ASSESSMENT OF SCIENCE TEACHERS' UNDERSTANDING ON LABORATORY SAFETY ISSUES IN SECONDARY SCHOOLS IN ILORIN WEST AND SOUTH L.G.A, KWARA STATE

By

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17/25PB006

A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF EDUCATION, UNIVERSITY OF ILORIN, ILORIN, NIGERIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE EDUCATION [B.Sc.(Ed.)] DEGREE IN CHEMISTRY

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CERTIFICATION

This is to certify that this study was carried out by ABIOLA, Fatimah Opeyemi (17/25PB006) and has been read and approved as meeting part of the requirements of the Department of Science Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria for the award of Bachelor of Science Education [B.Sc.(Ed.)] degree.

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DEDICATION

I dedicate this project to Almighty Allah, the Omnipotent and Omniscient for His infinite mercy guidance and grace upon my life for guiding me throughout my Bachelor of Science Education degree programme.

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ABSTRACT

This research was carried out to assess the science teachers' understanding on laboratory safety issues in secondary schools in Ilorin South and West Local Government, Kwara state. Three research questions with two hypotheses were formulated to guide this study. The study adopted a descriptive research of the survey type. The population of this study comprised of all senior secondary school science teachers in Ilorin South and West Local Government area, Kwara state. A total of one hundred and fifty senior secondary school science teachers were selected using simple random sampling technique from eighteen (18) senior secondary schools. The research instrument used for this study was a questionnaire adopted from the study of Akpullukcu and Cavas (2016). The research questions were answered with frequency counts and percentages, while t-test and ANOVA statistics was used to test and analyze the hypothesis at 0.05 level of significance. Findings from this study revealed that secondary school science teachers have better understanding on laboratory safety issues, also the gender and teaching experience does not have a significant influence on the science teachers' understanding of laboratory safety issues. The study therefore concluded that science teachers have better understanding of laboratory safety Issues in secondary schools in Kwara state. It is hereby recommended among others that educational agencies as well as school administrator should encourage less experienced teachers to learn more about laboratory safety practices and put in place appropriate mentoring programmes to enable them to acquire the relevant skills, competency and knowledge for better understanding on laboratory safety issues and practices.

CHAPTER ONE

INTRODUCTION

Background to the Problem

Science (Latin, scientia meaning "knowledge") is defined as a systematic enterprise that builds and organizes knowledge in the form of testable explanation and prediction about the universe according to Chriswa (2003). It could also mean a body of knowledge itself, or the types that can be rationally explained and reliably applied. Science knowledge has been widely applied in many facets of life to improve the living conditions of man in the society. Abimbola and Omosewo (2006) stated that "science can generally be defined as a body of knowledge, a way of investigating and a way of thinking in pursuit of an understanding of nature".

Nature of science might be defined as "social and cultural values of science, and values and beliefs regarding scientific knowledge (Roth & Roy Choudhury, 2003).In broad terms, the discipline of science is characterized by its central commitment to evidence as the basis of justified belief about material causes and the rational means of resolving controversy. In addition to this, the perceptions of teachers into NOS and their classroom practices affect students' views of science. Therefore, it is primarily necessary for teachers to think as scholarly literate and to have enough information about NOS (Lederman et al.,

2002). The most important steps on this issue are teachers' understanding of science and nature of scientific knowledge correctly and transmitting these into their students through appropriate methods and techniques in classroom practices (Küçük, 2006). By this means, it could be possible to train science literate students who can learn science by doing science and discover NOS by his/her own experiences. That is, instead of presenting today's "planet" concept as it has been, students need to be informed in details about different views on this issue suggested previously and why Pluto is now a dwarf planet after 76 years. By means of such an approach, it would be possible to actualize more meaningful and permanent learning about "planet" concept, which forms a part of NOS. In consequence, developing required strategies about the content of NOS and teaching its importance to teachers raising the future generations are considered to be important In order to realize this, different methods and techniques (project, analogy, discussion, trip, observation) prompting students to do research are supposed to be used instead of traditional methods while searching for the nature of scientific knowledge about the subjects of science courses. The existence of various studies in literature supporting these kinds of action has had an effect upon carrying out the current study (Lederman & Lederman, 2004; Schwartz et al., 2007).

One of the primary aims of science education is to develop students' and even teachers' beliefs of NOS (Kang, Scharmann, Noh, & Koh, 2005). Nowadays, teachers unfortunately cannot go beyond giving examples of scientific knowledge in theory and practice in science courses. In addition to this action, students need to become aware of

NOS and there needs to be an understanding about how scientific knowledge is formed and which phases it completes to develop (Crowther, Lederman, & Lederman, 2005; Schwartz, Akom, Skjold, Hong, Kagumba, & Huang, 2007). Bringing students' cognitive, affective and psychomotor skills into action through such an attitude could enable the students to understand NOS better (Sert Çıbık, 2014). Students need to be enlightened through examples about how and why the subjects in science courses change until today as new theories and laws are set forth (Crowther et al., 2005; Çakıcı, 2009). For instance, there used to be 9 planets in the space as mentioned in textbooks, magazines and encyclopedias in the past and Pluto was accepted as the smallest one. However, many researchers currently study on clarifying the description of planet as Pluto is rather a dwarf planet (Doğan, Çakıroğlu, Bilican, & Çavuş, 2009). Hence promoting teacher's understanding of the NOS is clearly a prerequisite for effective science teaching.

Science teaching is an approach used in all levels of science classrooms whereby teaching and learning is approached with the same rigor as science itself. Scientific teaching involves active learning strategies to engage students in the process of science and teaching methods that have been systematically tested and shown to reach diverse students, (Handelsman et al. 2004).

The 2007 volume Scientific Teaching lists three major tenets of scientific teaching:

1. Active learning: A process in which students are actively engaged in learning. It may include inquiry-based learning, cooperative learning, or student-centered

learning. Active learning is a method of learning in which students are actively or experientially involved in the learning process and where there are different levels of active learning, depending on student involvement. Students participate in active learning when they are doing something besides passively listening. There are a variety of methodologies for promoting active learning. Some of which indicates students must do more than just listen in order to learn. They must read, write, discuss, and be engaged in solving problems. This process relates to the three learning domains referred to as knowledge, skills and attitudes. In particular, students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation.

2. Assessment: Tools for measuring progress toward and achievement of the learning goals.In education, the term assessment refers to the wide variety of methods or tools that educators use to evaluate, measure, and document the academic readiness, learning progress, skill acquisition, or educational needs of students. While assessments are often equated with traditional tests especially then standardized tests developed by testing companies and administered to large populations of students, educators use a diverse array of assessment tools and methods to measure everything from a four-year-old's readiness for kindergarten to a twelfth-grade student's comprehension of advanced physics. Just as academic lessons have different functions, assessments are typically designed to measure specific elements of learning e.g., the level of knowledge a student already has about the concept or

skill the teacher is planning to teach or the ability to comprehend and analyze different types of texts and readings (William, 2004). Assessments also are used to identify individual student weaknesses and strengths so that educators can provide specialized academic support, educational programming, or social services(Freeman, 2007).

3. Diversity: The breadth of differences that make each student unique, each cohort of students unique, and each teaching experience unique (William, 2004). Diversity includes everything in the classroom: the students, the instructors, the content, the teaching methods, and the context. Teaching for diversity refers to acknowledging a range of differences in the classroom.

These elements should underline educational and pedagogical decisions in the classroom. The “scale-up” learning environment is an example of applying the scientific teaching approach. In practice, scientific teaching employs a "backward design" approach. The instructor first decides what the students should know and be able to do (learning goals), then determines what would be evidence of student achievement of the learning goals, then designs assessments to measure this achievement.

There are various teaching techniques for the science classroom and explanations of them. Some of these techniques include:

1. Real-life scenarios that involve case studies and ways of analyzing current problems.

2. Peer-to-peer teaching, which involves students in their own education.
3. Hands-on activities that engage students beyond the lecture and teach useful scientific concepts.
4. Science projects, which teach the scientific methods of inquiry and experiment.
5. Field research journals, which are notes and other documentation of trusted science experiments or from the students in your classroom.

Finally, the instructor plans the learning activities, which should facilitate student learning through scientific discovery. Science teaching in Nigeria has faced a lot of setback (Akuobguo, 2002). One of the setbacks is the assessment of science teachers in understanding the laboratory safety issues in secondary schools in Kwara State. If the science teachers are to be assessed, this will enlighten them and make them to understand the laboratory safety issues effectively.

Science teachers instruct students in subject-specific classrooms. They create lesson plans; evaluate student performances; and teach using lectures, technology and hands-on learning experiences. They also model expected behavior to establish and maintain an orderly, disciplined classroom. Create daily lesson plans and learning activities for students based on national, local and school standards in science education and research and knowledge of developmental behaviors. Science teachers' roles on science teaching also include: deliver high-quality, engaging instruction in the form of discussion, direct teaching, demonstrations and independent practice using a variety of proven methods,

differentiate lessons when needed to give all students access to the curriculum regardless of disability, instructional level, English proficiency or level of interest in the subject, evaluate student performance on tasks established by the standards using different methods such as observation, performance-based tasks or other standard test practices, maintain a safe, orderly and supportive classroom by modeling expected behavior and standards, promoting positive interactions and quickly addressing behaviors that are not in line with the school discipline plan, communicate with parents regarding student progress, potential and behavior periodically through phone or electronic means and at parent and teacher conferences, improve skills and knowledge in teaching by regularly taking classes, attending workshops and discovering new methods of delivering exciting content to students.

Science teachers need essential facilities in the teaching of science which are laboratories, conducive classroom and environments, instructional materials. Since the school laboratory is the most important learning environment and the most widely used in teaching science, the attention of specialists in science education has been drawn up to study how to activate and utilize its content in order to effectively contribute to achieving the goals of teaching science.

Ezeliora (2001) defined laboratory in science teaching as a workshop where science is done or where scientific activities are carried out under conducive environment. Igwe (2003) observed that a laboratory can be indoor such as the sufficiently designed and

equipped room found in most schools or outdoor involving such places as riverside, workshop, field and even market for carrying out scientific studies. According to Omiko (2007) "A laboratory is a room, or building or a special period of time equipped and set apart for practical or experimental studies to take place". He sees the laboratory as the heart of a good scientific program which allows students in the school to have experience which are consistent with the goals of scientific literacy. This implies that science teaching and learning cannot be completely done in a secondary school where there is no equipped laboratory.

Udonfu (2009) and Omiko (2015) observed that the use of the laboratory in science teaching has the following roles:

1. Laboratory teaching makes the students/learners to learn about the nature of science and technology in order to foster the knowledge of human enterprise of science and thus enhance the aesthetic and intellectual understanding of the child. Dienye and Gbamanja (1990) opined that science is known to be a way of doing certain things by the observation of natural phenomena, quantifying the observed thing, integration of such quantities and interpretation of the results in order to make useful meaning out of the exercise. The students can identify cause and effect relationships and, in this process, develop important skills.

2. Learning scientific inquiry skills that can be transferred to other spheres of problem solving (that is acquisition of problem-solving skills). One of the basic goals of science education is to help students learn skills that can be applied to other life situations in future. It thus follows that the exercise of transfer of such learning condition must have something in common with the situation to which it will be applied.
3. Students learning to appreciate and in fact, emulate the role of the scientist through acquisition of manipulative skills.

Queensu (2008), an internet website on good practice (laboratory-based learning) states that science educators believe that the laboratory is an important means of instruction in science since late 19th century. According to them laboratory instruction is considered essential because it provides training in observation, supplies detailed information, and aroused pupil's interest. It also goes further to say that "developing and teaching in an effective laboratory requires as much skill, creativity, and hard work as proposing and executing a first-rate research project. They also listed the following number of possible goals that can be achieved through a developed laboratory program:

(i) develop intuition and deepen understanding of concepts

(ii) apply concept learned in class to new situations

(iii) experience basic phenomena

(iv) develop experimental and data analysis skills

(v) learn to use scientific apparatus

(vi) learn to estimate statistical error and recognize systematic errors

(vii) develop reporting skills (written and oral).

Omiko (2015) and Ufondu (2009) were of the same opinion where they observed that laboratory teaching is sometimes used in conjunction with large lecture courses so that students may acquire technical skills and apply concepts and theories presented in the lecture. Omiko (2015) stated that "hands-on experience encourages students to develop a spirit of inquiry and allows them to acquire scientific skills and the right attitude to handle scientific tools and materials. Science laboratory provides students with the richest experiences which they will transfer to the society and their various places of work. It helps in providing the students the opportunities to practice science as the scientist do. In order for the laboratory to be effective, students need to understand not only how to do the experiment, but why the experiment is worth doing, and what purpose it serves for better understanding of a concept, relation, or process.

Hofstein and Lunetta (2004) emphasized the importance of rethinking the role and practice of laboratory work in science teaching in general and in the context of chemistry education in particular. It is true that very often research has failed to show a simplistic relationship between experiences provided to the students in the laboratory and learning science. However, sufficient data do exist to suggest that the laboratory instruction is an

effective and efficient teaching medium to attain some of the goals for teaching and learning science.

However, the use of laboratory is shrouded in many difficulties and problems that hinder its activation appropriately. The risk caused by the improper use of laboratory equipment or tools, poor storage and preservation of certain materials or errors results from the improper practices in handling materials or implementing some operating procedures. Therefore, the concern in activating the role of laboratory was integrated with an equal concern in providing first aid and skills.

After establishing that the laboratory is one of the most important learning environments in teaching science, there is also a need for laboratory safety practice which is the practical aspect that covers all practical activities associated with science course (Robert H. Jr., and Finster, 2010).It is necessary that these activities are sound and performed properly in accordance with the instruction regulating them. Failure to perform tasks due to the lack of knowledge negligence or haste may cause accident. In order to achieve laboratory safety practices, the following requirements are to be met;

1. Risk Management**:** It is the preventive aspect of laboratory work and is intended to prevent or reduce the risks to individuals and facilities, to minimize losses and to avoid the occurrence of accidents (Abdel-Moneim, Kashef & Kasab, 2008).

   Therefore, school laboratory staff should be introduced to those who use the laboratory including teachers, students, and technicians with the practices, tools,

materials, and devices that may be dangerous and make them aware of the expected injuries resulting from the misuse of such materials and devices (Jo et al., 2002). Despite the importance of the preventive aspect, field studies such as Al-Abdalatif (2011), Julius and Thomas (2014), Hackling (2009), and Mogopodi, Paphane, and Petro (2015) revealed a clear decline in the level of preventive awareness among school laboratory users in several countries including Saudi Arabia. Abdel-Moneim (2006), categorized risks into two primary groups: External Unpredictable Risk, External Predictable Risk.

2. First Aid**:** First aid is the first and immediate assistance given to any person suffering from either a minor or serious illness or injury, with care provided to preserve life, prevent the condition from worsening, or to promote recovery.

It represents the therapeutic aspect, which is no less important than the preventive and practical ones as for the measures of safety in the laboratory. In many cases, good behavior in emergency situation and providing first aid to those who get injured inside the laboratory may be crucial. Therefore, first aid can be described as the immediate primary care provided to the injured prior to the arrival of medical assistance (Mansoura University, 2009).

As laboratory accidents are expected to occur at any time, it is necessary to qualify laboratory users to provide the necessary assistance to themselves and others when required. Consequently, an adequate scientific knowledge and special skills of how to behave when an accident occurs and ways to handle the various

laboratory injuries are a must. The key aims of first aid can be said to preserve life, prevent further harm, promote recovery.

To ensure judicious use of the laboratory, a considerable amount of understanding of safety practices by the teacher must be in check. Teachers should not only be knowledgeable in the subject content, but also make students know the hazards of working in the school laboratory and preventive measures to ensure safety. The teacher like any other professional need appropriate tools to carry out his job effectively. According to Baurerle (2008), proper enlightenment of teachers on the nature of dangers associated with laboratory materials and strict adherence to the rules and regulations governing the use of laboratories will help in minimizing accident if not total eradication of the accidents associated with the use of laboratory.

Over the years, science educators have identified multiple variables influencing attitudes toward science (Osborne et al., 2003). The nature of this influence, however, has been contradicted by different studies. Early studies found that males hold consistently more positive attitudes toward science than females (Weinburgh, 1995), but more recent studies have reported that females are more positive in their attitudes (Murphy & Beggs, 2003). Gender is a specially constructed phenomenon that is brought about as society ascribes different roles, duties, behaviors, and mannerisms to the two sexes, (Mangvwat,2006).

Babajide (2016) alluded that good application of laboratory management skills may guarantee laboratory safety, eliminate or minimize risks and hazards associated with laboratory practices and experimentation. Undoubtedly, standard laboratories at the secondary school level have common features but subject-specific laboratories have related features that distinguish one from another. All these features have to be managed by each subject teacher irrespective of gender role. Some studies however have shown conflicting reports on gender role in the utilization of laboratory management skills. For instance, a study by Tsmango (2016) indicated no gender differences in utilization of laboratory management skills in the aspect of stocking and ordering among physics teachers.

A related study by Okwo and Otubar (2015) showed that more male science teachers than females utilized, stocking, maintenance and safety from among the laboratory management skills. Such inconsistency in reports on gender role in the utilization of laboratory management skills, coupled with the persistent public outcry on the poor state of secondary school science laboratories across Nigeria has provoked this current study which sought to assess the science teachers understanding on laboratory safety issues.

Also, Onyeukwu (2000) sees gender as the dichotomy of roles culturally imposed on the sexes. Teachers cannot be dissociated from the schools they teach andacademic results of schools. It would therefore be logical to use the standardized students' assessments results as the basis for judging the performance of teachers. Teachers celebrate and are rewarded when their schools and teaching subjects are highly ranked. Basu and

Chakroborty (2001) reported that student taught by male teacher achieve higher than those taught by female teachers this was in contrast with Adedipe (2003) that reported a conflicting finding in which students that are taught by female teachers performed significantly better than those taught by their male counterparts.

Teacher experience has to do with the increased awareness of diversifying search for new ideas, new commitments and new challenges. Teachers' experience and knowledge of subject matter are unique qualities for teaching effectiveness. According to Rice (2010) the magnitude of the effect of teacher experience varies depending on the teacher's level of education and the subject area. It was further opined that experience gained over time, enhances the knowledge, skills, and productivity of workers. These qualities facilitate students' skills and abilities to think about chemistry processes, useful for exploration and analysis, and also enables thorough understanding of chemistry concepts. Experienced teachers are great asset to novice teachers who need advice, encouragement and continuous guidance. Okey (2012) stated that experience is directly related to teachers' ability to plan lessons, address divergent student responses, reflects on their teaching effectiveness and their ability to stimulate student inquiry. Akinyele (2001) and Commey-Ras (2003) commented that experience improves teaching skills while students learn better at the hand of teachers who have taught them continuously over a period of years. Seneschal (2010) found that teacher experience has a significant positive effect on student's achievement, with more than half of the gains occurring during the teacher's first few years, but substantial gains occurring over subsequent years; albeit, at a slower rate. Furthermore,

teachers with long years of experience are confident in handling the laboratory equipment with safety measures.

It is therefore important to consider the roles of gender and teachers' experience in a laboratory setting to ensure adequate safety during the lessons.

Statement of the Problem

The specialists in scientific education realized the importance of school laboratory and its relationship with science courses that represent a key to the students' knowledge in the years of preparation as these courses are based on stimulating thinking, analyzing phenomena, and dedicating the scientific methodology in research and gaining knowledge (AL-Levy, 2016).A lot of risks are involved during practical classes, which needed to be addressed; otherwise there would be casualty of students and teachers in the laboratory.

Achimugu (2012) reported that science teachers cannot display correct understanding of the science process as they cannot organize and conduct practical classes. It is against this background that this study is set out to find out the science teachers understanding of laboratory safety issues in secondary schools in Kwara State, Nigeria. Perhaps, many of the science teachers are ignorant of these safety issues talk less of guiding against them or they tend not to care, if they are aware.

This study is aimed at assessing science teachers understanding of laboratory safety issues in secondary schools in Kwara State and in turn pave the way for scientific growth in Kwara State, Nigeria.

Effective science teaching is linked to a stimulating and practical laboratory environment by ensuring its human and material requirements in any school belonging to the age of knowledge and technology (Aldandani, 2010). Trowbridge et al. (2004) argue that laboratories are essential for the study of science and modern science courses in most development programs and projects.

Despite the importance of the role of Science teacher in terms of safety in the laboratory and the provision of first aid to laboratory injuries, many studies, *e.g.* Almodifer (2005), Alshuaile and Almaamari (2006), Al-Abdalatif (2011), Al Habeel and Aish (2012), Zaveri (2012), Ali(2013), Julius and Thomas (2014), Schroder et al. (2015), and Alahmadi (2016) showed that the level of safety measures awareness and knowledge of first aid among science teachers is low.

The importance of safety in the laboratory is to ensure that all potential hazards are communicated to the students in the school. Tracking and labeling secondary containers is essential for safety in the school. The present situation of laboratories in most schools in Nigeria is poor labeling of stock solutions or secondary containers, inadequate equipment to carry out proper laboratory practical, fear of students breaking equipment which enhances locking of science laboratories.

Ajayi (2008) also reported that science teachers in secondary schools have always lamented that among the various obstacles to effective teaching of practical includes lack of laboratory space and equipment, large class and inadequate time allocation. Oludare,

Abiodun and Ajayi (2006) also reported that there are no enough classrooms and laboratories. There is a general consensus among science teachers that science teaching in schools has continued to be theoretical and not practically oriented (Ihieglulem, 2006). As a result of this learners do not think practically and they are not able to apply the knowledge acquired.

An accident happens suddenly, and the teacher should be well prepared for such cases. It is therefore important to create an environment in which appropriate laboratory behavior is maintained.

Planning the activities carefully, providing careful directions before allowing students to attempt independent projects, protecting the health welfare and safety of their students, reporting all hazardous conditions, and being present in the laboratory to ensure adequate safety supervision are some of the necessities during the lessons.

Purpose of the Study

This study was aimed at the assessment of science teachers understanding of laboratory safety issues in secondary schools in Kwara State, Nigeria. This study sought to determine:

1. Science teachers understanding of laboratory safety issues in secondary schools in Kwara State

2. Influence of teachers' gender on their understanding of laboratory safety issues in secondary schools in Kwara State
3. Influence of teachers' experience on their understanding of laboratory safety issues in secondary schools in Kwara State

Research Questions

The following research question were raised and answered in the study:

1. What is the level of teachers understanding of laboratory safety issues in senior secondary science laboratory?
2. What is the influence of teachers' gender on their understanding of laboratory safety issues?
3. What is the influence of teachers' experience on their understanding of laboratory safety issues?

Research Hypotheses

The following hypotheses were formulated as guides for the study:

H_{01}: There is no significant difference between male and female science teachers understanding of laboratory safety issues.

H_{02}: There is no significant difference between the experienced, moderately experienced and less experienced science teachers' understanding of laboratory safety issues.

Scope of the Study

The study is limited to "the assessment of science teachers in understanding of laboratory safety issues in secondary schools in Kwara State". The targeted populations are mainly science teachers in senior secondary school 1-3 and the sample of this study is limited to secondary school science teachers in Kwara State. Questionnaire is used as the research instrument.

Significance of Study

The findings of this study would assist the education stakeholders such as the administrators, technicians, ministry of education, facilitators, curriculum developers including the teachers especially the science teachers to understand better on the laboratory safety issues.

Science teachers would be able to observe better safety measures (such as laboratory risk management, proper laboratory practices, and first aid for laboratory injuries) in teaching their students practical in the laboratory, on the basis of the findings of the study. Findings from this study may also help to develop the science teachers' preparation programs with respect to the safety issues practiced in the laboratory. It will also help science teachers to be aware of their own knowledge of safety issues in the

laboratory and as such improve upon them. The results of the study may help develop science teacher preparation programs regarding safety measures practiced in the laboratory and It will highlight the role of the different sources of information about safety measures practiced in the laboratory.

Researchers in science education will equally benefit from the findings of this study by using it as a stepping-stone for further studies in understanding the safety measures and practices in laboratory.

On the part of the curriculum developers, in the course of curriculum designing, planning, revision and modification, these experts shall utilize the relevant data based on the findings of this study. For instance, pieces of information on the safety measures or precautions that guide working in the science laboratories will be utilized in the appropriate stages of curriculum planning, modification or revision.

Similarly, the findings of this study shall be useful to the ministry of education/government. The findings will provide information which could sensitize the government/ministry of education on the need for workshop, seminars, refresher courses, conferences on the best ways to create awareness for the science teachers on how to manage and ensure safety in the laboratory, the laboratory safety issues that will be encountered and the safety precautions to be taken. The study could yield convincing empirical evidence for the understanding of laboratory safety issues by the science teachers.

Clarification of Terms and Variables

Science teachers: includes the teachers that teaches biology, physics and chemistry because their work deals with laboratory practices. Science teachers are trained person who manages and directs the teaching and learning process effectively and efficiently be it in a classroom or laboratory settings.

Laboratory: is a building that is equipped to conduct practical experiments, investigate the procedures or teaching of science using specific equipments and procedures. Science laboratory in this study refers to physics, chemistry and biology laboratories.

Laboratory safety: They are rules and procedures guiding all the activities in the laboratory so as to prevent damages, or any hazards or accidents and provide a safe working place. Safety are to be considered swiftly.

Experience: This refers to the number of years that a teacher has spent in service.

Less experienced: The less experienced has 0-5 years' experience in the teaching profession

Moderately experienced: moderately experienced has 6-10years experience in teaching service.

Highly experienced: highly experienced has 11years above experience in teaching profession.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviewed related works on the assessment of science teachers in understanding the laboratory safety issues in secondary schools in Kwara State. The review of literature is considered in the following sub-headings:

1. Concept of Science Laboratory Resources and Safety Issues in the Laboratory
2. Empirical Review of Studies on the Level of Teachers' Understanding of Safety Measures Practiced in Laboratories
3. Studies on Influence of Teachers' Gender on their Understanding of Safety Issues in the Laboratory
4. Studies on Influence of Teachers' Experience on their Understanding of Safety Issues in the Laboratory
5. Appraisal of Literature Reviewed

Concept of Science Laboratory Resources and Safety Issues in Science Laboratory

Laboratory resources are those human and materials resources that is available for teaching and learning process. The process of managing and organizing resources for teaching and learning is referred to as resource utilization (Lewin 2000). Resources utilization has to do with the extent to when facilities are provided to schools, these are three possibilities, they are either used effective or inefficiently or they may remain unused. When item of equipment is maximally used such as equipment is effectively utilized. If the

equipment is not maximally used it can be said to be underutilized. When there is so much pressure on the use of an equipment this may result to over utilization which could lead to breakdown of such item of equipment. Facilities improves the quality of teaching and make learning content meaningful. According to Ihiegbulem (2006) resource materials utilization during practices lessons inculcates in the students the spirit of careful observation, manipulative skills, respective thinking and creativity in the learners.

Lewin (2000) however reported that science facilities are only important when they are used. One of the major problems facing the teaching and learning of science is connected with the management of available resources. Ogunleye (2002), movement of resources requires the science teacher himself be resourceful and creative and be careful in handling and using available facilities are handled cautiously especially the fragile ones. This is necessary because once the facilities are misused, they cannot offer the best service required. Resources are vital for any teaching-learning process to proceed effectively. The desirability of adopting material resources for teaching science subjects cannot be over emphasized in making the lesson concrete and practicable. They are necessary tools that facilitate learning. Chime (2010) is of the opinion that resource materials enable the teacher to teach more effectively or better still enable the children to learn more readily. Learning resources motivate students and serve as effective ways to explain and illustrate subject content. In a similar vein, Oladipo (2008) asserted that resource materials facilitate understanding of concrete materials, creative motivation and interests for the subject. These

laboratory resource materials reinforce learners to retain information for a long period of time.

Laboratory resources are broadly classified into two, namely: human and material resources. Human Laboratory Resources otherwise called resource persons are people who possess more authentic knowledge and needed information and skill, and are also willing and able to communicate to students the information, and have the right or authority to give the information out. Their invitation and selection depend on the content, objectives and methodology most appropriate for each topic. Laboratory human resources are both academic staff as well as the laboratory staff. Nwagbo (2005) highlighted some of qualities of a laboratory teacher as a competent resource person as: being emotionally stable, have good disposition, show a democratic and cooperative attitude.

Laboratory resources could be divided into four namely: audio-visual materials, visual/non-projected materials; audio media and projected media. Chimezie et.al (2002) classified material laboratory resources as instructional media, instructional materials and educational media. Audio-visual materials are the materials that involved the use of both eyes and ear so as to aid the teaching and learning process in the laboratory; Non-projected visual media makes the instruction more realistic and engaging such as charts, graphs posters etc. and projected media are designed in which still images are enlarged and displayed on a screen such as digital, software and document cameras.. All the laboratory resources are needed to be maintained and taking care of.

Laboratory equipment and facilities must be adequately taken care of in order to ensure their normal working conditions. Maintenance prevents deterioration and also weeds out obsolete items which no longer serve the required function. Momoh and Onjewu (2006) identified the objectives of maintenance of facilities: To ensure that facilities are always available to provide services to for maximum benefits to staff and students, to ensure operational readiness of facilities for continuous service so as to reduce losses which may result from down time, To protect operating personnel and save facilities, and to extend the use of the facility for maximum benefit.

The process in which good care is taken of tools and equipment to prolong their life span is referred to as maintenance. It involves all activities put in place to keep and restore the condition of facilities. Momoh and Onjewu (2006) define maintenance as any action or group of action taken to keep a facility in good working conclusion for as long as possible. When activities such as repairs, servicing, greasing etc. are put in place to keep or restore the component of an item, the item is being maintained.

Maintenances could be routine ongoing activities such as daily or weekly cleaning of the laboratory equipment and facilities, it could be periodic activities such as inspection and lubrication of parts of equipment to ensure continued working condition or corrective maintenance which include activities carried out to fix back a failed equipment or facility maintenance also involves the security of the equipment and facilities. Security here covers protection from physical damage from pests, fire, rain etc. It also pertains to protection

from theft or unauthorized use. Teachers should not wait for an equipment to breakdown completely before it is serviced. Report of the need for repairs or replacement of equipment must be made to school authority with the view to making immediate arrangement for the repairs and maintenance to avoid waste and depreciation.

However, it has been reported that one of the major problems facing the teaching and learning of science is connected with the management of available resources (Ogunleye, 2002) that inability to appropriately manage resource in the laboratory is a sign of poor management. Kalat (2006) also reported poor maintenance culture among teachers. That outright hostility, manhandling, inferior texture, weathering, over use etc. are among the factors inhibiting proper management of facilities. Moses (2006) reported that maintenance culture is very poor in Nigerian schools, homes, offices and industries. That facilities and equipment are laying waste due to breakdown; some are forced to breakdown by dust and cobwebs due to negligence and lack of care.

Laboratory safety involves the development of skills, responsibility and must be an integral part of every science curriculum. Safety awareness must be integrated into each laboratory courses 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 institutions. At the departmental level, the head of department needs to assume responsibility for continuing review of safety issues with teachers and research laboratories. At the administrative level, there will be involvement of

implementing a chemical hygiene plan that is in agreement with any school chemical hygiene or safety efforts and must address the safety handling, storage and disposal of chemicals. Eye wash and showers must be in operating and good conditions, and fume hoods with proper sashes are essential. A clean uncluttered laboratory is more likely to encourage careful work. Anyone working or visiting the laboratory must wear safety goggles and consumption of foods or drinks must not be permitted.

The American Chemical Society (2017) committee on chemical safety has recently published some useful resources that provides guideline for chemical safety in academic institute and help in the identification and evaluation of hazards in research laboratories.

Development of safety skills may be divided into four major areas; Recognize hazards, Assess risk, Minimize risk and Prepare for emergencies.

Recognition of hazards: hazard is a potential source of danger that can result from working with chemicals, equipment and instruments. Hazards can be described such as toxic, flammable and corrosive. Information should be obtained from chemical labels, Safety Data Sheet (SDS), and other reference sources. Chemical hazards encountered in the laboratory should be explained in a very detailed way like acids, bases, flammable, and toxic compounds, more details of physical and chemical hazards should be explained so that students will be able to identify the hazards by themselves in any experiment they encountered with such as compressed gases, types of toxic compounds, cryogenic, pressurized systems, peroxides, reactive, unstable compounds, pyrophoric, explosive

reactive, toxicology, nano materials, biohazard and radiological hazards become relevant when the science curriculum becomes broader in scope.

*Assess Risk: O*nce hazard is recognized, laboratory safety really required assessment or evaluation of risks gotten from a certain exposure to hazards. Identifying potential routes of exposure is followed by judging the relative risk posed by the hazard of the experiment. The hazardous physical, chemical and toxic properties of solvents, reactants, catalyst, products and wastes should be considered as well as circumstances of the experiment like how much is being used? Is the right equipment available? Can the hazard be controlled or minimized? Are the reactions exothermic or endothermic? Are there risks associated with the experiment to be carried out?

Minimize Risk: Experiments should be designed to minimize risks based on a risk assessment. The 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 waste is a critical component. It is often useful to consider case history of incidents that have resulted in injury or damage. What could have been done to prevent or minimize such incidents? Discussions can be implemented by giving students picture of a risky or hazardous environment and, by asking them about what is wrong with the particular picture.

Prepare for emergency: 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 use of some resources in the laboratory is important and the laboratory equipment are outlined below;

Fire Blanket: Flame-retardant wool or other types of materials can be helpful in smothering small fires. Never wrap a standing person on fire in a fire blanket. This can create a "chimney effect." Wall-mounted canisters or boxes with appropriate signage should be used.

Goggle Sanitizer: Ultraviolet (U-V) goggle sanitizer cabinets are available and take about 15 minutes to sanitize goggles. Goggles must be sanitized if used by more than one student. Alternatives to sanitizers include disinfectants, alcohol or dish detergent.

Electrical Safety Controls: All science laboratories, storerooms and preparation rooms should have ground fault circuit interrupters (GFCI) electrical receptacles to protect occupants from electrical shock.

Acids: Acids are very dangerous and must be handled with extreme care. When diluting acid with water, "*AAA" — Always Add Acid to Water!* Slowly stir and swirl the contents, being watchful of the heat produced, particularly with sulfuric acid. An alternative to diluting acids is purchasing diluted acids in lieu of concentrated acids from commercial supply houses.

Chemical Spill Control: A chemical spill cart should be available to handle small spills in the laboratory. Large spills and leaks require evacuation and the immediate contact of the local fire department's hazmat team. All emergency numbers should be posted in each laboratory with direct means of communications with the front office by phone or intercom. Spill kits can be made in-house or secured through a commercial lab supplier. Spill kits should include the Spill control pillows, Neutralizing agents for acid spills (sodium hydrogen carbonate), neutralizing agents for alkali spills (sodium hydrogen sulfate), Pick up equipment such as brush, broom, pail, dust pan, Personal protective equipment, and Inert absorbents such as sand or kitty litter

Chemical Storage: Chemical storerooms are secured areas and must be kept under lock and key with limited access to appropriate certified science staff and paraprofessionals.

Shelving should be made of finished wood or other chemical resistant material with a front lip approximately 0.75-inch (1.9 centimeters) high. Chemicals should not be stored alphabetically. For example, acetic acid and (acetaldehyde) could be adjacent neighbors on a shelf and are an incompatible pair. Also, flammable liquids should be stored in flammable liquid storage cabinets. Flammable and combustible cabinets should not be directly vented. Venting of these cabinets is not recommended or required except for odor control of malodorous materials. The openings on the bottom and top of the cabinets should be sealed with bungs supplied with the cabinet. If the cabinets are to be vented, vent from the bottom openings and makeup air from the top openings (NFPA 30, 4-3.2). Also, corrosive

chemicals such as acids and bases should be stored in separate appropriate chemical storage cabinets. Store corrosive liquids and solids in separate cabinets. Nitric acid should be stored separately from acetic acid in a separate cabinet.

Lithium, potassium and sodium metals should not be stored or used in a middle school science laboratory.

All peroxide-forming chemicals (e.g., ethyl ether) should not be stored or used in a middle school science laboratory.

Heavy items should be stored on lower shelves.

Never store chemical containers on the floor.

Chemical storage areas should be kept dry and in a temperature range of 50-80 degrees Fahrenheit.

Chemical storage should be stored by a compatibility and use system, in addition to being secured behind locked doors and cabinets.

Chemicals can be separated into organic and inorganic families, and then into compatible and related groups. Compatible groups can be separated by use of different shelves. Only store chemicals alphabetically within a related and compatible group.

Empirical Review of Studies on the Level of Teachers' Understanding of Safety Issues Practiced in the Laboratory

There are several related studies to the survey on the assessment of science teachers understanding of laboratory safety issues in secondary school. Akpullukcu and Cavas (2016) conducted a study on the development of laboratory safety questionnaire for middle school science teachers. The purpose of the study is to develop a valid and reliable laboratory safety questionnaire which could be used to assess science teachers' understanding about laboratory safety issues during their science laboratory activities. The questionnaire was developed from a literature review and prior instruments developed on laboratory safety issues. To address content validity, the questionnaire was examined by experts from the field of science education. The questionnaire consists of 36 Likert-type items related to chemicals, usage of glassware equipment, fire and electrical control, personal protection, biological hazards, and emergency. The study was carried out with 127 teachers who have experience in science laboratories and work in middle schools in Turkey. The instrument was found to be internally consistent with high reliability scores. Significance value shows that the data come from a multivariate normal distribution and are suitable for factor analysis. The factor analysis indicates that the items in the questionnaire accumulate around a single dimension named as safety issues. The results provide evidence that the instrument is valid for further implementation on a wider scale and in larger samples. The results of this study showed that the questionnaire has an

appropriate scale to determine the secondary school science teachers' understanding toward laboratory safety issues.

Azuibuike (2014) conducted a study on evaluation of safety practices in laboratories in selected secondary schools within Gumel Emirate, Jigawa state. The study was carried out to find out the extent the teachers and students are aware of safety practices and devices while working in the science laboratories during practical sessions. The methodology was thoroughly explained with the use of questionnaire and interview. Ten (10) secondary schools were selected randomly for the research work and a total of twenty-three (23) science teachers and one hundred (100) students were used.

The data collected were analyzed with a descriptive statistical analysis in which frequency counts and percentage were employed which revealed that 71% of the students and 73% of the teachers in the selected secondary schools are BSc.(Ed) holders with the number constitute 65% with 5-10years working experience and majority of the laboratories have inadequate first aid kit(which only has cotton wool, bandage, Dettol solution and iodine solution). The finding revealed that teachers and students in the selected schools have good understanding of safety practices but majority of the schools lacked safety gadgets and inadequate first aid kits.

Oludipe and Etoboro (2018) also conducted a study on science education undergraduate students' level of laboratory safety awareness in Lagos state university, Ojo, Nigeria. They reported that science faculties simply don't consider instructions in

laboratory and chemical safety to be important enough to devote a whole course to the topic and this can be detrimental to the development of safety awareness among science students, hence the need to investigate science education students' laboratory safety awareness. Fifty (50) second year science education undergraduate students in the second semester of their degree program participated voluntarily in the survey, and a self-developed questionnaire titled Science Laboratory Safety Awareness Test (SLSAT) was used for the data collection.

The SLSAT was a thirty-eight-item multiple choice objective test with four options per item which was meant to measure the student's level of safety awareness with regard to good or safe practices, appropriate attire, emergency procedures, recognition of laboratory signs and clean-up of spills. The SLSAT was given to two lecturers of Faculty of Science, Lagos State University for its face and content validity. The study employed descriptive survey design, questionnaire was used to gather data and percentages, mean frequency and t-test statistics were used to answer the research questions. The findings of the study revealed that awareness demonstrated in students' responses to the questions related to good/safe practices (96%), appropriate attire (80%) and emergency procedures (72%). The study revealed that students lack awareness in two important safety issues; clean-up of spill (38%) and recognition of laboratory signs/symbols (0%) and the study also revealed that there is no significance difference in the level of safety awareness of both male and female students and recommendations were made based on the findings that both

the students and science based faculties should bear in mind that knowing and following safety practices are part of learning in science.

Adah (2019) conducted a study on assessment of laboratory management skills among chemistry teachers in Ogoja Educational zone of Cross River state. The study was carried out to determine the aspects of laboratory management skills most frequently utilized by the teachers and to find out if gender is an influential factor in the utilization of laboratory management skills. Descriptive survey design was used to assessed the most frequently used laboratory management skills. Two null hypotheses and two research questions were formulated for the study. Two hundred and twenty (220) chemistry teachers were selected via stratified sampling techniques from the population of four hundred and forty-nine(449) secondary school chemistry teachers in public schools in Ogoja Educational zone of Cross River state, Nigeria. A modified Likert scale type research instrument adopted was titled Chemistry Teachers Laboratory Management Skills Checklist (CTLMSCL) which was employed to generate data. The instrument was validated by two specialists in chemistry and one expert in measurement and evaluation all in Cross River University of Technology while the reliability of the instrument was tested with the use of Cronbach alpha method within SPSS package which was considered to be good enough to collect credible and reliable data for the study. The data was analyzed using the descriptive statistics, t-test and repeated measures analysis of variance (ANOVA) at 0.05 level of significance. Findings indicated that the laboratory management skills mostly utilized are ordering, stocking, maintenance and safety while Gender is not a significant influential factor in utilization of

laboratory management skills. Recommendations was made based on the result of the findings that teachers should be encouraged to undergo further training to be able to acquire new knowledge and skills in laboratory management.

Muhammad (2017) conducted a study on assessing the laboratory safety and security skills among science technology and mathematics (STM) teachers in Sokoto state, Nigeria. It examines STM teachers' skills in the state-of-the-art procedures and practices. Descriptive survey design was adopted for the study and a sample of ninety (90) teachers of the core science subjects were selected through stratified random sampling method from the population of science teachers in Sokoto state. Thereby, three (3) research questions were answered based on the gathered data. The findings of the study indicated that the science laboratories in Sokoto state lack the most essential safety devices and also the STM teachers are safety conscious but they lack the skills for good planning of laboratory activities. Recommendations was made based on the findings of the study that there should be effective teachers' preparations and training program that emphasizes on the acquisition of skills and competencies as against the current system of training which is theoretically oriented.

Fagihi (2018) conducted a study on the level of awareness of safety measures practiced in school laboratories among pre-service science teachers at Najran University. The study examined the sources of safety measures awareness and the statistically significant differences among the sample responses due to specialization and grade

variables. A scale of forty-three(43) questions was prepared and the population of the study comprised of fifty-six(56) pre-service science teachers in the eighth level of physics and chemistry at the college of science and Arts, Najran University in the first semester of the academic year (2017-2018), while the sample comprised of forty-nine (49) female students was used for the targeted population sample. The scale covers the aspects of; laboratory risk management, proper laboratory practices and first aid for laboratory injuries. Descriptive survey design was adopted and four (4) research questions were raised and answered based on level of significance value.

Based on SPSS, the arithmetic averages and standard deviation were calculated to identify the level of safety measures awareness in the school laboratory. The t-test, ANOVA and Scheffé test were applied to highlight the significance of the differences in the sample's performance and their attitude according to the variables. Additionally, frequencies and percentages were estimated to identify the importance of knowledge sources as perceived by the participants. The result of the finding concluded that the awareness was low and the statistically significant differences among the sample responses due to specialization are in favor of chemistry and the grade is in favor of higher grades.

Nwele (2013) conducted a study on extent of availability of safety instruments/equipment in science laboratories in secondary schools in Ebonyi State in Nigeria. The study examined the extent of availability of safety instruments in science laboratories in secondary schools in Ebonyi state of Nigeria. The researcher used forty-five

(45) secondary schools and 180 science teachers and laboratory attendants were used for the targeted population sample. Descriptive survey design was adopted 11-item four-point scale structured questionnaire was used to collect data. The data collected were analyzed using mean and standard deviation for the research question while t-test was used to test the hypothesis at 0.05 alpha level of significance. Result of the data analysis revealed that the extent of availability of safety instruments is very low in secondary schools in Nigeria. The implication of this is that sustainable development of science laboratory skills in the state will be hampered. The researcher recommends that the government of that State should ensure that safety instruments are provided to a very high extent in secondary schools in the state.

Studies on Influence of Teachers' Gender on their Understanding of Safety Issues in the Laboratory

Over the years, science educators have identified multiple variables influencing laboratory safety attitudes toward science (Osborne et al., 2003). Gender is the strongest and most consistently influential. The nature of this influence, however, has been contradicted by different studies. Early studies found that males hold consistently more positive attitudes towards laboratory safety practices than females (Weinburgh, 1995), but more recent studies have reported that females are more positive in the laboratory safety attitudes (Murphy & Beggs, 2003).

Tsmango (2016) conducted a study on Science teachers' use of laboratory management skills which indicated that no gender differences in utilization of laboratory management skills in the aspect of stocking and ordering among science teachers which shows a conflicting report on gender role in the utilization of laboratory management skills i.e. gender is not a significant factor in the utilization of laboratory management skills.,

Okwo and Otubar (2015) conducted a study on Gender as factor in teachers' laboratory management skills. Two hundred and twenty chemistry teachers were selected via stratified sampling procedure from the population. The Chemistry Teachers Laboratory Management Skills Checklist was employed to generate data and it was analyzed using the descriptive statistics, t-test and repeated measures analysis of variance at 0.05 level of significance. It was opined that more male science teachers than females utilized, stocking, maintenance and safety from among the laboratory management skills. Such inconsistency in reports on gender role in the utilization of laboratory management skills, coupled with the persistent public outcry on the poor state of secondary school science laboratories across Nigeria has provoked the study which sought to assess the laboratory management skills most frequently utilized by secondary school science teachers in Ogoja Educational Zone of Cross River State.

Oludipe and Etoboro (2018) conducted a study on science undergraduate students' level of laboratory safety awareness in Lagos state University. The study sought to answer the research question, will there be any significant differences between male and female

students' current level of laboratory safety? The study employed the descriptive survey design and fifty-second-year science education students in the second semester of their program participated voluntarily in the survey. A self developed questionnaire titled 'Science Laboratory Safety Awareness Test' was used for data collection. The SLSAT was a thirty-eight-items multiple choice objective test with four options per item. Percentages, mean frequency and t-test were used to answer the research questions. With the use of t-test statistical package between the two independent variables in the findings shows that male respondents have better safety knowledge than their female counterparts. However, the study revealed that there is no significant difference in the safety awareness of both male and female respondents (t=0.78, df=48, p=0.44). Based on the findings of the study, recommendations were made,

Ayse and Rasit (2015) conducted a study that was carried out to determine whether laboratory attitudes of science teachers working in secondary schools change according to their gender, graduation field term of service and lots more. The study comprises of science teachers working in the center, towns and villages of Bitlis, Turkey between 2013-2014. No sampling method was used, the research was carried out with 110 teachers, questionnaire was used for the collection of data and SPSS was used for the data analysis. The findings show that 52 out of 110 teachers (47.3%) are female and 58(52.7%) are male which indicated that more than half of the science teachers working in Bitlis are male and the p-value is less than 0.05 which denotes that; there is a significant difference in terms of laboratory attitudes among science teachers by gender which is in favor of male teachers.

Sendil, Aksay and Orhan (2015) conducted a study on Investigation of pre- service science teachers' attitudes towards laboratory safety. The purpose of the study was to investigate the pre-service science teachers' attitude towards laboratory safety in relation to variables such as gender. The sampling of the study conducted by using survey method which consists of 135 first- and fourth-year students attending Science Teaching Department of Education in 2012-2013 academic year. At the end of the study, independent samples t-test was run to test whether there is a significant difference among the students' attitudes towards laboratory safety based on gender vary and the results concluded that out of the pre-service science teachers, 89 are females and 46 are males. Thus, the students' attitude scores for laboratory safety do not significantly change depending on gender ($t=1.44$, $p>0.05$). It was interpreted as the variables of gender does not have a significant effect on pre-service science teachers' attitudes towards laboratory safety and there is no statistically significant difference between the mean attitude scores of male and female students.

Onyeukwu (2000) opined that gender as the dichotomy of roles culturally imposed on the sexes. Teachers cannot be dissociated from the schools they teach andacademic results of schools. It would therefore be logical to use the standardized students' assessments results as the basis for judging the performance of teachers. Teachers celebrate and are rewarded when their schools and teaching subjects are highly ranked.

From the studies reviewed, it is apparent that teachers' gender is an important factor so as to have the ability to handle the laboratory safety issues and this study will investigate on the influence of science teachers' gender on their understanding of laboratory safety issues.

Studies on Influence of Teachers' Experience on their Understanding of Safety Issues in the Laboratory

Teacher experience has to do with the increased awareness of diversifying search for new ideas, new commitments and new challenges. Teachers' experience and knowledge of subject matter are unique qualities for teaching effectiveness. According to Rice (2010) the magnitude of the effect of teacher experience varies depending on the teacher's level of education and the subject area. It was opined that experience gained over time, enhances the knowledge, skills, and productivity of workers. These qualities facilitate students' skills and abilities to think about laboratory practices, useful for exploration and analysis, and also enables thorough understanding of safety concepts. Experienced teachers are great asset to novice teachers who need advice, encouragement and continuous guidance.

Okey (2012) stated that experience is directly related to teachers' ability to plan lessons, address divergent student responses, reflects on their teaching effectiveness and their ability to stimulate student inquiry. Akinyele (2001) and Commey-Ras (2003) commented that experience improves teaching skills while students learn better at the hand of teachers who have taught them continuously over a period of years. The teachers'

experience has a significant positive effect on student's achievement, with more than half of the gains occurring during the teacher's first few years, but substantial gains occurring over subsequent years; albeit, at a slower rate.

Azuibuike (2014) conducted a study on evaluation of safety practices in biology laboratories in selected secondary schools within Gumel Emirate, jigawa sate. The research instrument used for the data collection was sets of questionnaires and interview for the teachers and students. Ten secondary schools were selected randomly for the research work with a total of twenty-three teachers and one hundred students were used for the respondents. The data collected were analyzed, which revealed that teachers and students in selected secondary schools in Jigawa state have good understanding of safety practices and the teachers that constitute majorly (65%) are the B.S.Ed. holders with 5-10years of experience. Furthermore, teachers with long years of experience are confident in handling the laboratory equipment with safety measures.

Akpullukcu and Cavas (2016) conducted a study on development of laboratory safety questionnaire for middle school science teachers. The study was carried out with 127 teachers who has experience in science laboratories. The findings show the distribution range of years of experience with frequency and percentage; 49 participants have been working for 1-5 years, 23 for 6-10years, 23 for 11-15years, 12 for 16-20years and 20 for over 21years. The result of the findings was in favor of 1-5years of experience with a frequency and percentage count of 49 (38.6%).

From the studies reviewed, it is apparent that teachers' experience is an important factor so as to have the ability to handle the laboratory safety issues and this study will investigate on how science teachers' experience influences their understanding of laboratory safety issues.

Appraisal of Literature Reviewed

This study focuses on the assessment of secondary school's science teachers' understanding of laboratory safety issues. An attempt to this research work also views the knowledge of the science teachers with respect to gender, qualification and teaching experience in understanding the laboratory safety issues common in secondary schools.

Akpullukcu and Cavas (2016) conducted a study on the development of laboratory safety questionnaire for middle school science teachers. In this study, the questionnaire was adopted but lay emphasis on senior secondary schools' science teachers. More so, the geographical locations are different, Akpullukcu and Cavas conducted their study in Aydun, Turkey while the location of this study is Kwara state. The studies are both tested with the same validity and reliability process. 127 teachers were used for the population sample size while 150 science teachers were used in this study.

Azuibuike (2014) conducted a study on evaluation of safety practices in science laboratories in some selected secondary schools within Gumel Emirate, Jigawa state. Questionnaires and interviews were used in gathering in his study while Questionnaire only was used in this study. Ten secondary schools were selected randomly in Jigawa state for

his research work while eighteen secondary schools were selected randomly in Kwara state for this study. It used both Science teachers and students as the population sample while in this study, only science teachers are the sample of the study. There is an interrelated study in Azuibuike's study which is related to the science laboratory safety practices.

Fagihi (2018) conducted a study on the level of awareness of safety measures practiced in school laboratories among pre-service science teachers at Najran university. A scale of 43 questions was prepared in the questionnaire while a scale of 36 questions were prepared in this study but they both uses questionnaire as the research instrument. The population sample and geographical location also differs; 56 pre-service science teachers at Najran university were used as the population of his study while 150 science teachers in secondary schools in Kwara state were used in this study. Descriptive survey design was adopted and four research questions were prepared in both studies. T-test, ANOVA, frequency counts and percentages were used to analyze the gathered data in both studies.

Muhammad (2017) examines the laboratory safety and security skills among science technology and mathematics teachers in Sokoto state while this study assesses the understanding of science teachers on laboratory safety issues in Kwara state. Descriptive survey design was adopted for the studies. A sample of 90 teachers of the core science subjects were selected through stratified random sampling method from the population of science teachers in sokoto state while a sample of 150 teachers of the physics, chemistry and biology subjects were selected through a simple random sampling method from the

population of science teachers in Kwara state. Three research questions were raised in both studies.

Adah (2019) conducted a study on assessment of laboratory management skills among chemistry teachers in Cross River state while this study was conducted on assessment of science teachers' understanding on laboratory safety issues in secondary schools in kwara state. It was carried out to determine the aspects of laboratory management skills most frequently utilized by the teachers while this study will be carried out to determine level of understanding of science teachers in laboratory safety issues. They both conducted this study so as to find out if gender is an influential factor in understanding the laboratory safety practices but this study won't focus on gender influence only, it also focuses on how experience of the science teachers influences their understanding on laboratory safety practices.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter is concerned with the methods used in the course of the study. It aims to describe the proposed method of research. This chapter is divided into Research type, Research instrument, Validation of research instrument, Procedure for data collection and data analysis techniques.

Research Type

The suitable research type for this study is purely a descriptive survey research type. A survey research involves gathering of data of a target population from a sample and generalizing the findings obtained from an analysis of the sample to the entire population. The type of research adopted is the descriptive type which aim at obtaining data from a targeted population. It is this research that simply look with intense and systematic accuracy at the phenomenon of the moment and describes precisely what the researchers view.

Population, Sample and Sampling Techniques

The target population of this study are secondary school science teachers in Kwara State, that is, teachers in senior secondary classes one, two and three. A sample of 150 science teachers were selected randomly with the use of simple random sampling techniques without being biased. The population size of this study is 150 science teachers in Ilorin south and west Local Government area, Kwara state.

Research Instrument

The instrument used in this research work was Questionnaire adopted from the work of Akpullukcu and Cavas (2016). The questionnaire was entitled "The development of laboratory Safety questionnaire in assessing the understanding of secondary school science teachers". The questionnaire consists of two (2) section that comprises of thirty-six (36) items in which the respondents were required to tick the appropriate response to each of the points which consists of four (4) Likert scale: Strongly Agree**,** Agree**,** Strongly disagree and Disagree. Each response on the questionnaire was assigned with a numeric value between 4 and 1. A neutral answer was not included to have an exact and clear understanding (positive or negative) about their decision.

Validity of Research Instrument

Validity in research is the degree of an instrument to measure what it claims or supposed to measure. Thus, a research instrument is said to be valid, if it perfectly aligns with the stated objectives of the study. Content validity addresses the match between test questions and the content or individual area which are intended to assess. With regard to the validity of the questionnaire, the questionnaire items were edited and the pilot version of questionnaire was created by Akpullukcu and Cavas (2016) in the development of laboratory safety questionnaire. Exploratory factor analysis was used to determine the construct validity of the questionnaire which attempts to bring intercorrelated variables and also the possibility of using the output in subsequent analysis.

In this process, descriptive statistics and the correlation matrix (with the coefficients, significance levels, determinant, Kaiser-Meyer-Olkin (KMO), and Bartlett's test of sphericity, inverse, reproduced matrix, and anti-image matrix) were obtained. The Bartlett's test of sphericity should be significant (p<0.05) for the factor analysis to be considered appropriate (Pallant, 2005). Significance value is calculated 0.00 which is a >0.05 (p<0.05). The value shows that the data come from a multivariate normal distribution and are suitable for factor analysis. It was also explained with the use of total variance and scree plot (Graph) to determine how many components meet the criterion. The eigenvalue of a factor represents the amount of the total variance explained by that factor which is called the Kaiser's criterion. Only the factors with an eigenvalue of 1.0 or more are retained for further investigation (Pallant, 2005). Only the first six components recorded eigenvalues above 1 (19.46, 2.64, 1.71, 1.31, 1.15, and 1.02). These six components explain a total of 73.73% of the variance. The total variance of the first component is 52.59% while the other five components have a smaller percentage of variance with contiguous values to each other.

The questionnaire with single dimension is considered if the percentage of variance equals or is above 0.30 (Büyüköztürk, 2003). Therefore, it can be thought that the questionnaire has a single dimension. To strengthen the data, it is important to look at the scree plot. The screen test is one of the techniques that can be used to assist in the decision concerning the number of factors to retain. This involves plotting each of the eigenvalues of the factors and inspecting the plot to find a point at which the shape of the curve changes

direction and becomes horizontal (Pallant, 2005). The scree plot shows that there is quite a clear break between the first and second components. Component 1 explains or captures much more of the variance than the remaining components. It is then recommended to retain only one component. The relationship enabled the collapse of the 37 items into one factor. It indicates that the items in the questionnaire accumulate around a single dimension. After determining the number of factors, the analysis was repeated. It is understood that most of the items load quite strongly above 0.4 except item 24. The item 24 has a value of 0.32, which is smaller than the criterion value. This supports the conclusion from the scree plot to retain only one factor for investigation. As a result, item 24 was removed and the analyses was repeated. The component matrix shows the results after removing item 24, which shows that there are no other items with a value of less than the criterion value (0.4). Moreover, all the remaining items have a similar meaning which we called "safety issues" for the single dimension.

The reliability of the instrument was tested with the use of Cronbach's alpha reliability coefficient value and item-total correlation of test score were examined and was found to be internally consistent with high reliability scores. Cronbach's alpha was 0.98 which is good considering that 0.70 is the cutoff value for being acceptable (Kurnaz and Yiğit, 2010) and shows that the data indicate a high level of internal consistency. Item-total correlation of test scores explains the relationship between item scores and the total score of the test substances. High and positive correlation of item-total test score indicates internal

consistency. The Akpullukcu and Cavas (2016) questionnaire has a good internal consistency, with a Cronbach's alpha coefficient reported of 0.98.

The results from Akpullukcu and Cavas (2016) findings provide evidence that the instrument is valid and reliable for further implementation on wider scale and in larger samples and it also showed that the questionnaire has an appropriate scale to determine the secondary school science teachers' understanding towards laboratory safety issues.

Procedure for Data Collection

This research study aimed at assessing science teachers' understanding on laboratory safety Issues in secondary schools in Ilorin west and south local Government, Kwara state. For the purpose of data collection, the following procedures were used in collecting relevant data;

The researcher obtained an official letter of introduction being signed by the Head of Department (Science Education), University of Ilorin before going to the field to administer the questionnaire. This letter was to help the researcher to gain access from the principal of the selected secondary schools. On getting to the selected schools, the researcher seeks the consent of the respondents from the school Principal and vice principals and was later directed to the delegated head of department of science in the selected schools. During the administration of the questionnaire, some of the respondents also gives the researcher some useful information and advices from their wealth of experience which lasted for an hour and the respondents information were used to guide the research work.

The researcher employed the service of two research assistants so that the research assistant took charge of some part of the local governments in Kwara state so as to make the research administering easier and faster. The research assistants were trained by the researcher so as to work effectively and coherently to meet with the objectives of the study while the researcher supervised the research assistants to ensure thoroughness in the discharge of their duties.

After each administration of the questionnaire to each selected school, the vice principal academics signed and stamped the questionnaire as an evidence for being to the school. The copies of the distributed questionnaire were adequately completed and subsequently used for the analysis.

Data Analysis Techniques

The data obtained from the study were subjected to descriptive and inferential statistical analysis. Frequency counts and percentage were employed to answer the research questions while t-test and analysis of variance (ANOVA) statistical analysis were used to test the hypotheses at 0.05 level of significance. The data obtained were recorded and analyzed using Statistical Package for Social Sciences (SPSS).

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

This chapter presents the analysis of the data gathered with the use of an instrument titled "Assessment of Science Teacher's Understanding of Laboratory Safety Issues in Senior Secondary Schools in Kwara State". The data collected were analyzed using both descriptive and inferential statistics. For the demographic data, frequency counts and percentages were employed while t-test statistical and ANOVA statistical tools were employed to analyze the hypotheses at 0.05 level of significance.

A total of 150 copies of the questionnaire were printed and administered to the respondents in the study but only 148 of those copies were correctly filled and returned. Hence, the analysis in this chapter would be based on the 148 questionnaires that were neatly returned.

Demographic Information

The demographic data of the respondents entails the distribution of respondents by the moderating variables such as gender, teaching subjects, and teaching experience. Therefore, this section presents the results of data obtained from the respondents in frequency counts and percentages.

Table 1 shows the demographic data of respondents. Thereby, gender distribution of the respondents shows that 47.3% of respondents were male and 52.7% of respondents were female. This reveals that there were more female participants in the study than males.

While the frequency distribution of respondents' teaching subject revealed that, the subject with highest number of teachers was biology 78(52.7%), followed by chemistry 45(30.4%) and then physics 25(16.9%). While the frequency distribution of respondents' teaching experience observed that 42(28.4%) have 0-5years of experience, 56(37.8%) have 5-10years of experience and 50(33.8%) have 10years and above experience. This shows that the majority of the science teachers have 5-10years of experience.

Table 1

Demographic Data of Respondents

Variable	Frequency	Percentage
Gender		
Male	69	47.3
Female	77	52.7
Total	146	100
Subject		
Chemistry	45	30.4
Physics	25	16.9
Biology	78	52.7
Total	148	100
Teaching Experience		
0-5years	42	28.4
5-10years	56	37.8
10years above	50	33.8
Total	148	100

Research Question One: What is the level of teachers' understanding of laboratory safety issues in a senior secondary science laboratory?

Table 2 shows the mean and standard deviation of each item, which measure science teachers' understanding of laboratory safety issues in a senior secondary science laboratory. It is well observed that all the respondents have a mean score greater than the benchmark 2.5 indicating that all the respondents who are teachers highly agreed to the items. Thus, the teacher's level of understanding of laboratory safety issues in senior secondary science laboratories is high.

Table 2

Mean Rating of Understanding of Science Teachers on Laboratory Safety Issues

S/N	Items	Strongly Agree	Agree	Disagree	Strongly disagree	Mean	Std. dev.
1	I always ensure the laboratory is clean and tidy	102	44	3	0	3.64	0.59
2	I know the precautions to be taken in case of fire in the laboratory	68	67	8	4	3.33	0.78
3	I know the precaution to be taken in case of spills and splashes of chemicals	72	65	9	4	3.33	0.80
4	I know which emergency kits have to be in a laboratory for use in case of an emergency	63	70	10	4	3.27	0.81
5	I know the phone numbers to call in an emergency	44	71	15	18	2.97	0.91
6	I have information about the health status of my students	41	67	19	23	2.87	0.96
7	I know how the standard of an ideal laboratory for schools should be	86	56	5	3	3.49	0.70
8	I know how to use the ventilation system	48	80	12	10	3.09	0.84
9	I know how to use electrical and lighting in the laboratory	62	66	14	8	3.17	0.90
10	I know how to use water system in the laboratory	61	72	11	4	3.24	0.83
11	I know how to use gas installation	59	63	9	18	3.15	0.86

S/N	Items	Strongly Agree	Agree	Disagree	Strongly disagree	Mean	Std. dev.
12	I know how to use the fire extinguisher in case of fire	61	53	14	22	3.07	0.96
13	I know how to use the bucket of sand in case of fire	60	74	9	6	3.24	0.79
14	I know how to use the fire blanket in case of fire	58	61	12	18	3.11	0.91
15	I know how to design the desks for the students in the laboratory	60	69	13	7	3.18	0.88
16	I know the needs and uses of an emergency exit plan	61	58	21	10	3.06	1.02
17	I know how to use first aid kits in the laboratory	76	53	8	11	3.33	0.84
18	I know how to store and keep solid chemicals	66	65	11	8	3.24	0.86
19	I always make sure the shelves are firmly attached to the wall	66	63	10	10	3.24	0.85
20	I always make sure all shelves have the protection sets on the front sides	59	64	18	9	3.09	0.96
21	I know how to store and keep the liquid chemicals	74	57	10	7	3.32	0.85
22	I know how to store chemicals that need to have special conditions	59	64	13	14	3.13	0.91
23	I work with an inventory that has the identifications of all chemicals in the laboratory	57	58	17	16	3.05	0.98
24	I always wear a laboratory coat during the activities in the laboratory	82	47	11	10	3.33	0.89
25	I know what should be done in case of bleeding	64	59	15	12	3.15	0.94
26	I know how to respond in case of burn which occurs with contact with hot objects	68	61	13	8	3.23	0.90
27	I know what should be done if any chemical splash to the eyes	63	65	12	10	3.19	0.88
28	I know how to intervene if the need occurs in case of ingestion of any chemicals	59	68	9	14	3.18	0.84

S/N	Items	Strongly Agree	Agree	Disagree	Strongly disagree	Mean	Std. dev.
29	I know how to intervene if the need occurs with inhalation of chemicals	57	69	13	10	3.34	2.59
30	I know how to intervene in the accident that occurred as a result of an electric current	56	72	11	11	3.15	0.85
31	I never leave the laboratory without checking the gas installations	75	54	16	5	3.25	0.95
32	I never leave the laboratory without checking all electric devices	73	60	10	6	3.32	0.84
33	I never leave the laboratory without checking the water system devices	80	51	15	4	3.31	0.93
34	I labeled the remaining material and store them in an appropriate manner after each laboratory activities	72	62	10	5	3.32	0.83
35	I always take care of the laboratory materials and make sure they are put in the right places after use	85	49	13	3	3.37	0.89
36	I get students to wash their hands and face with water after the activities in the laboratory	65	68	12	5	3.24	0.86
	Grand Mean					**3.22**	

Research Question Two: What is the influence of teachers' gender on their understanding of laboratory safety issues?

H_{01}: There is no significant difference between male and female science teachers' understanding of laboratory safety issues.

Table 3 shows the calculated t-value was 0.16 while its calculated significance value is 0.27 at an alpha level of 0.05. On this basis, the null hypothesis that there is no significant difference between male and female science teachers' understanding of laboratory safety issues was therefore not rejected. This means that there was no significant difference in the experience of science teachers towards their understanding of laboratory safety issues between male and female teachers. The reason was that the calculated significance value (0.27) was greater than the 0.05 alpha level (ρ>0.05).

Table 3

t-test showing the difference in Science Teachers Understanding of Laboratory Issues based on Gender

Gender	N	Mean	Std Dev.	t-cal	Sig	Decision
Male	69	3.22	0.52			
				0.16	0.27	Not Significant
Female	77	3.21	0.45			

Research Question Three: What is the influence of teachers' experience on their understanding of laboratory safety issues?

H_{02}: There is no significant difference between the experienced, moderately experienced, and less experienced science teachers' understanding of laboratory safety issues.

Table 4 shows the calculated f-value was 0.99 while its calculated significance value is0.40 at an alpha level of 0.05. On this basis,the null hypothesiswas therefore not rejected.

This means that there was no significant difference in the experience of science teachers towards their understanding of laboratory safety issues. The reason was that the calculated significance value (0.40) was greater than the 0.05 alpha level (ρ>0.05).

Table 4

ANOVA table showing the difference in the Experience of Science Teachers towards their Understanding of Laboratory Safety Issues.

	Sum of Squares	Df	Mean Square	F	Sig.	Significant status
Between Groups	0.66	3	0.22	0.99	0.40	Not significant
Within Groups	31.78	144	0.22			
Total	32.439	147				

Summary of Findings

Based on the data collected, analyzed, and interpreted, the following findings were obtained;

1. All the science teachers agreed that they understand the laboratory safety issues in science secondary school laboratories. Thus, the level is high.
2. There was no significant difference in understanding of science teachers on laboratory safety issues based on gender (p-value=0.27, ρ > 0.05); and
3. There was no significant difference in the experience of science teachers(experienced , moderately experienced and less experienced) towards their understanding of laboratory safety issues(p-value=0.4, ρ > 0.05).

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

The study was set out to assess science teachers' understanding of laboratory safety issues in senior secondary schools in Kwara State. The study also sought to consider the respondent's demographic data. The variables considered in the demographic data of the respondents include gender, teaching subjects , and years of experience. In the course of the study, a research instrument was adopted from the work of Akpullukcu and Cavas (2016) to elicit the necessary information from the respondents. The instrument contained 36 items designed to assess science teachers' understanding of laboratory safety issues in senior secondary schools in Kwara State. Two null hypotheses were generated for the study and tested at 0.05 alpha level of significance using t-test and ANOVA statistical method. Thus, this chapter contains mainly the discussion of findings, conclusions, recommendations, and suggestions for further studies.

Discussion of Findings

The findings were discussed by supporting them with the evidence from related literature, despite the differences between these studies regarding community, environment, spatial and temporal dimensions.

The findings reached from this study revealed that all the science teachers understand the laboratory safety issues in secondary school laboratories. This finding is in line with Baurerle (2008) who emphasized that proper enlightenment of teachers on the nature of dangers associated with laboratory materials and strict adherence to the rules and regulations governing the use of laboratories will help in minimizing accidents if not total eradication of the accidents associated with the use of laboratory. Also, Azuibuike (2014) conducted a study on evaluation of safety practices in laboratories, the findings from the study revealed that teachers and students in the selected schools have good understanding of safety practices in the laboratory. The only contradiction from the study is the involvement of the students. Science Teachers should note that they are not only knowledgeable in the subject content but also, they make students know the hazards of working in the school laboratory and teach them preventive measures to ensure safety. The science teachers agreed that they are aware of the hazard that could occur while using the laboratory and measures that should be taken just as the ACS Committee on chemical safety has recently published some useful resources that provide a guideline for chemical safety in the academic institute and help in the identification and evaluation of hazards in research laboratories. Also, this findings is in line with Nwele (2013) which revealed that science teachers understood laboratory safety issues such as knowing the standard of an ideal laboratory, usage of the ventilation system, gas installation, ensuring proper usage of laboratory, and other rules and regulations regarding the use of some resources in the laboratory and the laboratory equipment.

The findings reached from this study revealed that there is no significant difference between male and female science teachers' understanding of laboratory safety issues. Both male and female teachers are equal in terms of understanding the proper usage of laboratory safe issues in senior secondary school. This finding is in line with Tsmango (2016) who observed that gender is not a significant factor in the utilization of laboratory management skills. Also, the findings of Oludipe and Etoboro (2018) revealed that there is no significant difference in both male and female science undergraduate students' level of laboratory safety awareness. Ayse and Rasit (2015) study contradicted the findings of this study, it opined that there is a significant difference in terms of laboratory attitudes among science teachers based on gender in which 52 out of 110 teachers were female and 58 were male I.e the result of the findings favored male teachers to female teachers.

The findings reached from this study revealed that there is no significant difference in the experience of science teachers towards their understanding of laboratory safety Issues in secondary schools. The findings of Azuibuike (2014) revealed that teachers with good understanding of safety practices that constitute majorly are the B.Sc.Ed. holders with 5- 10years of teaching experience. However, the findings in this study also revealed that the science teachers with good understanding of laboratory safety Issues are those with 5 - 10years of teaching experience with a frequency and percentage count of 56(37.8%). Therefore, the finding matches the findings of Azuibuike (2014). The findings of this study contradict Akpullukcu and Cavas (2016) study in which the frequency count of the teachers' experience is; 49 participants have 1-5 years of teaching experience, 23 for 6-

10years, 23 for 11-15years, 12 for 16-20years and 20 for over 21years. Thus, the findings were in favor of 1-5years of teaching experience. Finally, the years of experience of the teachers does not have a significant effect on the understanding of safety issues in senior secondary school this is supported by Okey (2012) which opined that experience is directly related to teachers' ability to plan lessons, address divergent student responses, reflects on their teaching effectiveness and their ability to stimulate student inquiry.

Conclusion

Based on the findings of the study, the conclusion reached was that Science teachers understand the laboratory safety issues in the senior secondary school laboratory, there is no significant difference in the understanding of science teachers regarding laboratory safety issues in senior secondary schools irrespective of the teachers' gender. Gender cannot influence the understanding of laboratory safety issues, lastly, there was no significance among years of teaching experience of science teachers' understanding of laboratory safety issues in senior secondary school.

Recommendation

Given what the research study discussed, it is recommended that;

1. Education stakeholders should create more awareness for science teachers regarding laboratory safety issues to manage hazards while using the laboratory.

2. Irrespective of the teachers' gender, they should equally be encouraged to be more involved in laboratory safety Issues practices.
3. Irrespective of the teachers' experience, they should equally be encouraged to be more involved in laboratory safety Issues practices.

Suggestions for Further Studies

1. This study assessed science teachers' understanding of laboratory safety issues in senior secondary school in Kwara state only. Thus, similar or subsequent studies or research work may be considered in the other states in Nigeria as their targeted population.
2. One hundred and fifty (150) respondents were used for the population size, future researchers should endeavour to use a larger sample size in other to make it more robust and tenable for generalisation.
3. The research type for this study was purely a descriptive survey, subsequent or similar studies may be considered using a pure experimental study.
4. Future researchers should also look beyond the demographic data (gender, teaching subjects, and teaching experience) that were used for this research work such as teachers' qualification, teaching duration and so on.

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APPENDIX

UNIVERSITY OF ILORIN, ILORIN, NIGERIA
FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE EDUCATION

ASSESSMENT OF SCIENCE TEACHERS' UNDERSTANDING OF LABORATORY SAFETY ISSUES IN SENIOR SECONDARY SCHOOLS IN KWARA STATE

Dear Respondent,

The purpose of this study is to assess your understanding of safety precautions, rules and issues encountered while using the laboratory. Please, read carefully and respond to the items in the questionnaire by completing the information below and tick(✓) the appropriate column for each statement as it applies to you. Kindly note that your responses and all information gathered shall be used purely for research purpose and treated with high confidentiality.

Thank you for your cooperation.

Yours sincerely,

ABIOLA, Fatimah Opeyemi

INFORMATION: Safety issues refers to the problems encountered in the laboratories but precautions are aimed to maintain the users of the laboratory such as students, teachers, laboratory technicians as well as materials, tools and equipment. It entails all the laboratory risk management, proper laboratory practice and first aid for laboratory injuries.

SECTION A: Demographic data of the respondent

Please, fill and tick (✓) the most appropriate response

Name of the school: …….....

Gender: Male( ) Female( )

Teaching subject: ……

Experience: 0-5 years ( ) 5–10years ( ) 10years–Above( )

SECTION B:

S/N	QUESTIONS	SA	A	SD	D
1	I always ensure the laboratory is clean and tidy				
2	I know the precautions to be taken in case of fire in laboratory				
3	I know precautions to be taken in case of spills and splashes of chemicals				
4	I know which emergency kits have to be in a laboratory for use in case of an emergency situation				
5	I know the phone numbers to call in an emergency situation				
6	I have information about the health status of my students				

S/N	QUESTIONS	SA	A	SD	D
7	I know how the standard of an ideal laboratory for schools should be				
8	I know how to use the ventilation system				
9	I know how to use electrical and lighting in the laboratory				
10	I know how to use water system in the laboratory				
11	I know how to use gas installation				
12	I know how to use the fire extinguisher in case of fire				
13	I know how to use the bucket of sand in case of fire				
14	I know how to use the fire blanket in case of fire				
15	I know how to design the desks for the students in the laboratory				
16	I know the needs and uses of an emergency exit plan				
17	I know how to use first aid kits in the laboratory				
18	I know how to store and keep solid chemicals				
19	I always make sure the shelves are firmly attached to the wall				
20	I always make sure all shelves have the protection sets in front sides				
21	I know how to store and keep the liquid chemicals				

S/N	QUESTIONS	SA	A	SD	D
22	I know how to store chemicals which need to have special conditions				
23	I work with an inventory which has the identifications of all chemicals in the laboratory				
24	I always wear laboratory coat during the activities in laboratory				
25	I know what should be done in case of bleeding				
26	I know how to respond in case of burn which occurs with contact to hot objects				
27	I know what should be done if any chemical splash to the eyes				
28	I know how to intervene if need occurs in case of ingestion of any chemicals				
29	I know how to intervene if need occurs with inhalation of chemicals				
30	I know how to intervene in the accident that occurred as a result of electric current				
31	I never leave the laboratory without checking the gas installations				
32	I never leave the laboratory without checking all electrical devices				
33	I never leave the laboratory without checking the water system devices				

S/N	QUESTIONS	SA	A	SD	D
34	I labeled the remaining material and store them in an appropriate manner after each laboratory activities				
35	I always take care of the laboratory materials and make sure they are put in the right places after use				
36	I get students to wash their hands and face with water after the activities in the laboratory				