulation of hypothesis, and measuring. In the course of carrying out these processes, science students are usually exposed to accidents which could be simple or serious. There are several factors that can lead to laboratory accidents even when the science laboratory is well equipped. Laboratory accidents do occur when a laboratory is not properly managed, and in most cases, negligence on the part of the teachers, laboratory staff and contributory negligence on the part of the students.

Causes of Laboratory Accidents

Below are some of the ways by which science laboratory accidents can be caused.

Structural defects:

Defects in the design of Laboratory building, furniture and amenities can lead to fatal accidents in the following ways:

- Use of substandard materials in the construction of the laboratory structures and furniture can lead to collapse of the building and the furniture.
- Improper fixing or defect of laboratory services such as electricity gas and water supply.
- Causing obstacle in a science laboratory through fittings on the laboratory walls, floor and pathways in the laboratory

Accident from Chemicals

Accidents as a result of chemicals can occur in the following ways. These are when:

- chemicals are stored haphazardly on a weak and high shelves
- chemicals which react violently are stored together
- chemical storage rooms are not supplied with adequate cooling facility

- chemical bottles are not properly labelled
- reagent chemicals are stored under direct sunlight

Accident from Glassware

Accidents due to glassware can be caused in the following ways:

- If lengths of glass tubing is carried horizontally instead of vertically.
- When glassware are stored in a high place in the laboratory.
- Improper use of pipette and burettes during laboratory practicals (e.g. using mouth operated pipette during titration in chemistry practical).
- Improper storage and careless carriage of glassware in the laboratory.

Accident from Gas Cylinder

These are widely used in schools and most accidents involving gas cylinders arise in the following ways:

- Inadequate storage of gas cylinders.
- Misuse of gas.
- Exposure of gas cylinder to heat (e.g. radiator, sunlight or corrosive fumes).
- Using hard object to open cylinder valves instead of opening it smoothly and slowly.
- Greasing or oiling a cylinder valve.
- Connecting gas cylinder to apparatus without first establishing and controlling the rate of gas flow.

Electrical accidents

Electrical accidents in a science laboratory is also a common type of accident. It can occur as a result of the following:

- Inadequate design of electrical equipment;
- Faulty electrical equipment; and
- Improper use of electrical equipment.

Accidents from Fire

Fire accidents in a science laboratory can be caused from the following:

- Faulty electrical equipment;

- Ignition of solvent vapours (e.g. ethoxyethane, carbon disulphide, when exposed to sparking of refrigerator can ignite);
- Ignition by reactive chemical (e.g. white phosphorus, alkali metals and their peroxides can react and cause fire when stored together in large quantity); and
- Carelessness in handling and heating of flammable chemicals (e.g. ammonium nitrate (v) acids).

Negligence

Standler (2000) identifies negligence as another major cause of school science laboratory accidents. According to him, issues of negligence include :

- Lack of rules and regulations for all laboratory users;
- Science teachers not present in the laboratory during practicals;
- Engaging students to carry out hazardous experiments;
- Assigning an incompetent teacher to teacher and supervise science practical especially at the elementary school level. It might as a result of negligence on the part of the school to assign such a teacher to supervise science experiment since he/she may not be capable of recognising a dangerous condition.
- Lack of safety equipment in the laboratory (eg eye goggles or face shield to prevent eye injury, ground fault interrupters in ac electrical circuits, fume hoods when working with toxic vapours, and laboratory coat)

Looking at the list of causes of accidents, it can be deduced that most laboratory accidents are avoidable if necessary care is taken during science practicals. Science students are usually vulnerable to laboratory accidents as a result of improper supervision of science teachers during laboratory practicals. Science teachers could be guilty of negligence.

Who is liable for laboratory accidents?

Most education law scholars are of the view that teachers and school administrators should be held liable for any form of accident that happens to students. This is because, as teachers and school administrators, they have duty of care to exercise on the students (Rogers, 1979; Alexander, 1980 and Peretomode, 1992). Alexander

(1980) further stresses that because of the teacher-student relationship, a teacher may be liable for an omission to act as well as an affirmative act. The above assertion was corroborated in the case of *Dailey v. Los Angeles School District* (1970). In this case, negligent teachers were held liable for injuries sustained by their students during practical activities in the laboratory.

Negligence and Its Ingredients

Simply put, negligence can be defined as the failure of a person to exercise sufficient care in his or her conduct thereby leading to foreseeable harm to another. Ordinarily, it can be said to be carelessness, or laxity on the part of a person who has duty of care. The term negligence in tort is a relatively complex concept. Although it is almost equivalent to carelessness, it is no doubt something more than a careless conduct. It is a form of legal accountability. According to Redmond, Price and Stephens (1979), negligence is failure or breach of a legal duty to exercise due care when there is a foreseeable risk of harm or damage to others. It is an act of commission or omission. A primary test of negligence, according to Alexander (1980) it is a test of foreseeability. Foreseeability can be described as a situation in which a reasonable man, with a normal intelligence, perception and memory and with such superior skills and knowledge could have foreseen the harmful consequence of his/her act, but disregards the foreseeable consequences. In a classroom situation, if a teacher could have foreseen that a student might be injured by some act of his/her or another person's, and the teacher disregards these foreseeable consequences, he/she will be liable for the injury sustained by his student as a result of his/her negligence.

In order for an action of negligence to succeed, the plaintiff must prove the existence of four elements. These are summarised as follows:

- (i) The defendant (i.e. teacher) must owe a legal duty of care to protect the plaintiff (i.e. student) against harm;
- (ii) The defendant must have failed to exercise an appropriate duty of care;
- (iii) The plaintiff must have suffered actual loss or injury which could be physical or mental; and

- (iv) The defendant's negligence must have been the legal cause of the plaintiff's injury.

Liability of the Teacher

According to Barrell and Partington (1985), teachers and laboratory staff should be concerned with the safety of science students during science practicals in the laboratory. It is advisable for teachers to strictly follow approved practices or guidelines in the supervision of activities during science practicals because they may provide the defence in law against action of negligence in case of any mishap in the laboratory.

It should be emphasised that science teachers have duty of care to their students during laboratory practicals. They must develop careful behaviour by adequately supervising the students whenever they are in the science laboratory. Science teachers can be held liable for injuries sustained by their students in the course of using the laboratory, especially if the facts established that the teacher could have foreseen that the pupil would encounter danger or be harmed. This assertion is corroborated in the cases of *Mastrangelo v. Westside Union High School* (1934), *Connett v. Fremont County School District* (1978) and *Lavoie v. State* (1982).

Science teachers may subject themselves to liability in the course of using the laboratory for science activities via:

- (i) Allowing students to remain in the science laboratory without the teacher;
- (ii) Non-supervision of students during practicals;
- (iii) Giving medical attention to an injured student when the injury is a serious one and when due care would have required that he/she calls, as quickly as possible, the emergency attention necessary;
- (iv) Causing science students to carry out dangerous experiments which are beyond the experience and physical capacity thereby causing them to sustain injury;
- (v) Making students taste substances or eat food in a science laboratory;

- (vi) Making students work in a laboratory that is not in a good condition (e.g. damaged furniture, and gas leakage,);
- (vii) Making students carry out science experiments using dangerous materials and chemicals (e.g. caustic and corrosive substances);
- (viii) Allowing students to use mouth-operated pipettes during chemistry practicals;
- (ix) Refusal to report damaged laboratory fittings or equipment which are potential hazard to the appropriate authority for necessary action; and
- (x) failure or refusal to provide students with rules and regulations that will guide them in the science laboratory.

Reported Cases

There are several cases that tend to illustrate the liability of science teachers due to their negligence during science activities. Examples are shown in the following case studies.

Case I:

In the case of **Mastrangelo v. Westside Union High School** (1934), A 16 year old boy was assigned to make gun powder in a high school chemistry laboratory. He erroneously substituted potassium chlorate for the potassium nitrate listed in the separate sheets of paper as listed in the instructions; he poured all the three ingredients into an iron mortar and pulverised them simultaneously with a pestle, which led to an explosion. The explosion blew off his left hand, seriously injured his left eye, such that he has difficulty in reading. The teacher was in the laboratory but stood 15 feet behind the plaintiff. The trial court granted defendant's motion for a non-suit (i.e. abandonment of a case at the trial). However, the appellate court and California Supreme Court reversed the lower court judgment, holding that there was sufficient evidence to find the teacher liable for negligence by causing a pupil of that age to make and ignite an explosive without proper supervision.

Case II:

In **Connett v. Fremont County School District** (1978), A 14 year old boy poured alcohol from a can into an aqueous solution in order to

determine the boiling point of solutions' of either sugar or salt in water. The addition of alcohol to the aqueous solution was not part of the assigned experiment but a spontaneous idea of the victim. The teacher was in an adjoining room at the time of the accident. The trial court granted the school's motion for summary judgement. The Wyoming Supreme Court reversed it, holding that the alleged negligence of the teacher was a question of fact that needed to be determined by a jury. The Wyoming Supreme Court's opinion was that the school owes the student the duty to supervise his activities. The court further stressed that this duty becomes more imperative in the classroom, given that risks of danger are foreseeable and thus, the degree of care should be higher, where young, inexperienced students are handling substances which for them are potentially dangerous.

Case III:

The case of **Lavoie v. State** (1982). This is a case that involved undergraduate students. In this case, a second year student in an organic chemistry laboratory took back a flask of diethyl ether from a fume hood to her laboratory bench. She put the flask about 75 cm from a lighted Bunsen burner. The ether vapour ignited and burned the student. The student sued the university because neither the directions for that specific laboratory experiment nor the instructors comments on that day, contained a warning to keep ether away from flame. The jury awarded student US\$45,000.00 and the appellate court upheld the award.

Liability of the Student

The fact that science teachers are liable for injuries sustained by their students during science practicals does not absolve science students completely from liability. Many laboratory accidents can also be caused by science students due to their carelessness or due to what can be called in law of tort as "contributory negligence". This refers to failure by the plaintiffs (i.e. students) to exercise prudence for their safety and which failure is a contributory factor bringing about the plaintiffs harm (Moran and McGrehey, 1980; Raymond and Others, 1979).

Frank (1975) describes contributory negligence as a conduct on the part of the plaintiff which falls below the standard to which he/she should conform to for his/her own protection and legally a contributing

cause cooperating with the negligence of the defendant in bringing about plaintiff's harm. For instance, in a science laboratory, if a science student's negligence contributed to his/her own injury, even when the teacher has exercised due care, then he/she is guilty of contributory negligence and he/she may not be awarded any damages. A student with the knowledge of risk involved in the preparation of explosives who goes ahead to prepare one, and in the process sustains injury cannot blame anybody for the injury sustained because he/she was contributorily negligent. Similarly, a science student who decides to swallow corrosive chemicals (e.g. concentrated acid) during science practicals, out of satisfying his/her curiosity, even when the teacher has exercised due care, is guilty of contributory negligence. Under the law of tort, a plaintiff is guilty of contributory negligence will not be awarded any damages.

Reported Cases of Contributory Negligence

Case I:

In *Moore v. Order Minor Conventual* (1958). A 15½ year old boy was granted access to the school chemistry laboratory for the specific purpose of assembling apparatus for an experiment to be conducted during chemistry class later that day. While in the laboratory, he made an explosive compound according to his own recipe out of curiosity. The explosion blinded his left eye, mangled his left hand so that it required amputation, and perforated his stomach with glass. The trial court ruled in favour of the defendant (i.e. teacher) owing to the contributory negligence of the plaintiff (i.e. student) in doing an unauthorised experiment hence, he was totally responsible for his injuries.

Case II:

In *Wilheim v. Board of Education* (1963) A 13 year old boy was assigned to build a record player in the school laboratory. Instead, he mixed chemicals for rocket fuel, which exploded and burnt him. Although the trial court awarded damages to the boy, the appellate court reversed it by holding that the boy was contributory negligent.

Case III:

In *Brazell v. Board of Education* (1990) A teenage boy stole sodium chlorate from a school laboratory, by concealing it in his pants pocket. That night at home, the chemical ignited and burned his leg. Although the trial court denied the school's motion for summary judgement, the appellate court reversed it, by holding that the intentional theft was a superseding force that absolved the school from liability.

Although a student may be guilty of contributory negligence, teachers must still prove that they have exercised precautionary measures and due care. This is because, according to Remmlein and Ware (1972:) "a child's youth and inexperience increases the precaution necessary on the part of the teacher to avoid an unreasonable risk towards the child". Alexander (1980) succinctly expresses similar idea when he points out that since a child is not expected to act with the same standard of care as an adult; teachers have more difficulty in showing contributory negligence than if the plaintiff were an adult. It should be noted that a child is by nature careless and often negligent hence, teachers should allow for additional margin of safety. The characteristics of children are proper matters for consideration in determining what is ordinary care with respect to them and there may be a duty to take precautions with respect to those of tender years which would not be necessary in the case of adults. Here in Nigeria, there has been no reported court cases of Science laboratory accidents to the best of the authors knowledge. Some of the reasons that may be responsible for this could be due to:

- Ignorance on the part of the parents to report such incidents;
- Ignorance on the part of the victims(students) to report laboratory accidents to their parents;
- Lack of well-equipped laboratories in our secondary schools; and Some secondary schools do not engage students in practical activities

Implications of School Laboratory Accidents Liability for Science Teaching

Liability for science laboratory accidents has a lot of implications for science teaching which include:

- I, Science teachers are presumptively endowed with superior skill, judgement, intelligence and foresight; hence they must

- fulfill the strong duties arising from their public position by exercising care commensurate with the immaturity of their charges and the importance of their trust.
- li, Science teachers should note that children generally have a known proclivity to act impulsively without thought of the possibilities of danger. It is this lack of mature judgement that makes supervision by teachers vital. It should also be noted that parents generally do not send their children to school to be returned to them maimed because of the absence of proper supervision or the abandonment of supervision.
 - lii, It is obvious that some hazards are inherent in science laboratory procedures but these hazards are not an excuse for injuries. Instead, the existence of these hazards requires that science teachers use appropriate caution when designing laboratory experiments and when supervising students in the laboratory class. A teacher should be able to modify an experiment so that it is less hazardous without impairing the educational experience of his/her students.
 - lv, Science teachers should see their relationship with their students as that of “good neighbours” under the law of tort. The concept of good neighbours according to Rogers (1979) requires an individual to take reasonable care to avoid acts or omission which he/she can reasonably foresee that may likely injure his/her neighbour. This special relationship imposes a duty upon a teacher to aid or protect a student in danger. Science teachers ought to exercise due care and diligence during laboratory activities in order to avoid incidents of negligence in which they are liable.

Making Science Laboratory Accident-free

From experience, the following suggestions will assist science teachers and other laboratory users to ensure that science laboratory is accident-free:

- (i) The design of the laboratory should be made in such a way that it will permit supervision and free movement of the teacher, laboratory staff and the pupils during practicals .

- (ii) The demonstration table in the laboratory should be placed where there will be adequate space for students to stand around without overcrowding.
- (iii) The windows of the laboratory should be low enough such that they can be opened without having to climb benches.
- (iv) The laboratory services such as electricity, water and gas main controls should be situated for accessibility where the teacher and other laboratory staff can easily reach them. If possible, the main controls should be situated near the exit.
- (v) The fittings on the laboratory walls and the floor should not stick into the pathways not to form obstacles to users.
- (vi) Fume cupboards should be provided for noxious and unpleasant vapours.
- (vii) Facilities should be provided for collection of waste materials separately for broken glassware, biological materials and wasted chemicals.
- (viii) Suitable fire extinguishers should be provided.
- (ix) Rules and regulations for users should be pasted boldly.
- (x) Under no condition should students be allowed into the science laboratory when the teacher is not there.

Conclusion

It should be noted that a science laboratory is an hazardous setting. This fact is more apparent when the various science activities both in indoor and outdoor laboratories are considered. Except science teachers realise this fact in supervision of activities in the laboratories, the duty of care required by them may be taken for granted with all of its attendant legal implications and consequences.

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