PERCEPTION AND ATTITUDE OF UNDERGRADUATE SCIENCE STUDENTS TOWARDS LABORATORY SAFETY IN FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

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ABSTRACT

The study investigated the perception and attitude of undergraduate science students towards laboratory safety in Federal University of Technology, Minna, Niger State. The researcher adopted Descriptive cross-sectional survey research design for the study. The population of the study consist of 486 students from Biology department, Physics department, Chemistry department, Biochemistry department and Micro-biology department and the target population is one hundred and fifty (150) students which were randomly selected from the population of 486 undergraduate science students of Federal University of Technology Minna,(SLS and SPS)in 500 level using disproportionate stratified random sampling technique. The instrument for data collection was structured questionnaire. The questionnaire was validated by three lecturers from Science Education Department, an English expert and a Psychologist. One pilot sheet study was constructed among 30 undergraduate science students in Federal University of Technology, Minna, Niger State and a reliability coefficient of 0.86 was obtained and the instrument was considered reliable. The questionnaire designed for the study were administered to the selected respondents by the researcher and all the administered questionnaires were collected. The data obtained were analyzed using descriptive statistics (mean and standard deviation) and inferential statistics (t-test). Research question were answered using mean and standard deviation with a decision mean of 2.5. The findings show that, there is high perception and positive attitude of undergraduate science students towards laboratory safety behavior. Also there is no significant difference between male and female perception and attitude toward laboratory safety. The significant difference was analyzed using t-test. This led to acceptance of the two hypotheses at 0.05 level of significant. Finally, it had been recommended that laboratory safety knowledge improve performance among undergraduate science students in laboratory activities.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

A crucial situation arises when one is in danger but does not known, and problem becomes critical due to lack of its awareness of its existent. In increasingly and rapidly build technological development, a country must have skilled workers and are aware of the use of equipment and more modern machines. Thus, students at the time of the present generation have a very important role in the realization of these increasingly sophisticated technologies. Jalil (2014), states that based on Malaysia's Transformation Program of Vocational Education, the academic system in schools will be reduced and will be changed and the addition of industry practice or practical for technical students will be implemented to create a skilled and knowledgeable individual that can produce high quality and efficient workers. Therefore, Technical and Vocational Education (TVE) is the field of education under the administration of the Ministry of Education to provide extensive opportunities for students to develop their potential and talent.

Technical and Vocational Education offers programs that enable them to participate in a variety of technical and vocational fields such as culinary. In addition, the field of electrical and electronics, welding, automotive, business services are offered. Alavi *et al* (2015), explains that most students choose to pursue studies in technical and vocational fields, especially in the field of hospitality, better known as culinary. The hospitality industry is one field that allows students to become semi-professional potential and enable them to market themselves in the employment sector. This is because in this course, it is more focused on learning through practical methods.

The process of learning through practical methods carried out by the student's will make them vulnerable to accidents and personal safety while studying and doing

practical work process Hidayat *et al.*, (2016). Based on the report from Malaysia's Department of Occupational Safety and Health (2016), parts of accidents that occur as a permanent disability that often occurs in the laboratory. Tran *et al* (2013), stated that safety in the laboratory field should be considered especially when undergoing practical work in the laboratory. Accidents which are common in the laboratory can be avoided if students continue to adopt and comply with the safety measures that have been provided (Jaafar *et al.*, 2015). Therefore, to train and develop the necessary manpower towards industrialized countries, the students need to be trained in order to have the right attitude and diligence to work (Yusof, 2014). According to Negarav (2012), workplace safety is an aspect that should be the main focus in doing practical work while in the laboratory. It should be emphasized not only while doing practical work even it at any time when students are in the laboratory. Therefore, the students should always be aware of personal safety at any time and any place of studies because of an accident or disaster regardless of time and place. In addition, students also have to adopt a clear stance before touched and keep safety in laboratories.

Considering the backwardness of practical work for university science students in Nigeria generally, the poor experimental work and impact in laboratory can be inadequate provision of safety measures. Having realized the enormously important of practical in all area of science discipline, Laboratory is a room or space having some equipment and facilities in which practical works are carried out. The school laboratories are essential venues for science learning which endowed with hazards which lead to the occurrence of accidents and jeopardize the safety of all its users, especially the students. Laboratory accidents commonly happen in the academic environment, even though highly standardized engineering and administrative controls have been implemented including chemical fume hoods, local exhaust ventilation, a

high air exchange rate of general ventilation, registration of hazardous equipment/materials, provided induction training, conduction of regular safety inspections, and the provision of Personal Protective Equipment (PPE).

The intrinsic job nature of laboratory research is full of uncertainties to create new materials and gain knowledge by innovative methods such that the use of various hazardous materials or experimental conditions is unavoidable. However, this may pose unknown hazards to the tertiary laboratory workers such as research students, research staff and technical staff who have to handle chemicals as part of their assigned duties in the research laboratory of a university (A.U.C Walters *et al.*, 2017). In addition, although there could be precautions regarding the handling of hazardous chemicals that are known to be corrosive, explosive, oxidizing, flammable, harmful, irritating, radioactive or environmentally unfriendly, laboratory accidents and near-misses could happen unexpectedly in the ways of fires, leaks, glassware implosions or explosions, spills or equipment failure. Thus, it is important to safeguard the life and health of the workers by preventing accidents as well as reducing chemical exposure in the academic work setting.

Ozilgen (2011), indicates that the accident is a major contributor to students who have no disciplined in a laboratory. The attitude of selfishness in practical works in the laboratory make minor accidents and minor injuries. Mahmood *et al* (2007), argue that the attitude of students who do not take care the aspects of safety interests would be exposed to the risk of an accident. Negara (2012), suggested that students need to be trained by the instructors at the school in order to have the right attitude to work and have positive values such as discipline, patience and dedication in order for them to safely practice in the laboratory so that accidents can be avoided.

Ahmad (2015), states that students who have a positive perception of themselves on the facilities at the school, they will affect the performance of other students. This is because the perception of students on a matter like safety will give a positive outlook that could reflect the impact of better safety practices in a laboratory atmosphere and if the perception of the situation otherwise it can give a negative impact on safety practices in the laboratory. Thus, in the effort to reduce this problem, the study on perception, knowledge and attitude towards practice and safety in laboratories was conducted, to prevent the occurrence of accidents and creating a work environment that is comfortable and safe for students.

Although there has been no research on the correlation between safety attitude and safety practices, researchers tend to have positive view towards the concept of laboratory safety. The best approach to prevent an incident is to create a strong safety culture within an institution which is described as a reflection of the action, attitude, and behavior of its member concerning safety (Washington, 2012). The safety knowledge of laboratory workers on the potential hazards in a laboratory influences their safety awareness that is reflected on, in addition to a set of perception and attitude and behavior.

Laboratory safety standard in the research environment are difficult to develop due to the barriers like pressure to pursue grant-supported research, inadequate training, the complexity of the organization in cross-discipline collaboration research projects, and minimal top management oversight. In contrast, the industrial environment performs better due to the fact that the clear hierarchy of power and accountability of the employer are clear, and there are more experienced workers to conduct the tasks assigned (Hansa *et al*, 2011). Safety in laboratory is the responsibility of both students

and teachers. This study was undertaken to evaluate the perception and attitude of undergraduate science students towards laboratory safety in Minna, Niger State.

1.2 Statement of the Research Problem

One factor that has perpetually maintained the status of Nigeria education as a less developing country is practical aspect. Up to this moment, many undergraduate science students cannot be guaranteed of adequate knowledge of handling chemical and equipment publicly. Students pursuing associate and bachelor degree in science should aware that laboratory has maintained its status as the most important characteristic of teaching science than other fields of knowledge (Yahaya, 2018). Laboratory also plays a clear and tangible role in advancing this field of knowledge and making it more interesting and enjoyable for student, teachers and researchers. Harvard University (2012) emphasized that, awareness is the most fundamental rule for safety in achieving the goal of learning, innovation, useful research in laboratory and promoting the importance of laboratory works and research for the economic and social benefits of a country. Undergraduate science students are yet to be practices laboratory safety tips practical. This could be attributed towards awareness of laboratory safety, perception, and attitude towards laboratory safety readiness to practices laboratory safety during practical. It is necessary to study the practices of safety by students in the university. With this promises in mind, this research aims to explore the state of undergraduate science students perception and attitude towards laboratory safety in Federal University of Technology, Minna, Niger State.

1.3 Aim and Objectives of the Study

The aim of this study is to investigate the perception and attitude of undergraduate science students towards laboratory safety Federal University of Technology, Minna, Niger State. The objectives of this study are:

i. To find out the perception of undergraduate students in toward laboratory safety.

ii. Determine the attitude of undergraduate science students towards laboratory safety.

iii. Determine the perception of undergraduate science students towards laboratory safety based on gender factors.

iv. Ascertain the attitude of undergraduate science students towards laboratory safety based on gender.

1.4 Research Questions

i. What is undergraduate science students' perception towards laboratory safety?

ii. What is the attitude of undergraduate science students towards laboratory safety measures?

iii. What is the perception of undergraduate science students towards laboratory safety based on gender?

iv. What is the attitude of undergraduate science students towards laboratory safety based on gender?

1.5 Research Hypothesis

HO_1: There is no significant difference between male and female undergraduate science students perception towards laboratory safety.

HO_2: There is no significant difference between male and female undergraduate science students attitude towards laboratory safety.

1.6 Significance of the Study

The findings of this study will be of benefit to students, teachers, lecturers, researchers, and university management. The findings and recommendations of this study are expected to provide a process or framework which should assist Government in

making decisions on how to adopt laboratory safety measure in schools. The planners and policy makers are expected to use the findings of this study as a base for revising the current laboratory safety policy in order to overcome the challenges and accident occur in laboratory. Lecturers are expected to find the result of this study useful as it highlights challenges they face during laboratory activities. Further, findings of the study are expected to open areas for further study by other researchers and academicians, hence benefiting the whole community. It will help the teacher with the knowledge and techniques of using and adoption of undergraduate science students laboratory safety procedure.

Finally the performance of Students will clear the general public on how undergraduates science students perception and attitude toward laboratory safety.

1.7 Scope of the Study

The study investigates the perception and attitude of undergraduate science students is limited to undergraduate science students of Federal University of Technology, Minna, Niger State. The dependent variables of the study are attitude and perception, the independent variable is the laboratory safety and the moderate variable is the gender. The study will last for six weeks.

1.8 Operational Definition of Terms

Attitude: This is the sets of emotions, or beliefs and behaviour of undergraduate science students towards laboratory degree.

Gender: Male and female undergraduate science students whose perception and attitude towards laboratory safety will be investigated.

Laboratory: Is a facility that provides controlled conditions in which scientific research, experiments and measurement are performed by undergraduate science students.

Laboratory safety: Undergraduate science students states of being safe, free from occurrence or risk of injury and danger in laboratory.

Perception: This is the organization, identification, and interpretation of undergraduate science students sensory information of laboratory safety.

Safety: The state of being safe, free from the occurrence or risk of injury, danger or loss.

Undergraduate student: A university student pursuing a bachelor degree whose perception and attitude towards laboratory safety will be investigated.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The review of related literature to this study was carried out under the following heading;

Conceptual framework

Theoretical framework

Empirical framework

2.2 Conceptual Framework

2.2.1 Undergraduate Laboratory Reform

Reforms are also occurring at the tertiary level. The needs of the general science curriculum are changing, as general science is often a service course that is required of many college majors. However, the curriculum of undergraduate general science has largely remained the same since the 1960s. The American Chemical Society has created a task force to develop standards for science education at the undergraduate level (Cooper, 2010). Current ACS guidelines (2015), state that "to prepare students properly for the foundation laboratories, laboratories in introductory of science courses must be primarily hands-on, supervised laboratory experiences. Students need to be instructed in basic laboratory skills such as safe practices, keeping a notebook, use of electronic balances and volumetric glassware, preparation of solutions, chemical measurements using pH electrodes and spectro-photo meters, data analysis, and report writing." These goals for the laboratory program emphasize the importance of laboratory work.

2.2.2 Concept of Laboratory safety

The scope of managing safety and health in educational institutions is rather wide, especially in a university context, where it deals with numerous facilities, such as laboratories, hostels, and cafeterias. These facilities may cause various safety and health issues, which would require specific approaches to resolve. A laboratory setting, for example; may contain multiple hazards, including chemicals and hazardous equipment. This realistic concern highlights that students often faced a variety of risks, dangers, and threats in the laboratory that could result in accidents (Ismail *et al*., 2015). Gibson *et al.*, (2014), noted that accidents in laboratories in universities were still rising despite engineering control systems have been implemented. Laboratory accidents at universities cannot be prevented by engineering control systems, although the system might increase laboratory testing performances (Steward *et al*., 2016). Thus, Purohit (2018), asserted that the need to develop, consolidate and enhance safety culture, especially related to safety behavior is highly anticipated. This is because safety behavior is revealed as a crucial action that encourages safety compliance and safety participation. Previous safety researchers have clearly distinguished these two categories of safety behavior. Safety compliance denotes generally mandated safety behavior for the maintenance of safety at work. However, based on safety behaviour in a laboratory, Steward *et al*., (2016), indicates that critical issues were aligned to the changing students' attitude. Thus, university management should carefully develop, formulate and monitor laboratory safety policies (Schröder *et al*., 2016). The lecturers and laboratory personnel should also participate and take responsibility for implementing laboratory safety policies (Staehle *et al*., 2015). In addressing issues with regards to safety behavior in a university laboratory, safety compliance is a troublesome factor for students to undertake.

2.2.3 Safety Perception

Health Belief Model Rosenstock, (1974), suggests that in deciding whether to engage in protective behaviour, one factor that individuals take into account is their perceived susceptibility to the danger, in addition to the perceived efficacy of the behavior, perceived barriers to the behavior and perceived severity of the risk (Taylor *et al.*, 2017). Based on the Protection Motivation Theory, severity of hazard, the likelihood that harm will occur, and the effectiveness of the protective mechanism influence the likelihood that a person will engage in a protective behavior (Snyder *et al.*, 2017). From the theories, this can be concluded that higher perception of safety risk will be related to a greater likelihood of behaving safely (Taylor *et al.,* 2017). Based on Health and Safety Executive (2005), the psychological component consists of shared values, attitudes, perception and beliefs that drive decisions and behavior regarding safety (Kim *et al.,* 2017). Risk is the possibility of suffering harm or loss which has two main components, the probability and the severity of a consequence (Hussein *et al.*, 2010). It is important to understand the perceptions of safety in order to pave for better ways to manage the exploitation. Based on Şimşekoğlu, *et al.*, (2012), Sjöberg (1999), concluded that perceived risk may be relatively in line with objective statistical accident distributions, especially when the risk sources are overall well known in a community.

2.2.4 Teaching in Laboratory

Safety considerations are an issue for everyone exposed to potentially hazardous substances, persons who routinely work with chemicals, for example students and persons working in laboratories are particularly at risk (Walters *et al.*, 2017). Laboratory is the cornerstone of technological progress. Its safety education is an important part of laboratory management (Lawler, 2000, Massie *et al.*, 1995 on Li, *et*

al., 2016), which is the key step to ensure the safety of laboratory because the perfect safety education system can improve personal knowledge and skills (Li *et al*., 2016). Langerman (2009), concluded that most of academic laboratories are unsafe venues for work or study (Marendaz *et al.,* 2012). Based on Olewski *et al.,* (2017), there is general perception that risks in laboratory universities are lower than industrial processes, but what highlighted in the literature is that;

Often researchers are within a few meters of the operating equipment and typically closer when collecting experimental data than industry personnel, which are typically several meters away or housed in control room;

A. Researchers in close proximity to the operating equipment for longer periods of time, more so than is typical for industry.
B. University research laboratory are often involved in the development of new technologies and do not have proven designs to build from; and
C. Due to the nature of using students to operate the research laboratories, the turnover of operating personnel is frequent, and the sharing of process safety knowledge during a formal handover often does not exist.

According to Marendaz *et al.,* (2012) the evidence is still serious concerns about safety in the laboratory and especially in academia, probably due to the fact that they receive less attention compared to industrial production plants. Dramatic accidents happen regularly, most of them being only published in local newspapers but some are reported in literature. Chemical security and safety in laboratories has become an important issue at University of Indonesia, as there have been a number of chemical accidents including laboratory fire accidents, fatalities involving the use of hazardous materials and adverse health exposures (Lestari *et al.,* 2015). Chemicals used in the

laboratories can be hazardous. Studies indicate laboratory chemists may have shorter life spans, more diseases, higher cancer incidence and higher suicide rates particularly for females (Lestari *et al.,* 2015). Workers in biomedical and chemical laboratories have potential exposures to varieties of occupational hazard (Lestari *et al.*, 2015).

2.2.5 Safety Knowledge and Safety Behavior

Safety knowledge is defined as comprehension of acquired hazard and safety controls through safety training (Goswami *et al*., 2011). Keiser *et al.,* (2019), pointed out that safety knowledge had a relationship with safety behavior, including safety compliance and safety participation. This is because safety knowledge increases vigilance and makes people more responsible and alert while conducting their tasks. A study conducted by Gressgård (2014), on employees of petroleum, oil and gas industries indicated that safety compliance was influenced by safety knowledge. Nevertheless, a study conducted by Al-Zyoud *et al*., (2019) expressed that comprehension of safety symbols and hazards in the laboratory among chemical engineering students at the German-Jordanian University in Jordan was mild. This showed that students' attitude towards laboratory safety were lacking and needed more safety training and awareness activities or programs in the university. The association between safety knowledge and safety behavior could also be clarified by the connection of safety knowledge and safety participation. Individuals with stable emotions are considered fit to take part in safety activities, disseminate safety information and help colleagues resolve technical safety problems (Mirza *et al.,* 2019). After having considered the association between safety knowledge and safety behaviour as found in previous literature, the following hypothesis was proposed in this study.

2.2.6 Safety Motivation and Safety Behaviour

According Griffin *et al.,* (2016), and Sawhney *et al.,* (2019), safety motivation is the

desire of an individual to perform any job safely and be able to reduce accidents and injuries. The effect of safety motivation on safety behavior was contradictory. Chen *et al.*, (2014), found that safety motivation had a positive impact on safety compliance, rather than safety participation. However, a study conducted by Wen Lim *et al*., (2018) and Abdullah *et al.*, (2020), showed that safety motivation had an impact on safety compliance and safety participation. Conversely, Pedersen *et al.*, (2011), found that safety motivation had a positive relationship to compliance with safety as safety motivation was able to motivate an individual to comply with safety rules and procedures to increase safety goals. This association means that an individual is tempted by himself to meet the essential needs (Rybnicek *et al*., 2019). The purpose of an individual is often changed because each individual has different needs depending on their interests. In the case of employees, the primary motivation that led them to perform a good job was a beneficial incentive or wage (Grant, 2019). In this regard, employers should ensure that they can provide employees with a compelling motivation to increase their level of safety at work. Based on previous discussion, the following hypothesis was proposed.

2.2.7 Effect of Safety Commitment

Safety knowledge and safety motivation are proposed to affect safety behavior via safety commitment. Safety commitment is defined as the degree to prevent risky activities, obey procedures and trust the effectiveness of safety initiatives of the organization (Stackhouse *et al.*, 2019). Safety commitment among students becomes a vital element in reducing accident rates in the laboratory (Salazar-Escoboza *et al.*, 2020). A study conducted by Mostafa *et al.*, (2014), on student safety knowledge, attitude and behaviour in the laboratory showed that 71.40% of students reported using safety equipment and 61.20% reported using safety equipment while performing

hazardous research. Tsuji *et al.,* (2016) found that safety knowledge enhanced students' commitment to safety, particularly in chemical safety. This situation was owed to the safety knowledge that provided students' details on proper handling and disposing of chemicals. Similarly, Marendaz *et al.,* (2011), stated that the laboratory safety program at the university enhanced student commitment and safety knowledge. The present research investigated factors influencing students' safety behavior in laboratory safety. The researchers used PLS-SEM to test the underlying measurement model. In this study, safety commitment was added to the basic model of TPB to strengthen the relationship between SN, PBC and safety behavior in the laboratory. The objective was to understand the behavioral change among students towards laboratory safety. This is because the researchers intended to examine the role of safety commitment that could help improve safety knowledge, safety motivation and safety behavior among students, which in turn, could lead to increase laboratory safety in universities. Ajzen (2015), claimed that any variables could also be included in a TPB model, but only behavioral beliefs that are strongly correlated with behavioral attitudes have the ability to mediate the influence of the variable on purpose and have the same impact on normative and control beliefs.

2.3 Theoretical Framework

2.3.1 Technology Acceptance Model

To provide a more general theoretical foundation for reasoned actions, Davis (1985), has developed the Technology Acceptance Model (TAM) based on the theory of reasoned action. The Technology Acceptance Model Questionnaire can be used to evaluate the acceptance of SBOT because Technology Acceptance Model can be used to evaluate participants' satisfaction with online training as a medium of instruction (Alsofyani *et al.,* 2012; Arbaugh, 2000). The purpose of this model is to explain and

predict the acceptability of an information technology, analyzing and exploring factors influencing the acceptability of a certain information technology. TAM points out that Perceived Usefulness (PU) and Perceived Ease Of Use (PEOU) are two factors that can affect the attitude. According to TAM, behavioral intention has a positive and substantial effect on actual behavior. Lee *et al.,* (2003) have conducted a meta-analysis of 101 studies related to TAM published from 1989 to 2003. They discovered that 74 studies indicated a significant correlation among perceived usefulness, behavioral intention, and actual behavior while 58 studies indicated a significant correlation among perceived ease of use, behavioral intention, and actual behavior.

Based on the theory of TAU, TPB, and UTAUT, Terzis *et al.,* (2011), have developed a behavioral intention model for computer-based assessment. Participants of their experiment were 173 students taking information technology courses. Results of their experiment indicated that both perceived usefulness and perceived playfulness directly affected behavioral intention while computer self-efficacy, social factors, facilitating conditions, content and expected targets could indirectly affect behavioral intention. Sanchez-Franco (2010), has used the technology acceptance model to explore learning effectiveness of using information technology as a learning platform. Results indicated that perceived usefulness, perceived ease of use, and perceived playfulness all could be used to effectively predict the learning behavioral intention of students. Kim (2010), has applied the Theory of Planned Behavior (TPB) and the expectation-confirmation model for 207 mobile data service users to explore their behavioral intention to carry on using the service. Results showed that customer satisfaction, perceived usefulness and perceived playfulness were key factors for customers to continue using the service. Luzhou *et al.,* (2009), have used the Technology Acceptance Model and the flow theory to investigate Chinese users' behavioral intention regarding Instant Messenger.

They concluded that perceived usefulness and perceived playfulness significantly affected users' attitudes. Taking the Theory of Planned Behavior into consideration, they discovered that subjective norms and perceived behavioral control could also significantly affect behavioral intention. In addition, Davis, (1989), has performed a survey on the usage of email and document processing software by 120 employees in IBM Canada Laboratory. They found that employees' perceived usefulness, perceived ease of use, and usage of the software were significantly and positively correlated.

2.3.2 Theory of Planned Behavior (TPB)

The TPB is an extension of the TRA. In TPB, an additional construct and perceived behavioral control is added. Perceived behavioral control (PBC) is defined as an individual's perception of ease or difficulty of performing a behavior (Ajzen, 1991). The PBC construct additionally predicts intention. Hence, it makes general sense that the more favorable the attitude and subjective norm with respect to adopting a behavior, the greater perceived control and higher intention to perform or adopt a behaviour. With these basic concepts, TPB has been widely and successfully used in understanding and predicting human behaviors (Fishbein *et al.*, 2010). As of today, TPB has been used for many intervention programs such as in the field of nutrition Kothe *et al.,* (2014); public health (Armitage *et al.,* 2011); mental health (Skogstad *et al.,* 2006), and many more. A recent meta-analysis by Steinmetz *et al.,* (2016) supports and validates previous findings on the predictive ability of TPB constructs on various behavior change interventions**.** This theory can be applied in policy formulation of laboratory safety awareness in undergraduate science students.

2.3.3 Constructivism Theory

Constructivism has been linked most directly to students' learning and integration of course content. The principles of constructivism are not, however, limited to learning

course content; all information is situated in scenarios (e.g. personal experience and classroom setting) that affect the method by which it can be learned (Brown *et al.*, 1989; Jarvela, 1998). Information, such as how to learn in a certain setting, must also be learned in order to participate effectively in that setting. Social constructionism accounts for the interactions of individuals in the process of learning and developing meaningful knowledge (Vygotsky, 1962). That knowledge is further associated with the arena in which it is learned, and can best be learned in an atmosphere of situated cognition. Situated learning experiences are those in which the material is presented within or in conjunction with a context relevant to the material (Brown *et al.*, 1989; Hendricks, 2001; Stewart *et al.*, 2003). In science education, the laboratory would seem to be an appropriate place for situated cognition to occur.

Each student creates her or his own unique perspective of the purpose of the laboratory through experiencing the laboratory and the course as a whole. The intended purposes of the laboratory, as constructed by the professor, cannot be directly transferred to the student. The student has the will and ability, by nature, to build her or his own perspective, independent of professorial intentions. The conceptions that students construct lead them to develop unique approaches to or mechanisms for functioning within the structure of the laboratory. These mechanisms of interaction are based on the students' larger goal of learning the information that they perceive to be most critical, independent of the professor's intentions with respect to relevance. The students' perspectives of the laboratory are an as yet extremely under-explored area in science education. As such, there is little previous work on which to base the findings of this study. However, grounded theory is the theoretical framework that informs the data collection and analysis of this study. In grounded theory, the researcher endeavors to extract a theory grounded in the views of the participants in the study (Strauss *et al.*,

1990). Primary characteristics of this framework are constant comparison of data with categories as they emerge and sampling of different groups of participants to maximize the depth of information.

2.4 Empirical Study

Previous studies revealed that before conducting experiments, students did not perform safety assessments. A research conducted by Ayi *et al.,* (2018), found that before performing practical work, 27% of students had not done any risk assessment. A study revealed that 50 % of respondents did not use safety information to design their experimental procedures (McEwen *et al.,* 2018). Sieloff *et al.,* (2013), found that 65 % of students did not wear gloves while conducting dangerous experiments. Therefore, it is evident that students working in laboratories have had perpetually been in risky and unsafe contexts. Laurent *et al.,* (2020), precautious ideas on safety behaviour provide an opportunity to integrate and future research to analyze individuals and situational circumstances related to safety behavior. Jeknavorian (2016), found that students were committed to monitoring laboratory accidents that could occur. However, their motivation was still weak due to the lack of supervision by lecturers. In 2017, the ACS Division of Chemical Information and Chemical Health and Safety baseline survey identified several key findings that over a third have never included safety information in their research publications, the safety data sheet (SDS) is the primary source of chemical safety information. Half of the safety procedures are communicated verbally or not performed by the respondent; familiarity of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) is increasing in academic laboratory researchers and informal risk assessments are more common than using a formal risk assessment methodology.

Other factors, such as safety knowledge and safety motivation, were also closely linked to safety behavior and need to be discussed further (Laurent et al., 2020). Therefore, this study would investigate the attitude and perception of undergraduates' students towards laboratory safety, how safety knowledge and safety motivation directly affect safety behavior in the laboratory among students. Also, this study discusses the mediating effect of safety commitment on the relationship between safety knowledge and safety motivation in the laboratory among students.

Walid Al-Zyoud (2019), this study investigates the state of the perception of chemical safety in laboratories among undergraduate students of the Biomedical Engineering, Pharmaceutical and Chemical Engineering departments at the German Jordanian University in Jordan. A cross-sectional survey was conducted anonymously with a random sample size of 174 students. A questionnaire of 32 questions was designed with five sections: demographic data, familiarity of chemical hazard signs, attitude towards chemical laboratory safety, safety practices, and familiarity with emergency equipment and procedure. The descriptive statistics showed that students demonstrated fair to good familiarity and understanding of chemical hazard warning signs. Most students had poor to fair attitudes towards chemical laboratory safety; but the assessment of students' chemical laboratory safety practices revealed fair to good practices. While students safety awareness and practices, but not attitude, at this university were acceptable, safety procedures need to be implemented within a more professional safety education and coherent risk and safety climate management.

Ismail *et al*., (2018), conducted a descriptive survey to assess perception, knowledge, and attitude of science students in the course of culinary about safety practices in culinary laboratories. The population consisted of 90 students from the first year until the fourth year, which comprises the entire study population involved in practical

works in the laboratory. Non random sampling using a purposive sampling technique used as the sampling method and involved 60 samples. The instruments were a questionnaire to obtain information. Data were collected and analyzed statistically. Based on the pilot study analysis, the reliability of the instrument was 0.91 categorized as high. Results showed that good safety practices give positive influence on knowledge, attitude and perception of students towards safety practice in culinary laboratories. The study showed that a safe and orderly work culture is capable of creating disciplined and responsible attitude.

Yahea Ali (2018), attempts to identify the level of awareness of safety measures practiced in school laboratories among pre-service Science teachers at Najran University. It also aims to identify the sources of safety measures awareness and the statistically significant differences among the sample responses due to specialization and grade variables. To achieve the study objectives, a scale of (43) questions prepared and applied to a sample of (49) students. The scale covers the following aspects: Laboratory risk management, proper laboratory practices and first aid for laboratory injuries, in addition to a question about the sources of safety measures awareness. Results concluded that the awareness level of safety measures among pre-service Science teachers was low. There were statistically significant differences among the sample responses due to specialization, in favor of chemistry, and grade in favor of higher grades. The sources of safety measures awareness include undergraduate courses, faculty members, the laboratory safety manual, and websites .

Ryan Kristopher (2017), on his study determined the student perception towards safety awareness by factors of gender and college from which students are enrolled. A sum of 324 students enrolled in Physics10 (Mechanics and Heat) and Physics11 (Electricity and Magnetism) in the Mindanao University of Science and Technology (MUST) were

randomly selected as survey respondents. A modified survey questionnaire was used as research instrument. The results show that the students had positive level of safety awareness and perceived positively on the preventive measures to reduce laboratory risk. Further, regardless of gender students enrolled in Physics 10 were more positively aware towards safety awareness than students enrolled in Physics 11. Similarly, a variation among the students perception towards safety awareness from the College of Engineering and Architecture (CEA) and College of Industrial and Information Technology (CIIT) occurred. Overall, present findings indicate a need to introduce laboratory safety awareness in Physics classes.

2.5 Summary of Reviewed Literature

This research work was proposed to find out the perception and attitude of undergraduate science students towards laboratory safety in Federal University of Technology, Minna, Niger State. The gap reveals that students neglect or attitude towards laboratory safety is as a result of either inadequate awareness on its relevance or their non challant attitude. In order to curb this menace and enhance efficient laboratory safety, this study therefore examines the perception and attitude of undergraduate science students towards laboratory safety in Federal University of Technology, Minna, Niger State.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methods and procedures that will be used in carrying out this study which are research design, population, sample and sampling, research instrument, method of data collection, validity and reliability of instrument and method of data analysis.

3.2 Research Design

Descriptive survey research design will be adopted for this study because it is aimed at ascertaining the perception and attitude of undergraduate science students towards laboratory safety. The method is appropriate especially for seeking individual opinions, attitude and perception in their natural settings. Hence, the descriptive survey research design is considered appropriate for the study.

3.3 Population of the Study

The population of all undergraduate science students of Federal University of Technology, Minna, (SLS and SPS). The target population is 500 Level students with a total population of 486 from Biology department, Physics department, Chemistry department, Biochemistry department and Micro- biology department.

3.4 Sample and Sampling Procedure

The disproportionate stratified random sampling technique was used to select (150) participants comprising 30 students in each considered department in SLS and SPS. The participant will be disproportional stratified randomly selected between the following departments: Biology department, Physics department, Chemistry department, Biochemistry department and Micro- biology department.

3.5 Research Instrument

The instrument for data collection was structured questionnaire developed by the researcher from the review of related literature for the study. The questionnaire developed consists of two major sections, Section A contains biography of the respondents. Section B requires responses of alternatives options that ranged from strongly agreed to strongly disagree from the respondents to tick the option they thought was the correct response.

3.6 Validity of Instrument

After the development of the questionnaire, the questionnaire was validated by three lecturers from Science Education Department, English expert and a Psychologist. Their suggestion and recommendations was used to modify the instrument.

3.7 Reliability of Instrument

To obtain the reliability of the instrument: One- sheet pilot study was conducted among 30 undergraduate science students in Niger State College of Education, Minna and a reliability coefficient of 0.86 was obtained and the instrument was considered reliable.

3.8 Method of Data Collection

Letter of introduction will be obtained from the Head of Department, Science Education. The letter will be used to seek for permission from the HOD of the respective department where the research will be conducted. The questionnaire designed for the study will be administered to the selected respondents by the researcher assisted by the various representatives. All the administered questionnaires will be collected and completed by the respondents.

3.9 Method of Data Analysis

The data obtained will be analysed using descriptive and inferential statistics. Research question will be will be answered using mean and standard deviation with a decision mean of 2.5 benchmark and hypotheses will be analysed using independent sample t-test using Statistical Package for Social Science (SPSS) version 23.

CHAPTER FOUR

4.0 DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter deals with the presentation of result, analysis of data and discussion. The results from the analysis of the data were used to answer the research questions and the formulated hypothesis as highlighted in the first chapter of this research. The objective is to determine perception and attitude of undergraduate science students towards laboratory safety in Federal University of Technology, Minna Niger State.

Table 1 student gender analysis

Gender	Frequency	Percentage %
Males	75	50%
Females	75	50%
Total	150	100%

The table above it indicated that 150 students participate in this research study where 50% are male students and 50% are female students. This indicated that there is equal representation of both gender of participant in this investigation.

4.2 Research Question One: What is undergraduate science students perception towards laboratory safety?

To answer this research question mean and standard deviation was used and the analysis was presented below.

Table 2 perception of student on laboratory safety data analysis

S/N	ITEMS	SA	A	SD	D	$(\overline{X})$	S.D	Decision
1.	There should be knowledge of laboratory safety before entering the laboratory.	95	35	15	5	3.47	3.03	Positive
2.	The use of ornaments is not allowed while doing practical works in laboratory.	130	15	4	1	3.83	3.32	Positive
3.	There is an emphasis on laboratory personal safety while doing laboratory activities.	89	41	15	5	3.41	2.99	Positive
4.	Practical work in laboratory could be started without the lecturer's instructions.	10	30	40	70	1.87	1.59	Negative
5.	Understand the method of using equipment properly before making use of them.	105	15	21	9	3.44	3.05	Positive
6.	Equipment should be kept in a proper places in the laboratory.	130	8	7	5	3.75	3.29	Positive
7	Permission should be seek from the laboratory attendant before making use of the laboratory equipment.	140	6	1	3	3.89	3.38	Positive
8	Chemical reactions can cause fire hazard and release of poisonous gas in laboratory.	130	16	4	0	3.84	3.33	Positive
9	All laboratory activities have health risk.	126	14	8	2	3.76	3.27	Positive
10	Laboratory activities can be done without wearing hand glove and lab suit in the Laboratory.	50	10	86	4	2.71	2.36	Positive
	GRAND MEAN					**3.40**	**2.96**	

THE GRAND MEAN = 3.40

Table 2 shows the analysis of perception of student towards laboratory safety in Federal University of Technology, Minna, Niger State. It indicated that items 1 to 10 are positive response except item 4 which show negative response because the mean is less than the benchmark (2.50). However, the findings also show that the Grand mean and standard deviation are 3.40 and 2.96 respectively. Since the grand mean (3.40) is greater than the benchmark (2.50), it can be deduced that the undergraduate science students' perception towards laboratory safety in Federal University of Technology, Minna is high.

4.3 Research Question Two: What is the attitude of undergraduate science students towards laboratory safety measures?

To answer the research question mean and standard deviation was used and the analysis presented below.

Table 3 analysis of attitude of undergraduate student towards laboratory safety

S/N	ITEMS	SA	A	SD	D	$(\bar{X})$	S.D	Decision
1	Over-confident attitude of students during practical activities can cause a danger to others.	120	10	18	2	3.65	3.20	Positive
2	The major causes of accidents in the laboratory are students carelessness.	112	28	7	3	3.66	3.19	Positive
3	Safety knowledge and practices during practical classes in the laboratory can be applicable in real job outside school.	135	4	8	3	3.81	3.33	Positive
4	Science laboratory activities make learning permanent if done by using visual materials and laboratory.	105	28	10	7	3.54	3.11	Positive
5	Experiments conducted in laboratory are effective than traditional method of teaching.	80	45	15	10	3.30	3.90	Positive
6	The laboratory is always clean before being closing.	70	65	12	3	3.35	2.89	Positive
7	My laboratory studies improve my study habit and perception.	118	17	8	7	3.64	3.20	Positive
8	Laboratory apparatus and equipment should be used in the appropriate way.	129	16	4	1	3.82	3.32	Positive
9	Skills and knowledge of laboratory safety should be learn continuous.	50	85	11	4	3.21	2.75	Positive
10	Equipment used should always be cleaned after the completion of laboratory practical activities.	135	5	7	3	3.81	3.33	Positive
	GRAND MEAN					**3.58**	**3.12**	

GRAND MEAN= 3.58

Table 3 reveals the attitude of undergraduate science students towards laboratory safety measures in Federal University of Technology, Minna. From the analysis, items 1 to 10 are all positive because they have mean score above the benchmark of 2.50. Hence, the attitude of undergraduate students towards laboratory safety measures,

since the Grand mean and standard deviation (3.58 and 3.12) were above the benchmark of 2.50, it therefore indicates that there is positive attitude of undergraduate science students towards laboratory safety in Federal University of Technology, Minna.

4.4 Research Question Three: What is the perception of undergraduate science students towards laboratory safety based on gender?

To answer the research question mean and standard deviation was used and the analysis presented below.

Table 4 analysis of male and female perception of undergraduate science student towards laboratory safety

Gender	**N**	$(\overline{X})$	**SD**	**Mean Difference**
Male	75	3.51	3.05	
				0.23
Female	75	3.28	2.85	

The analysis of table 4 above shows the male and female perception of undergraduate science student towards laboratory safety. The table shows that the mean and standard deviation of male is 3.51 and 3.05 and the female mean and standard deviation is 3.28 and 2.85. This reveals a difference between the two groups and the mean difference is 0.23 in favor of the male.

4.5 Research Question four: What is the attitude of undergraduate science students towards laboratory safety based on gender?

To answer the research question mean and standard deviation was used and the analysis presented below.

Table 5 analysis of male and female attitude of undergraduate science students towards laboratory safety

Gender	N	$(\overline{X})$	S.D	Mean Difference
Male	75	3.68	3.21	
				0.20
Female	75	3.48	3.03	

Table 5 indicates the Mean score of male students having 3.68 and female students having 3.48 with Standard Deviations of 3.21 and 3.03 for male and female students respectively. This implies that there is a mean difference of 0.20 between the mean score of male and female students attitude towards laboratory safety.

4.6 Testing of Research Hypothesis

HO_1: There is no significant difference between male and female undergraduate science students perception towards laboratory safety.

To test the research hypothesis, t-test was used and the analysis is presented below.

Table 6 t-test analysis of perception of male and female undergraduate science students towards laboratory safety.

Gender	N	$(\overline{X})$	SD	Df	t	p-value	Decision
Male	75	3.51	3.05				
				148	2.17	0.06	Accepted
Female	75	3.28	2.85				

NS: Not Significant at $p > 0.05$

Table 6 shows the t-test of perception of male and female undergraduate science students towards laboratory safety. The table reveals the perception scores of male and female undergraduate science students towards laboratory safety [$t(148)= 2.17$, $p = 0.06 > 0.05$]. The p-value (0.06) is greater than the level of significance (0.05), that is

0.06>0.05. Hence, hypothesis one which states that there is no significant difference between male and female undergraduate science students perception towards laboratory safety is accepted.

HO_2: There is no significant difference between male and female undergraduate science students attitude towards laboratory safety.

To test the research hypothesis t- test was used and the analysis presented below.

Table 7 t-test analysis of attitude of male and female undergraduate science students towards laboratory safety.

Gender	N	$(\bar{X})$	SD	df	T	p-value	Decision
Male	75	3.68	3.35				
				148	2.14	0.061	Accepted
Female	75	3.48	3.03				

At 0.05 level of significant

Table 7 shows the analysis of the attitude of male and female undergraduate science students towards laboratory safety. The table reveals the difference in the attitude of male and female undergraduate science students towards laboratory safety [t(148) = 2.14, p = 0.06 > 0.05]. Hence, the null hypothesis two is accepted. This implies that there is no significant difference between male and female undergraduate science students attitude towards laboratory safety.

4.7 Summary of Findings

The following are summary of the findings from the study.

i. There is high perception of undergraduate science students towards laboratory safety behavior.

ii. The attitude of undergraduate science students towards laboratory safety behavior is positive

iii. There is no significant difference between male and female undergraduate science students perception towards laboratory safety

iv. There is no significant difference between male and female undergraduate science students towards laboratory safety

4.8 Discussion of Results

The investigation examines the perception and attitude of undergraduate science students towards laboratory safety Federal University of Technology, Minna, Niger State.

Table 1 show the student gender analysis. It indicates the percentage of male students (50%) and female students (50%) that participate in this research. Hence, there is an equal representation of both gender.

From table 2, 3, 4 and 5, the research questions one, two, three, four and five are answered using Mean and Standard Deviation. It was observed from table 2 that items 1 to 10 are positive except item 4 which show negative response because the mean is less than the benchmark (2.50). The findings also show that the Grand mean and standard deviation are 3.40 and 2.96 respectively. Since the grand mean (3.40) is greater than the benchmark (2.50), the undergraduate science students' perception towards laboratory safety in Federal University of Technology, Minna is high.

Table 3 reveals the attitude of undergraduate science students towards laboratory safety measures in Federal University of Technology, Minna. From the analysis, all items are positive because they have mean score above the benchmark of 2.50. Since the Grand mean and standard deviation (3.58 and 3.12) were above the benchmark of

2.50, it therefore indicates that there is positive attitude of undergraduate science students towards laboratory safety in Federal University of Technology, Minna.

It was observed from table 4 that the mean and standard deviation of male is 3.51 and 3.05 and the female mean and standard deviation is 3.28 and 2.85. This reveals a difference between the two groups and the mean difference is 0.23 in favor of the male.

Table 5 also indicates the mean score of male students having 3.68 and female students having 3.48 with standard deviations of 3.21 and 3.03 for male and female students respectively. This implies that there is a mean difference of 0.20 between the mean score of male and female students attitude towards laboratory safety.

Table 6 and 7 answers the research hypotheses using t-test at 0.05 level of significance. Table 6 shows the t-test of perception of male and female undergraduate science students towards laboratory safety and the table reveals the difference in the attitude of male and female undergraduate science students towards laboratory safety [$t(148) = 2.17$, $p = 0.06 > 0.05$]. Since the p-value (0.06) is greater than the level of significance (0.05), that is 0.06>0.05. The null hypothesis is thus accepted such that there is no significant difference between male and female undergraduate science students perception towards laboratory safety.

Table 7 also shows the t-test of attitude of male and female undergraduate science students towards laboratory safety and the table reveals the difference in the attitude of male and female undergraduate science students towards laboratory safety [$t(148) = 2.14$, $p = 0.06 > 0.05$]. Since the p-value (0.06) is greater than the level of significance (0.05), that is 0.06>0.05. Hence, the null hypothesis two is accepted which implies

that there is no significant difference between male and female undergraduate science students towards laboratory safety.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter deals with discussion of the result, conclusion, implication, recommendation and summary.

5.2 Summary

The study investigated the perception and attitude of undergraduate science students towards laboratory safety in Federal University of Technology, Minna, Niger State. The researcher adopted Descriptive cross-sectional survey research design for the study. The population of the study consist of 486 students from Biology department, Physics department, Chemistry department, Biochemistry department and Micro-biology department and the target population is one hundred and fifty (150) students which were randomly selected from the population of 486 undergraduate science students of Federal University of Technology Minna,(SLS and SPS)in 500 level using disproportionate stratified random sampling technique. The instrument for data collection was structured questionnaire, validated by three lecturers from Science Education Department, an English expert and a Psychologist. One pilot sheet study was constructed among 30 undergraduate science students in Federal University of Technology, Minna, Niger State and a reliability coefficient of 0.86 was obtained. The data obtained were analyzed using descriptive statistics (mean and standard deviation) and inferential statistics (t-test). The finding shows that, there is high perception and positive attitude of undergraduate science students towards laboratory safety behavior. Also there is no significant difference between male and female perception and attitude toward laboratory safety. The significant difference was analyzed using t-test which led to acceptance of the two hypotheses at 0.05 level of significance. Finally, it had

been recommended that laboratory safety knowledge improve performance among undergraduate science students in laboratory activities.

5.3 Conclusion

The purpose of the study is to find out the "perception and attitude of undergraduate science students of Federal University of Technology, Minna, Niger State". Findings from the analysis of the research question base on perception and attitude of undergraduate science students of Federal University of Technology, Minna of the research, indicate that 0there is perception of undergraduate science students towards laboratory safety, because the grand mean is greater than benchmark, the researcher agree upon to be 2.50.

The perception of male and female towards laboratory safety indicate that there is no significant difference between male and female perception of laboratory safety which lead to acceptance of hypothesis one. Also based on attitude of undergraduate science students towards laboratory safety, it was revealed that there is no significant difference between male and female attitude towards laboratory safety, which therefore leads to the acceptance of hypothesis two of the research question.

5.4 Recommendations

The present study recommends:

1. Conducting a comprehensive review of program for Science teacher preparation at Federal University of Technology, Minna, to include continuous activities in order to increase students' awareness, perception, attitude and knowledge towards laboratory safety practiced in school laboratories.

2. Giving the practical aspect of laboratory practices and first aid skills, a special attention should be acquired and evaluated through the process of teaching, lectures or performing experiments.
3. Incorporating activities in the practical education study plan to develop pre-service Science teachers' knowledge and skills in laboratory safety measures in school laboratories.
4. Overcoming the shortcomings of pre-service Science teachers in relation to work, skills and safety in the laboratory through appropriate in-service training and preparation programs.
5. Diversifying the sources of awareness and education for laboratory safety and benefiting from social media and new media channels.
6. Coordinating efforts between the university and the concerned authorities such as the Red Crescent and Civil Defense to disseminate and promote safety measures awareness in school laboratories.

5.5 Suggestion for further studies

1. The reality of safety measures in the educational laboratories in schools and universities.
2. Safety measures awareness in the laboratory among pre-service and in-service Science teachers (a comparative study).
3. Designing and testing a safety skills development program in school laboratories.

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APPENDICES
QUESTIONNAIRE

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

QUESTIONNAIRE: ON PERCEPTION AND ATTITUDE OF UNDERGRADUATE SCIENCE STUDENTS TOWARDS LABORATORY SAFETY.

Dear Respondent,

This Questionnaire is designed to elicit responses on the topic above. Please be rest assured that the information obtain from this survey will be kept with strictly confidential. Thanks for your participation and assistance. Your input is much appreciated.

Sincerely yours.

SECTION A

Instruction: Please tick (√) on appropriate option for each item.

Age: 15 – 20 ( ) 21 – 25 ( ) 26- 30 ( ) above 30 ( )

Gender: Male ( ) Female ( )

SECTION B

Tick (√) from the following options the appropriate position of under listed facilities in your school.

Where Strongly Agee = SA, Agree = A, Disagree = D and Strongly Disagree = SD

Section B: Perception of laboratory safety.

S/No	ITEMS	SA	A	SD	D
1.	There should be knowledge of laboratory safety before entering the laboratory.				
2.	The use of ornaments is not allowed while doing practical works in laboratory.				
3.	There is an emphasis on laboratory personal safety while doing laboratory activities.				
4.	Practical work in laboratory could be started without the lecturer's instructions.				
5.	Understand the method of using equipment properly before making use of them.				
6.	Equipment should be kept in a proper places in the laboratory.				
7	Permission should be seek from the laboratory attendant before making use of the laboratory equipment.				
8	Chemical reactions can cause fire hazard and release of poisonous gas in laboratory.				
9	All laboratory activities have health risk.				
10	Laboratory activities can be done without wearing hand glove and lab suit in the Laboratory.				

Attitude towards laboratory safety.

S/no	ITEMS	SA	A	SD	D
1	Over-confident attitude of students during practical activities can cause a danger to others.				
2	The major causes of accidents in the laboratory are students' carelessness.				
3	Safety knowledge and practices during practical classes in the laboratory can be applicable in real job outside school.				
4	Science laboratory activities make learning permanent if done by using visual materials and laboratory.				
5	Experiments conducted in laboratory are effective than traditional method of teaching.				
6	The laboratory is always clean before being closing.				
7	My laboratory studies improve my study habit and perception.				
8	Laboratory apparatus and equipment should be used in the appropriate way.				
9	Skills and knowledge of laboratory safety should be learnt continuously.				
10	Equipment used should always be cleaned after the completion of laboratory practical activities.				