THE INFLUENCE OF ELECTRONICS LABORATORY PRACTICES ON SKILL ACQUISITION BY TECHNICIAN TRAINEES IN NAIROBI COUNTY, KENYA.

BY

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DECLARATION

Declaration by the candidate:

This thesis is my original work and has not been submitted for any academic award in any institution; and shall not be reproduced in part or full, or in any format without prior written permission from the author and/or University of Eldoret.

Stella Kwamboka Okemwa **Signature ………………… Date …………….**

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Declaration by the University supervisors:

This thesis has been submitted for examination with our approval as university supervisors.

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DEDICATION

This study is dedicated to my beloved husband Jared Manyara, my children Enoch, Ellen and Elisheba.

ABSTRACT

Skill training for TVET graduates is very important as it prepares them to enter the world of work. Basic skills in electronics are acquired through regular laboratory instruction practice taken by trainees. This study aimed to investigate the influence of electronics laboratory practices on skills acquisition among technician trainees in public technical and vocational education training institutions in Nairobi County. The study sought to determine the skill levels among technician trainees. It also endeavoured to establish the influence of management and utilization of laboratory equipment, tools and materials and electronic laboratory instruction practices on skill acquisition. The study further sought to find out the existing TVET-industry collaborative practices on laboratory instruction and strategies used to enhance trainees' skill acquisition. The study adopted the mixed methods research design in which a concurrent triangulation strategy was used where both qualitative and quantitative data were collected simultaneously. The study's target population comprised electrical and electronics department heads, trainers and final year diploma trainees in the eight public TVET institutions in Nairobi County. The study used census, purposeful and convenient sampling methods to select the respondents for the study. The research instruments utilized in this study were questionnaires, interview schedule, and an observation checklist. Quantitative and qualitative data analysis techniques were employed. From the study, it was found that: the level of skills acquired by final year technician trainees was inadequate; effective management and utilization of laboratory equipment, tools, and materials for skill acquisition was neglected; electronics laboratory instruction practices as embraced could not effectively facilitate skills acquisition among technician trainees; there were no collaborations between TVET colleges and industry on laboratory instruction; trainers employed some strategies in laboratory practice owing to the challenges faced in laboratory instruction. From the above findings it was concluded that: the level of skills acquired by final year technician trainees made them ill-prepared for the place of work; TVET institutions lacked proper and adequate training laboratories, equipment, tools and materials; the influence of electronic laboratory instruction practices on skill acquisition could not be strongly established although there appeared to be a relationship between the two variables; the institutions had little interest in seeking out partnerships with the industry which would have been a great support in laboratory training of the trainees and the trainers made an extra effort by employing strategies to enhance the skill acquisition by technician trainees. It was, therefore, recommended that TVET institutions invest in adequate and quality laboratory facilities and equipment; place equal emphasis on both electronics theory and laboratory practice; develop collaborations with specific industries for purposes of supporting laboratory instruction, KNEC to make electronics laboratory practice examinable at diploma level and trainers to consider experiential learning to make technician trainees' laboratory learning more effective.

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ABBREVIATIONS AND ACRONYMS

BB	Bread Board
CBET	Competency Based Education Training
CBMC	Competency Based Modular Curriculum
DHOD	Deputy Head of Department
FGD	Focus Group Discussion
HE	Higher Education
HOD	Head of Department
KICD	Kenya Institute of Curriculum Development
KNEC	Kenya National Examination Council.
MoEST	Ministry of Education, Science and Technology
MoICT	Ministry of Information Communication and Technology
MoPSYGA	Ministry of Public Service, Youth and Gender Affairs
MoTID	Ministry of Transport and Infrastructure Development
NACOSTI	National Council for Science Technology and innovation.
NCA	National Construction Authority.
PCB	Printed Circuit Board
RMIT	Royal Melbourne Institute of Technology
SPSS	Statistical Package for Social Sciences.
TEP	Technical Education Programme
TVET	Technical and vocational Education and Training.
TVETA	Technical Vocational Educational and Training Authority
TX	Transformer
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEVOC	**UNE**SCO and **VOC**ational education

OPERATIONAL DEFINITION OF TERMS

Acquisition - Refers to the process of attaining a skill.

Electronics Laboratory/workshop - Refers to a room/facility equipped for laboratory practices

Laboratory practice - Refers to the customary, habitual, or expected procedure of conducting laboratory sessions in TVET institutions by trainers.

Module Three – Final year diploma trainees (students)

Skill – Refers to the ability to design, interpret and fabricate an electronic circuit professionally.

Technician Trainee - Refers to a learner-undertaking diploma in electrical and electronic engineering course in TVET institution.

Trainer - Refers to an instructor who conducts skill training in electrical and electronic engineering trainees in TVET institutions.

TVET institution - Refers to an established and accredited institution where teaching and learning of technical courses like electrical and electronics take place.

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May the Almighty God richly bless each one of you.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The chapter presents the background of the study which identifies why this topic deserves attention. It describes the research problem that was investigated and states the purpose of the study. The chapter proceeds to clarify the objectives of the study and research questions that the study sought to answer. The chapter, further, outlines the significance, scope, limitations of the study, with the theoretical framework that informed the study and ends conceptual framework.

1.2 Background of the study

An education system is expected to produce skilled workers to make a significant contribution in the world of work. Ozturk (2001) asserts that education is critical for the economic development of a country in addition to enhancing the productivity of the country's force. What this implies is that for any economy to grow, the education system must provide the workers who will participate in all sectors of the economy of a country including manufacturing sector. As a report of the National Construction Authority (NCA) (2017) asserts, that manufacturing is the key to a newly industrializing country, which is only possible with availability of highly skilled workforce.

The skills needed to drive the economy are imparted through technical and vocational education and training (TVET). Simiyu (2009) says that for improvement of any economy, TVET is the bridge between the school system and the work place. TVETA (2018) in its strategic plan 2018-2022 adds that, “TVET holds the key to building the technical and entrepreneurial workforce for driving the engine of industrial and economic growth” (p.1). According to Tumba & Shuaibu (2016), technical and vocational education aim at providing students with knowledge, attitudes and practical skills that will guarantee sustainable development. Bhurtel (2015) adds that vocational education equips trainees with employable skills which are required by the employers. Emphasizing the purpose of vocational education, Kailani, Gyallesu and Yaro, (2017) reveal that it ensures that there are no skill gaps in the economy by reducing “skill shortages through production of skilled manpower relevant to the needs of the labour market” (p.1382).

Vocational education is offered in Technical and Vocational Education and Training (TVET) institutions. According to Eze and Ekuma (2016), these TVET institutions have an enormous task of imparting the needed technical skills. Kailani, (2014) emphasizes that, TVET colleges are mandated to prepare students to be craftsmen and technicians who have required skills for jobs both in public and private sectors of the economy.

Kiprono, Okemwa, and Kanyeki (2020) point out that there is a relationship between technical skills acquired and skills required. Therefore, employers usually expect graduates to possess relevant skills as they join the industry. These employability skills must, at all costs, be factored in the curriculum. Dania, Bakar, and Mohamed (2014) emphasizes that the curriculum for teaching and learning will become more attractive if a special session or semester is held for students to conduct practical training. TVET must, therefore, meet the needs of the individual trainee in terms of making a graduate employable and also the employers’ needs in terms of skill requirements (Arnold & Stahl, 1967). Therefore, the demand by employers for graduates with employability skills requires high quality training by TVET institutions.

However, achieving high quality training is the greatest challenge. The fact is that the skilled manpower that employers are seeking to get require a thorough training but this is where the problem is (NCA, 2017). This aspect of low-quality training has also been pointed out by Technical Vocational Educational and Training Authority (TVETA). According to the TVETA (2018), TVET training in Kenya is of low quality caused by lack of trainers, lack of adequate equipment and resources. This has led to skills mismatch and shortages of relevant skilled personnel.

The training of skilled people in TVET institutions has attracted a lot of attention. Over the years, several strategies have been proposed to improve the possibilities of trainees acquiring the requisite technical skills needed by employers. These strategies include: developing innovative laboratory practices, offering the trainees productive learning environment to enhance practical skills acquisition (Mathew and Earnest, 2004); developing appropriate teaching, supervisory and assessment strategies for acquisition of practical skills (Tumba & Shuaibu, 2016); updating trainers skills, availing of necessary training tools and materials, facilities and equipment maintenance, continuous supply of power to workshops (Kailani, Gyallesu & Yaro, 2017).

However, even with the above proposed strategies, there are some challenges faced in skill acquisition. Among these challenges include: inadequacy of instructional materials, large class sizes, inappropriate teaching methods, poor supervision of trainers' performance, trainer's lack of design, obsolescence of machines and equipment, insufficient workstations (Dasmani, 2011).

The interest in skill acquisition has not left out the area of electrical and electronic technology. In electrical and electronic technology, students require technical skills to be functional at the work place. This enables trainees to carry out relevant work functions which include: inspection, identification of problems, test, diagnose or troubleshoot, and do repairs any fault on electronic appliances in the world of work (Alome, Ogumah & Uduafemhe, 2018). These skills can mostly be obtained in the electrical workshops and electronics laboratories. According to Krivickkas and Krivickkas (2007), it is impossible to conceive technical education without laboratory instruction. Herrera, Alves, Fuller and Aldunate (2006) add that laboratories must be present in any institution having technical education programs. This is for the simple reason that laboratory experience is inevitable as it helps trainees to integrate theory and practice thereby providing them with opportunities to develop the critical practical hands-on skills. Additionally, laboratory experience helps trainees to develop other important employability skills needed in the world of work. These skills include: effective communication skills, teamwork skills, personal responsibility, learning from failure, leadership skills (Krivickkas & Krivickkas, 2007; Salim, Puteh & Daud, 2009). Coppens (2016) adds that laboratory instruction makes theoretical understanding better through practice. This is accomplished through teaching students how to properly use equipment, fostering students' enthusiasm for their studies, and helping students to learn through social interactions.

The acquisition of skills among technician trainees takes place in various instructional laboratories. According to Krivickkas and Krivickkas (2007), instructional laboratories or workshops utilized in the various TVET institutions fall into three categories: hands-on laboratory; simulated laboratory; remote learning laboratories. The authors point out that the hands-on laboratory or workshop is the oldest. This laboratory usually requires trained technical staff to run it (Budhu, 2002). The trainees and trainers are required to be physically present during the training session (Gibbins and Perkin, 2013). The simulated laboratory, on the other hand, employs the use of computer operation to simulate or animate the conducted experiments (Chan & Fok, 2009). Virtual or simulated labs have activities that are simulated in advance and can be watched on a computer (Gibbons and Perkin, 2013) or on a smartphone. Finally, the remote learning laboratory is where students undertake laboratory learning activities on real equipment at a distance from a physical location of the hands-on laboratory, however, students use a computer to maintain control of input (Gibbins & Perkin, 2013). Adding on the remote learning laboratories, Herrera, Alves, Fuller and Aldunate (2006) say that these remote learning laboratories are advantageous in that students can access most expensive equipment from anywhere and anytime of the day if there is internet connection. Trainers can, also, connect to a remote lab to demonstrate experiments and explain concepts during a normal learning session in the institution.

All these three categories of laboratories play an important role in helping students acquire the important skills needed. However, according Chan and Fok (2009) point out that traditional (hands-on) laboratories may be preferred by students than remote and virtual because hands-on laboratories provide students a chance to acquaint themselves with real laboratory equipment, instruments and devices. The authors, further, assert that the other two should complement the traditional hands-on laboratory.

Although the electronic laboratory plays an important role in the acquisition of skills; little attention has been given to this aspect of training. This is evident from the fact that students are not prepared well for laboratory sessions and inadequate resources are availed to the students to enable them undertake necessary laboratory procedures (Watai, Brodersen & Brophy, 2005). Feisel and Rosa (2005) add that “while much attention has been paid to curriculum and teaching methods, relatively little has been written about laboratory instruction” (p.121).

Despite the little attention being paid to laboratory training, institutions and countries have made efforts to take specific actions to improve skill acquisition. In Malaysia, Salim, Puteh & Daud (2009) point out that, a Malaysia university, Universiti Teknologi Malaysia, reviewed the diploma curriculum in the year 2000 to ensure that laboratory experiments were separated from theory so that they are taught separately. Despite the challenges encountered, the institution strove to provide hands on training to their students.

Many countries, Kenya included, have also made efforts to improve skill acquisition. According to Sessional Paper No. 14 of 2012, the skill development system in Kenya has not been able to develop competent skilled people because the system employed was “curriculum-based, time-bound approach rather than demand driven approach” (Republic of Kenya, 2012, p.111). This approach to developing skills has been following a system commonly known as Technical Education Program (TEP). A look at the TEP curriculum shows that practical aspects of the TVET programmes were not clearly specified. According to the same Sessional Paper, this had not been able to meet the industry needs and this necessitated a shift to the Competency Based Modular curriculum (CBMC) program. In the CBMC the practical aspects of the course are clearly specified in the curriculum. However, according to the TVETA Strategic Plan 2018-2022, there is low quality TVET training (TVETA, 2018), probably because training in most TVETs is more of delivering theory as opposed to combining of theory and practice (Republic of Kenya, 2012).

There has also been a growing interest in the research on laboratories over the years. The studies have focused on various aspects of engineering laboratory. However, more gratifying is the fact that some of the studies have focused on laboratory activities and even laboratory practices. One of the was conducted in Belgium by Coppens (2016) to find out if there was a relationship between activities and learning in the electronics laboratory among engineering technology students. In this study, Coppens (2016) points out that the results failed to reveal the exact relationship between laboratory activities and eventual learning outcome as there was very little change in the learning outcome of the students after the laboratory exercise. However, the author reveals that, even though, there was a little change in the conceptual learning outcome, there was an increase in the procedural learning. This demonstrated that laboratories are playing a great role in enhancing student skills learning.

Salim, Puteh and Daud conducted a study in 2009 in Malaysia which reviewed current laboratory practices in a Malaysian University that had developed a new curriculum. The study found out that redesign of the curriculum and laboratory practices enhanced laboratory learning although the implementation of the curriculum had some drawbacks.

These two studies, among other studies, show a growing interest in the role of electronic laboratories because laboratories are critical in the acquisition of required skills. What is evident here is that these studies were done a university setting as opposed to a college setting level. Even those that have been done at college diploma level have focused on issues like factors influencing skill acquisition, strategies for skill acquisition, equipment and skill acquisition, and challenges of skill acquisition. This is the case in Kenya. Studies focusing specifically on electronic laboratory practices and skill acquisition were few. As this is the case, more research in the same line would be beneficial in the understanding of the area of skill acquisition.

1.3 Statement of the problem

Kenya is aiming to be a middle-income economy by the year 2030 (Ndung'u, Thugge, & Otieno, 2011). To attain this goal, there is need for a critical mass of high skilled workforce in various disciplines in a bid to grow the economy. To obtain these required skills, TVET institutions play a critical role in the acquisition of needed skills (TVETA, 2018; Wanyeki, Kitainge, & Ferej, 2012). For TVET institutions to fulfil this role, the institutions must ensure that the skills acquired by trainees are of high quality, relevant to the world of work and in the informal sector (Wanyeki, Kitainge, & Ferej, 2012).

However, according to TVETA (2018) there exists a mismatch between skills offered in TVET institutions and the skills needed by the industry. Because of this mismatch, there is large number of graduates from tertiary training institutions who are unemployed. Wanyeki, Kitainge, and Ferej (2012) attribute this unemployment to the failure by employers to participate in training activities and graduates lacking essential hands-on skills. This is reflected in the "striking disparities in the nationality of key engineers in major manufacturing industries and also the owners of the industry in Kenya" (p.20). In fact, the problem of graduates lacking practical skills is more serious in Kenya (Republic of Kenya, 2020).

According to Wanyeki, Kitainge, and Ferej (2012), the lack of hands-on skills has been attributed to several reasons. One of the reasons is low quality of training in TVET institutions. According to the authors these institutions have been laying emphasis on teaching theory at the expense of training the hands-on skills. This is because trainers are concerned with preparing students for theory examinations since there are no practical exams. Other reasons for lack of hands-on skills include: lack of facilities, equipment and materials; inadequately trained trainers; and outdated curriculum.

In Kenya, engineering has been identified as one of great drivers of vision 2030. According to a paper authored by the Ministry of Industrialization “Brief on Vision 2030 Manufacturing Sector,” engineering is seen as playing a critical role in manufacturing sector which is one of the Big Four Agenda. Since there is lack of technical skills, the Ministry of Industrialization proposes that the engineering training must be prioritized. The engineering curriculum for training engineers and technicians need to particularly address the practical aspects of the training which plays a big role in the manufacturing sector (Republic of Kenya, n.d.).

One of the engineering disciplines in TVET institutions that play a critical role in achieving vision 2030 is electrical and electronics. According to Pati and Bhawani (n.d.), electronics has “numerous applications in our daily life from home to any industry” (n.p.). The authors further point out that electronics is applicable in consumer, commercial, agricultural, industrial, communication, military and defence, automobiles, and aerospace among other areas. With these vast applications of electrical and electronics, there is need for quality training of technicians. Electrical and electronic technician training is a hands-on discipline that requires practitioners to possess the requisite skills to enable them perform the required tasks in the world of work. Feisel and Rosa (2005) assert that engineering is a hands-on profession where practice is very critical. Kailani (2014) adds that electrical and electronics programs in TVET institutions are aimed at training students to be craftsmen and technicians with the required skills for jobs both in public and private sectors of the economy. The author further adds that after completion of the course the graduates can venture into self-employment rather than being employed.

The training of the electrical and electronic technicians' hands-on skills takes place in electronic laboratories in TVET institutions. As Mathew and Earnest (2004) assert that the laboratory is the "primary location to develop the skills and competences that industry requires" (p.167) and it is "one of the best places in an engineering institution" (p.168). It is, thus, of great interest to understand what laboratory practices exist in TVET institutions as they try to impart requisite skills among their trainees.

There are a good number of research studies that have been carried out on laboratory instruction that exist. These studies have focused on: effectiveness of laboratory instruction in enhancing students' performance (Krivickkas & Krivickkas, 2007); students' activities and learning outcomes in the laboratories (Coppens, 2016), laboratory practice but narrowed to the assessment practice of the students in the laboratory (Salim, Puteh, & Daud, 2009), innovations in laboratory instruction (Mathew & Earnest, 2004). While these studies have made a significant contribution to our understanding effectiveness of laboratory instruction in skill acquisition, they have focused on one aspect or another on laboratory instruction. Additionally, many studies that have been carried out have been done at university level and few at diploma level. Therefore, a comprehensive analysis of electronic laboratory practices is needed to reveal the weaknesses of the existing practices. This would provide strategies for enhancing laboratory practice and ultimately improve acquisition of skills among technician trainees. This was the focus of this study.

In view of this, it was important for a study to be carried out in this area to find out the influence of electronics laboratory practices on skill acquisition among technician trainees in TVET institutions in Nairobi, Kenya.

1.4 Purpose of the study

The purpose of this study was to establish the influence of electronics laboratory practices on skill acquisition among electrical and electronic engineering technician trainees in public TVET institutions in Nairobi County.

1.5 Objectives of the study

The objectives of this study were:

i. To determine the skill levels acquired by technician trainees in TVET institutions in Nairobi County.
ii. To determine the influence of the management and utilization of laboratory equipment, tools, and materials on the level of skill acquisition among technician trainees.
iii. To establish the influence of laboratory instruction practices on the level of skill acquisition among technician trainees.

iv. To find out the TVET-industry collaborative practices that aided laboratory instruction practice.
v. To establish the electronic laboratory instruction strategies trainers used to enhance the trainees' skill acquisition.

1.6 Research questions of the study

To achieve the above objectives, the following research questions were presented.

i. How do trainees and trainers rate the level of skills acquired among the technician trainees in TVET institutions?
ii. Does management and utilization of equipment, tools, and materials influence the level skill acquisition among technician trainees?
iii. Do electronic laboratory instruction practices influence the level of skills acquisition among technician trainees?
iv. What are the existing TVET-industry collaborative practices that aid electronic laboratory instruction practice?
v. What strategies did the trainers use to enhance electronic skill acquisition by the technician trainees?

1.7 Significance of the study

This study is of great significance to a number of stakeholders. To education policy makers the study identifies the skill levels of the trainees which will enable them come up with policies that will encourage hands-on training in institutions offering technical training so that the trainee will achieve their desired goals. It will also help the curriculum developers revise the electrical and electronic curriculum to include specific skills trainees need to attain, equipment, tools and materials needed and the strategies employed in the delivery of the required skills. Trainers on the other hand will be enlightened on the strategies they should use in electronics laboratory practice as to be effective in the delivery of hands-on experience to trainees as stipulated in the curriculum. Electrical and electronic trainees, whose desire is to gain the requisite skills needed for the job market, will get enlightened on the skills they need to acquire before they graduate from college.

This study will also be important to the management/administration of the TVET institutions in their work towards producing graduates who are competent. This will help them acquire the materials, tools and equipment necessary for imparting skills on time to facilitate learning. Employers will also get enlightened on the level of skills acquired by their prospective employees and how they can contribute towards skill acquisition.

1.8 Limitation of the study

The study had some limitations. First, the sample selection was confined to TVET institutions in Nairobi County where the respondents may have a tendency of responding uniformly because of similar geographical location which is an urban area setting. Probably the respondents in rural areas may have different responses because of different geographical location. Second, since the respondents were from different TVET institutions, with different quality of equipment and facility, their responses were based on their different learning environments in as much they were in same year of study. Third, almost in all the institutions the electronic laboratories sessions were part of the lecture hours. It was hard to know when lab session was scheduled. So, the researcher had to confirm with the trainer involved for the actual schedule for the purpose of doing observation.

1.9 Scope of the study

The study sample included all final year (module 3) technician trainees, electronic trainers and HODs in electrical and electronics departments in TVET institutions. The reason for selecting the said sample was because the intended respondents needed a first-hand understanding of the skills required in electronic engineering for them to give approparíate responses.

1.10 Theoretical framework

In developing a theoretical framework on the influence of electronics laboratory instruction practices on skill acquisition, this study was anchored in Vygotsky's social constructivist theory. This theory was developed by seminal Russian psychologist known as Lev Vygotsky who was a psychologist best known for his social cultural theory. According to Adam (2017), this theory falls in the category of learning theories called constructivism theories. Constructivism theories views a learner as an active participant in the learning process in constructing new concepts or ideas. In this study the trainees were considered active participants in the laboratory practices as they aim to acquire the skills needed to be successful in the place of work.

Opara (2013) views social constructivism as anchored in Vygotsky's theory in which learning takes place because of social interaction between the learner and the trainer. What this implies is that the social environment plays an important role in the development and learning of an individual. In social interaction, learners can achieve more when working in groups than when learning alone. Citing Vygotsky, Purzer (2009) says that learners can learn more when guided or when they work in groups. This is possible because in group setting, learners learn within their zone of proximal development (ZPD) and get support because of enhanced social interaction.

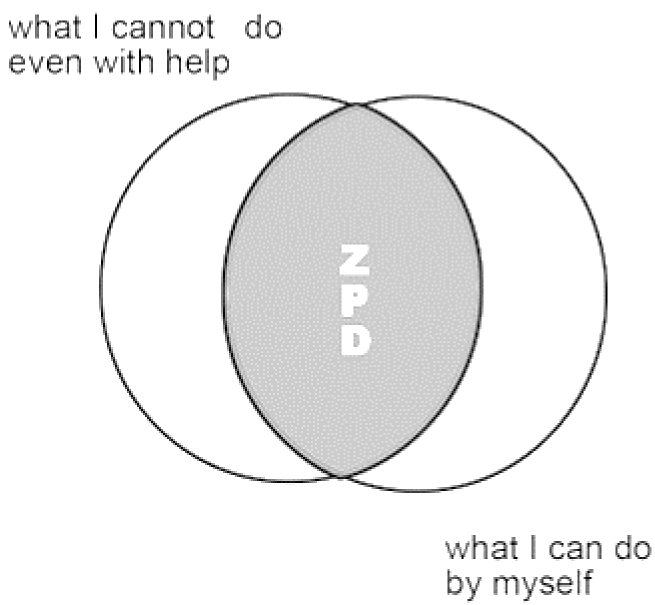

Figure 1.1 Zone of proximal development (ZPD)

(Source: Purzer 2010)

ZPD is the term employed by Vygotsky to help explain this aspect of learning through social interaction. ZPD refers to the "difference that exists between what a learner can do on their own and what they can do with help from trainer or more capable learners in class" (Purzer, 2009, p.1 citing Vygotsky). Figure 1.1 gives an illustration. In laboratory teaching and learning, which was the focus of this study, learners were guided by their trainers in the performance of the laboratory activities as they worked in groups. Because of social interaction with the trainer and fellow trainees in the laboratory, they were able to learn the necessary skills.

Although a good concept, there were challenges in operationalizing the concept of teaching in ZPD. According to Verenikina (2008), the term scaffolding was introduced by Wood, Bruner and Ross (1976) to solve this challenge. In normal context the term scaffolding refers to the temporary structure made of wooden planks or metal poles placed on the outside of a building, to be used by workers when building, painting, doing repairs, or cleaning. In educational circles, the term scaffolding instruction refers to "instructional techniques that help a trainer move students forward to stronger understanding of what they are learning and to a greater independence in their own learning processes and development" (Rousseau, 2018 n.p.). Cherry (2018) adds that learners are given appropriate "activities, instructions, tools, and resources known as scaffolding" that they require to learn a new skill. In this technique, the student is given more temporary support in the beginning which is progressively withdrawn as the learner becomes more knowledgeable and competent (Van Der Stuyf, 2002). In laboratory practice, scaffolding is very critical if the trainees must acquire the required skills. In this study scaffolding could be achieved through laboratory practices, tools, materials, resources like manuals and instruction approaches employed by the trainer.

According to Adam (2017), Vygotsky's social constructivist theory has several applications in education. The applications include: the reciprocal teaching in which the teacher and a group of students take turns being the teacher in interactive dialogues; peer collaboration where students cooperate while working on tasks; and "apprenticeships as they occur in cultural institutions like schools and agencies which helps in transforming learners' cognitive development" (p.6-7).

Some authors have recognized that Social Constructivist theory can be employed in the teaching and learning laboratory sessions. Explaining the relevance of constructivism in laboratory teaching and learning, Davies (2008) points out that the theory recognizes that students come to the learning environment with some knowledge and "that learning takes place by changing and adding to pre-existing knowledge or understanding" (p.6). The author, therefore, contends that laboratory sessions should be designed to consider learner's prior learning.

Davies (2008) identifies two models based on constructivism that are applicable to laboratory learning. One model is experiential learning, popularly called 'learning by doing'. The author points Kolbe's learning cycle with four stages (doing, reviewing, concluding, and planning) as the most popular model of experiential learning. The other model is enquiry-based and problem-based learning. This model is student-based and trainers act as facilitators. Enquiry-based learning can be employed in learning by designing "small-scale investigations and project work that may be conducted via practical or laboratory activities" (p.8).

In this study, Vygotsky Social constructivist theory was very useful in illustrating how the trainer and the trainee interacted to enable learning of skills take place. The theory also helped in identifying for the various elements that served as a scaffold to enable trainees attain the needed skills. Further, the theory assisted in showing how lab activities were organised to enable trainer-trainee interaction and peer collaboration.

1.11 Conceptual framework

The purpose of this study was to explore the influence of electronics laboratory instruction practices on skill acquisition among electrical and electronic engineering technician trainees in public TVET institutions in Nairobi County. Therefore, the conceptual framework for this study was formulated on the basis of study variables. Applying Vygotsky's Social Construction theory, the study conceptualized how the trainers' practices in laboratory instruction enable electronic technician trainees acquire the necessary skills. Since in Social Constructivist theory the teacher scaffolds the trainees from dependence to more independence, the conceptual framework shows how the trainer employs in various instruction practices to enable the trainee acquire the necessary skills while considering the intervening variables influence.

Figure 1.2 shows, the critical laboratory instruction practices that relate to the acquisition of skills by trainees in electronics. These include: effective management and utilization of equipment, tools and materials, electronic laboratory instruction practices, industry collaborative practices and trainer lab practice strategies employed to enhance skill acquisition. Practices in these areas determine the level of skills acquired and how students acquire the industry relevant skills in electronics. The conceptual framework is schematically presented as follows.

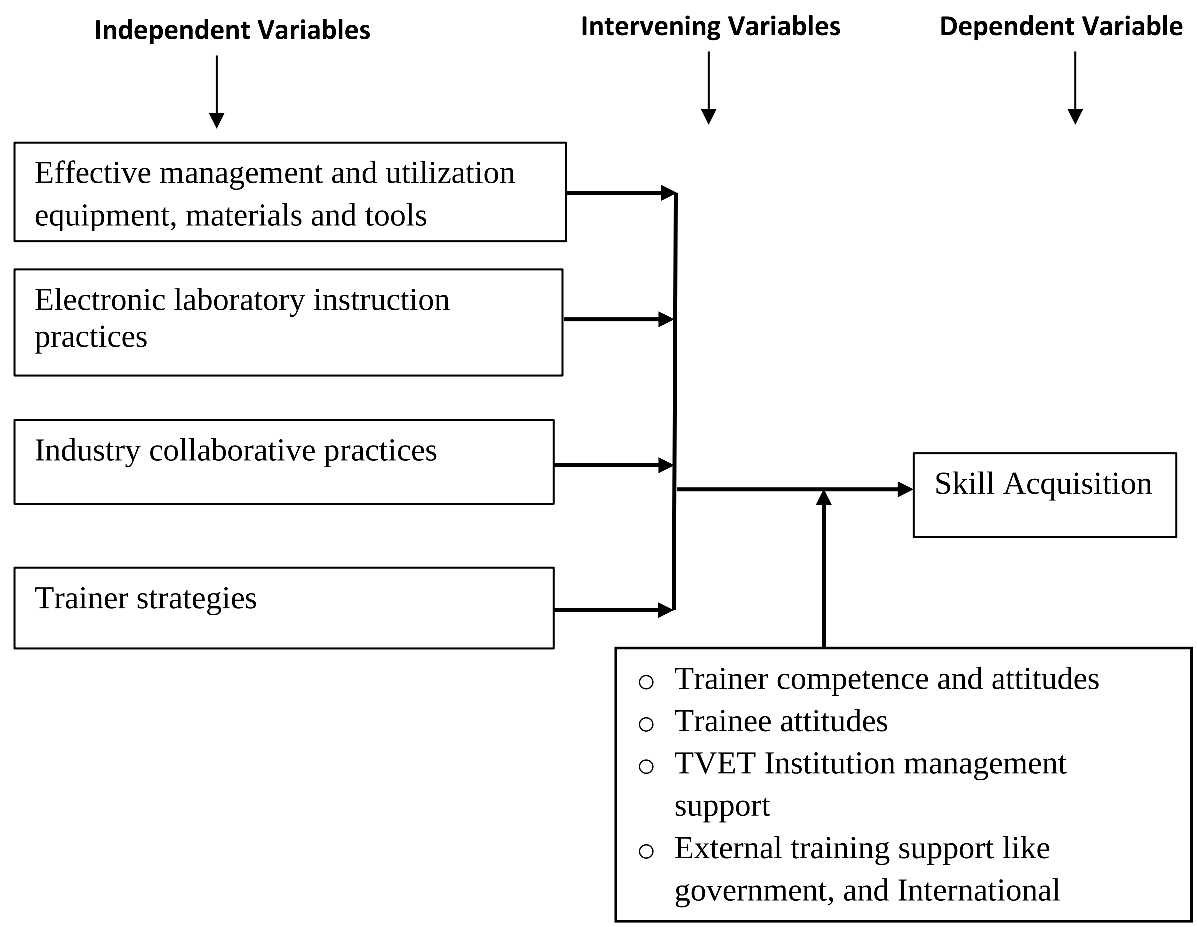

Figure 1.2: Conceptual framework

(Source: Author, 2019)

1.12 The summary of the chapter

This study was done to find out the influence of electronics laboratory practices on skill acquisition among technician trainees. This chapter laid the background of the study and identified the problem of investigation, the objectives to be achieved, and research questions formulated. The findings of the study are of benefit to policy makers, curriculum developers, trainers, electrical and electronic trainees, TVET institutions management, and employers. Vygotsky’s social constructivist theory was employed in trying to explain the relationship between the electronic laboratory practices and skill acquisition. Finally, the conceptual framework was developed that identifies the independent, dependent and intervening variables of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature related to this study. It focused on several areas including: technical and vocational education and training in skill acquisition; engineering instruction laboratories and their role in engineering and technical education. The chapter explored the various electronic laboratory practices in TVET institutions. A review of past studies on laboratory practices was done to see what others have done in this area of study.

2.2 Technical and vocational education and training and skill acquisition

2.2.1 Definition of skill acquisition

According to Thomas and Amaechi (2016), the term skill refers to "observable competence to perform a learned behaviour regarding the relationship between mental activity and body movement" (p.475). On their part, Ogundele, Feysetan and Shaba (2014) define skill as the "ability to do something, usually gained through training or experience that is needed" (p.51). From these definitions, skill can be explained as possessed observable abilities that enable one to carry out a task well. These abilities or skills are a result of the coordination of mental activity and body movements in the performance of a task. Acquisition refers to the act of obtaining something. Therefore, skill acquisition refers to the act of obtaining those abilities or competences that can be employed to do the job or perform a task. The authors further point out that when one possesses a skill, he can carry out a task naturally as if that performance is part of him or her. The possession of a skill comes because of repetitive performance or practice of task.

2.2.2 Importance of skill acquisition in a country

Skill acquisition is important to a country and society. According to Udo (2015) the benefits of a skill can be economical, political, social, and personal. Economically, acquisition of skills and competence enables a country achieve high productivity leading to sustainable development. The high productivity is brought about by the efficiency and effectiveness of the competent graduate. On the political sphere, the skills possessed by graduates of institutions and/or nation give greatness and pride to an individual and nation. This in turn determines behaviour of the individual or nation internationally. Socially acquired skills enables an individual provide "amusement, happiness, love, affection and enjoyment" (Udo, 2015, p.28) to society and the nation. On a personal level, qualified individuals with the requisite skills will be in a better position to engage productively in self-employment or full-time employment.

2.2.3 Role of TVET in skill acquisition

According to Ogundele et al. (2014), skills can be acquired through "education, training or experience that will inculcate into the individual on how to carry out or discharge effective responsibilities very well with the new knowledge" (p. 51). Arnold and Stahl (1967) assert that it is the responsibility of vocational education to produce highly skilled technical people all the way from high school to tertiary educational institutions. Vocational and technical education is normally offered in technical institutions. According to Nyataya (2019) it is

VET education which equip trainees with requisite skills for self-employment and self-reliance.

2.2.4 Factors affecting the acquisition of skills in TVET institutions

It is now common for students to leave college lacking the requisite skills needed in the world of work (Ogundele et al., 2014). There are several factors that influence the quality of skill acquisition among students. These factors fall into four categories: institutional, external, teacher related and student-related factors.

Among the institutional factors affecting skill acquisition is the number of students admitted. Dasmani (2011) points out that when the classes are large the resources needed for skill acquisition are not enough and this has a negative impact on the quality of training. In addition to the straining of the already inadequate resources, Kailani, Gyallesu and Yaro (2017) stress that large classes also make it difficult for lecturers to plan and carry out practical sessions.

Equipment and facilities (infrastructure) and related instructional materials and resources are another institutional factor affecting skill acquisition. This factor is related to the number of students admitted. The facilities and equipment needed to facilitate instruction and learning can be inadequate especially if the institution has many students because the workstations will be insufficient for any meaningful practical work (Udo, 2015; Kailani, Gyallesu & Yaro, 2017). According to Kumazhege and Egunsola (2014), this inadequacy of facilities also leads to the use of other alternatives for practical work and this will undermine the achievement of the course objectives. Watai, Brodersen and Brophy (2005), also, points out that when instructional resources are inadequate it leads students to rely heavily on the instructor. The net effect of this over-dependence on the instructor will result in great frustration by the teachers and their students and finally loss of interest in practical activities. Okolie and Ogbaekirigwe (2014) emphasize that this throws students into confusion when they proceed to the world of work after leaving school.

Related to the equipment and facilities is the poor maintenance culture of equipment and facilities in existing TVET institutions. According Kumazhege and Egunsola (2014) the nature and quality of facilities available in TVET institutions determine the quality of instruction provided to the trainees. Udo (2015) points out that facilities and equipment in schools and colleges especially in Nigeria were in a bad state and what is so disturbing is that heads of those institutions were not bothered with the state of equipment in their institutions.

Another institutional challenge or factor influencing skill acquisition is supervision of instructors' laboratory performance. Kailani et al. (2017) points out that the supervision of instructors while undertaking practical teaching in the laboratory is inadequate. Without proper supervision of the instructors in their teaching of practical skills will not make it possible for students to acquire the necessary skills.

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The other category of challenges affecting skill acquisition is the external factors. One of the external factors is the external curriculum support from government and other stakeholders. In the face of inadequacy of equipment, facilities and other instructional materials, Udo (2015) laments that there has been lack of willingness on government and other stakeholders like private organizations, local communities and even parents to invest in the purchase enough modern facilities and equipment to facilitate practical sessions for the students especially in developing countries.

Curriculum structure is another factor that affects adequate skill acquisition. The way the curriculum is structured has a negative impact on the acquisition of relevant skills. According to Udo (2015) the curriculum structure focuses more on theory as opposed to practical. What the author points out is that the curriculum allows more hours for theory than the number of hours that are allocated for practical sessions. Kumazhege and Egunsola (2014) concur with Udo (2015) that in most technical colleges, instruction rarely focuses on teaching practical skills hence resulting in students completing their studies without adequate skills in their various courses.

The other set of factors affecting skill acquisition among TVET trainees are teacher-related factors. One of the teacher-related factors is the number of training staff (teachers, laboratory technicians and technologists) in TVET institutions can also be a challenge. According to Udo (2015), in many TVET colleges there are few trainers or instructors for practical skills needed by the students to make them relevant in the employment world. The other teacher-related factor is the qualification of the trainers. Ogbuanya, Akintonde & Bakare (2017) revealed from their findings that teachers in technical colleges are inadequate in terms of “qualification and numerical strength to handle all practical lessons” (p.7512).

Finally, the last category of factors affecting acquisition of skills is student-related factors. One of the student-related factors is the negative attitude of students towards practical work (Udo, 2015). Kumazhege and Egunsola (2014) got similar findings on student attitude that it was negative towards practical lessons as they did not show much interest. According to Udo (2015), the students were having a negative attitude and low interest in the acquisition of professional skills and competence. This negative attitude could be because of the unsatisfactory practical session attendance hence leading to poor attendance of, low interest of, and lack of intellectual preparedness for practical sessions.

Lack of willingness by students to buy items and tools to facilitate their training is another critical student factor that affects skill acquisition. TVET institution may not be able to provide all the required tools for practical training. Students are required to buy tools, materials, and instruments like soldering iron, solder suckers, breadboards, and meters among others for their practice. Udo (2015) found out that the students were unwilling to spend money on buying materials and tools for the practical training.

Attendance of class and laboratory sessions is another student related factor that affects skills acquisition. Kumazhege and Egunsola (2014) carried out a study on skill acquisition and found out that attendance of laboratory sessions by students was unsatisfactory meaning that the possibility of the students gaining the necessary skills may be an uphill task given that they may not be able to cover the required content. Other student related factors that influence acquisition of skills include: punctuality in attendance, intellectual preparation, interest and motivation, physical preparation, attitude towards practical lessons, concentration in lessons, purchase of material resources for their own training, seriousness of students, gender mainstreaming, interest in skill and skills.

2.3 Training laboratories and TVET

2.3.1 Definition of a laboratory

According to Kostulski and Murray (2010) a laboratory, from a training perspective, refers to a “facility that allows students to engage with material and equipment and to conduct experiments” (p.66). The authors further clarify that the definition excludes any facility that is equipped with computer-only facilities for the purpose of training. A similar definition is given by the University of California. In its booklet, Facilities Inventory Guide 2002, the university defines a laboratory as a facility with equipment or designed for providing instruction in a discipline or a closely related group of disciplines. These activities may be individual or group in nature, with or without supervision. Laboratories are found in almost all disciplines including engineering. Based on this, an engineering laboratory can be defined as a facility within a training institution that is equipped with necessary equipment designed for providing instructional activities to engineering students to enable them acquire the relevant skills.

2.3.2 Types of laboratories

Feisel and Rosa (2005) classify engineering laboratories into three basic types. These are development laboratory, research laboratory and the educational laboratory. The development laboratory is solution oriented and is “used to answer specific questions about nature that must be answered before a design and development process can continue” (p.121). In other words, the development laboratory’s major focus is on two issues. One is providing data to engineers that will enable them design and develop a product. Two, is to ensure that designs perform as expected.

Research laboratory's basic concern is expanding the general knowledge in the field of engineering. The knowledge may be either natural knowledge or human developed knowledge. In this laboratory there is no practical use that is considered from the outcome or results of the research laboratory (Feisel & Rosa, 2005).

The educational laboratory, also called the instructional laboratory, is basically designed to equip students with skills, that is, helping them "learn something that practicing engineers are assumed to already know" (Feisel & Rosa, 2005, p.121). This is meant to prepare students for the world of work by equipping them with the necessary skills they need to perform in the industry. In this study the focus was on the education laboratory where students acquire the skills required for the world of work.

Educational or instructional laboratories are further classified into three types. According to Krivickkas and Krivickkas (2007) the three categories of instructional laboratories are: hands on laboratory or physical laboratory; simulated or virtual laboratory; remote learning laboratories. The hands-on or physical laboratory is considered the oldest type of laboratory and has equipment and real instruments. Budhu (2002) says that this type of laboratory requires technical personnel to make it function well. The virtual laboratory refers to the "environment in which experiments are conducted or controlled partly or wholly through a computer operation, simulation and/or animation either locally or remotely via the internet" (Chan & Fok, 2009, p.71). The remote learning laboratory on the other hand entails students undertaking laboratory learning at a distance from the physical location of the hands-on laboratory but the students maintain control of input through their computer (Gibbins & Perkin, 2013)

Among the types of instructional laboratories, there has been debate on which of three (hands on laboratory or physical laboratory; simulated or virtual laboratory; remote learning laboratories) is better placed to equip the students with required hands skills. Researchers don't seem to agree on which of the three labs are effective. Chan and Fok (2009) in their study found out that traditional (hands-on) laboratories may be preferred by students to remote and virtual. The reason for this was that hands-on laboratories provided students with a chance to acquaint themselves with real laboratory equipment, instruments, and devices. The authors, further, assert that the other two types (remote and virtual) should complement the traditional hands-on laboratory. A Comparative Review of Literature of 60 articles by different authors on Hands-On, Simulated, and Remote Laboratories by Ma and Nickerson (2006) revealed that it might be difficult to tell which of the three laboratories is effective because of two major reasons. One of the reasons is that as they have different objectives with hands-on laboratory concern with design skills, while remote laboratories emphasize conceptual understanding of the learners. The second reason is that the "boundaries among the three labs are blurred in the sense that most laboratories are mediated by computers, and that the psychology of presence may be as important as technology" (p.1). This makes it difficult to do any meaningful comparison. They proposed further research that probably integrated the use mixed methodologies.

There are some studies that have been done that attempt to mix methodologies. One of the studies that has been carried out by Taher and Khan (2015). The researchers carried out a study on the comparison between simulation and hands-on laboratories in teaching of an Electronics course. They found out that neither simulation nor hands-on only was effective in teaching the course. The study was carried out among 24 freshmen who were undertaking an 8-week Electronics and Computer Engineering Technology course in a private university. The course was a prerequisite for undertaking an engineering degree course at the university. Therefore, the researchers proposed that laboratory practice should be done in three steps. The first step is that the students undertake a lecture. In the second step the students carry out a simulated lab experiment, and in the final step the students undertake physical or hands-on laboratory work.

Another study by Chowdhury, Alam, and Mustary (2019) piloted 20 students at RMIT University with a three-step laboratory teaching and learning methodology for a fluid mechanics laboratory course. The teaching and learning methodology comprised of a video clip which students watched before carrying out the actual laboratory experiment or a computer simulation of the same. After this, the students submitted their work which was assessed and they were given feedback that enabled them improve their understanding of the experiment. Through this pilot study which was used on a number of engineering courses, they concluded that the methodology could be used in any engineering discipline. Their conclusion was that neither hands-on or simulations or web-based could be used alone but all are required to be used. However, a balance between them must be considered to “provide students with an appropriate level of simulated and hands-on laboratory experience” (p.810). From the above studies it can be concluded that all the three can be used with an appropriate balance to enable trainees acquire the required skills.

2.3.3 Role of laboratories in TVET

It can be asserted that the laboratory is a very critical component in skill acquisition. Mathew and Earnest (2004) point out that “in today’s competitive world, industry requires results oriented competent people to perform their jobs proficiently as soon as they are recruited from educational institutions” (p.168). In this respect the electronics laboratory training must be aligned to industry needs (Edward, 2002).

Davies (2008) in her booklet entitled “Learning and Teaching in Laboratories” outlines four benefits of laboratories in technical education. One of the benefits is the motivation of students’ interest in engineering. The manipulation of the equipment in the lab can make it more exciting for the student as they see how things function. The second benefit is the deepening of the students’ understanding of the subject. This comes about because the students can link the theory and practice. The third benefit the author presents is the opportunity students get in developing teamwork and communication skills. As students work together during laboratory activities, they interact and as such they can develop appropriate communication and teamwork skills. The final benefit is the development of engineering competence. Laboratory exercises enable the students to acquire the requisite skills required in the world of work and the professional field. This enables the engineering graduates to meet the expectations of their employers who require competent employees. These competent employees can perform their assigned tasks competently a soon as they start working.

2.4 Laboratory practices

There are various laboratory practices that may have a bearing on skill acquisition. These practices may, among others, include the following.

2.4.1 Management and utilization of equipment, tool, and materials and skill acquisition

Ogbuanya and Oziegbunam (2012) assert that when laboratory equipment, tools, and materials are managed and utilized properly, skill acquisition is assured among trainees. Effective management keeps equipment in perfect working condition for teaching and learning. It can be argued that perfectly working tools and equipment influence the quality of instruction positively because students have more time for laboratory activities.

One aspect of effective management and utilization of equipment, tool, and materials and skill acquisition is adequacy of laboratory space and equipment for electronic laboratory practices. When there is adequate laboratory space and adequate equipment the level of skill acquisition is enhanced among trainees. If laboratory space is matched with the student population, then trainees will have an opportunity to attend more sessions and will enhance their skill acquisition. However, the reality is that space and equipment are inadequate in many institutions. Kailani (2014) in his study on the adequacy of electrical and electronic laboratory facilities in technical colleges in Kaduna state, Nigeria found out that the facilities in both electrical and electronic labs were inadequate. In Kenya the situation is not any different. Mutua (2019) in a study on the adaptation of facilities for acquisition of skills among visually impaired students in two institutions (Machakos Technical Institute for the Blind and Sikri Technical Training Institute for Deaf-Blind) found out that facilities for training were not adequate.

The facilities and equipment to facilitate instruction and learning can be inadequate especially if the institution has many students because the workstations will be insufficient for any meaningful practical work (Udo, 2015; Kailani et al 2017). This is the situation in many institutions where laboratory space is not enough. According to Kumazhege and Egunsola (2014), this inadequacy of facilities also leads to the use of other alternatives for practical work and this may undermine the achievement of the course objectives. Watai et al (2005) points out that when instructional and resources are inadequate it leads students to rely heavily on the instructor. The net effect of this overdependence on the instructor results in great frustration among the teachers and their students and finally there is loss of interest in practical activities. Okolie and Ogbaekirigwe (2014) emphasize that this threw students into confusion when they proceeded to the world of work after leaving school.

Another aspect of management and utilization is guidance of students on the safe and proper use of equipment, tools, and materials. This minimizes breakages, injuries to the students and damage to a lot of expensive equipment during laboratory sessions (Nwachukwu, Bakare and Jika, 2009 cited in Ogbuanya and Oziegbunam, 2012).

Putting measures in place to safeguard laboratory equipment, tools, and materials from loss or misuse is another critical aspect of management and utilization of laboratory equipment. According to Muhammed (2009) cited in Ogbuanya and Oziegbunam, (2012), there are a lot laboratory equipment and tools that have been lost as a result poor record keeping and failing to put in place adequate measures to safeguard equipment, tools, and materials in laboratories.

Maintenance and repair of facilities and equipment is another critical aspect. Well maintained facilities and equipment are appropriate for training, but in many TVET institutions there is poor equipment and facilities repair and maintenance culture (Okwelle and Ojotule, 2018). Because of poor maintenance, infrastructure and training facilities TVET institutions are in deplorable state (Kemevor and Kassah, 2015). Udo (2015) points out that facilities and equipment in schools and colleges especially in Nigeria were in a bad state and what is so disturbing is that heads of those institutions are not bothered with the state of equipment in their institutions.

Acquisition of new equipment and replacing old ones is another area of effective management and utilization of equipment, tools, and materials for skill acquisition. Krivickas and Krivickas, (2007) in their study found out that laboratories with modern equipment are a good motivator to students learning skills in engineering. This demonstrates that it would be prudent that institutions continue acquiring new equipment and they should also replace old or damaged equipment. However, Ogbuanya and Okoli (2014) point out that acquisition of modern equipment is a challenge to most TVET institutions due to lack of funds for the purchase of new equipment.

2.4.2 Laboratory instruction practices

There are various laboratory instruction practices which include the following.

2.4.2.1 Incorporation of technology in laboratory instruction practices

According to Gibbins and Perkin (2013), technology has changed the way laboratory instruction is undertaken. The authors point out that technology can be employed in pre-laboratory activities which include: providing students with information on safety and health in laboratory; equipment use; and demonstration of the experiment to be undertaken. According to Powell, Anderson, Spiegel, and Pope (2002), the use of technology for laboratory session preparation frees a lot of time that is available for conducting of the experiment while at the same time allows more work to be done during the actual laboratory session. In addition, to technology supporting pre-laboratory activities, Gibbins and Perkin (2013) say that there is, also, the use of remote and virtual laboratories to support the hands-on laboratories.

Technology can also be used to replace physical laboratory activities. There has been research that has been carried out on the effectiveness of use of technology on laboratory instruction and on the effect of the use of simulations in remote laboratories training. Campbell, Bourne, Mosterman and Brodersen (2002) in their research on the effectiveness of learning simulations for electronic laboratories point out that learning in virtual laboratories can be equivalent to learning in physical labs. Gustavsson (2003) shares the same view that the outcome of practical laboratory work is the same regardless of whether it is done in physical laboratory or a virtual one. However, the effectiveness of this kind of learning is dependent on the user interactivity and the extent to which the simulations are close to the physical laboratory (Budhu, 2002; Balamuralithara & Woods, 2009). Further Balamuralithara and Woods (2009) assert that virtual learning cannot replace physical laboratories.

2.4.2.2 Laboratory scheduling practices

Laboratory activities can be scheduled either separately or together with the theory in the timetable. In some institutions the laboratory practice is handled separately where laboratory activities are considered as courses and even allocated course codes hence scheduled separately (Salim, Puteh, & Daud, 2009). Another way of scheduling laboratory practice is where the theory and practice sessions are scheduled together and then distribution of hours can be done between theory and practical based on features and type of the course (Krivickas & Krivickas, 2007). However, where theory and practice sessions are scheduled together the adequacy of time allocated for laboratory practice is not adequate (Ogbuanya, Akintonde, and Bakare, 2017)).

2.4.2.3 Teaching approaches

According to Audu, Kamin, Musta'amal, and Saud, (2014) in a study in north central states of Nigeria, skills acquisition among trainees can be made possible with competent teachers and employing appropriate teaching approaches. These appropriate teaching methods include: “demonstration, work-based learning, simulation, fieldtrip, context-based learning, discussion, problem-based learning, tutorials, and seminar methods” (p. 39). The authors also propose that teachers should use a variety of teaching methods since there are a variety of methods that are employed in teaching skills to students. From the various methods employed, Dogara et al (2018) found out the demonstration was the most common teaching method used in teaching skills acquisition. However, the researcher said that demonstration has its limitations in that it can be used to show a few skills, although the method is good in creating interest in the skill to be learned.

For laboratory instruction, Davies (2008) citing Hazel and Baille (1998), presents the five design options sequentially from the teacher – led demonstrations to the student – led projects. These options are: demonstration; exercise; structured inquiry; open-ended inquiry and finally project. The author says that the student-led projects can help students learn more skills.

2.4.2.4 Work organization practices

In terms of organization of laboratory activities, several ways can be adopted. According to Altalbe (2018) “laboratory exercises can be conducted individually by students, or the students can work in groups (2 or 3 students) to undertake the experiment.” (p.11). However, of these two working styles, the researcher says that working in groups is the most preferred working style during engineering laboratory instruction. Kostulski and Murray, (2010) in a study on laboratory education in Australia also found out that laboratory activities were organized around groups as opposed to individual students carrying out laboratory experiments.

In terms of access of the laboratory outside the scheduled hours, there are certain circumstances when students could access the laboratory outside the scheduled times. A study by Kostulski and Murray, (2010) in a survey the researchers carried out in Australia on laboratory education found out that although junior undergraduate students could only access the laboratory only during scheduled times, senior undergraduate and postgraduate students could access the laboratories unsupervised. Similar findings were found out by Gibbins and Perkin (2013) in an investigation carried out on how laboratory education was handled in the UK. The researchers point out that there are cases where students can have opportunities to do laboratory work outside the scheduled time. In this case the students could book a time when they could wish to go to the laboratory so that they are given an opportunity to do so. This provided students more opportunities to practice and master skills.

Also, in organizing laboratory activities, the number of trainees who attend a laboratory session is a great consideration for optimum achievement of instruction objectives. Citing School improvement in Maryland (2014), Mohammed and Inuwa, (2016) indicate that an ideal number that should attend is 24 students per session and when they are many, they shouldn't exceed 28 students per session.

2.4.2.5 Laboratory session preparation practices

For laboratory sessions, it is important to have adequate preparation. According to Rathod and Kalbande (2016) preparation for laboratory sessions should be encouraged. Davis (2008) asserts that preparation is very critical for any practical session therefore impacting greatly on the quality of skills gained. Proper preparation ensures that no time is wasted during laboratory session setting up the laboratory for experiment.

One of the areas of preparation for laboratory aspects is the consideration of the student population. According School improvement in Maryland (2014) cited in Mohammed and Inuwa, (2016), the number of students can impact on the quality of academic experience of the trainers hence recommend that for any meaningful learning to take place, the student population must not exceed the laboratory capacity. Therefore, during preparation, the trainer must ensure that if trainees are many he can plan to divide them into groups.

Equipment check is another important area of preparation. According to Mohammed and Inuwa (2016), before holding a laboratory session with trainees, it will be critical for the instructor and/or the technologist or laboratory technician to ensure that equipment is functional. This will ensure that no time is wasted during the laboratory session.

2.4.2.6 Laboratory session delivery process and assessment skill acquisition

According to Machotka, Nedic, Nafalski, and Göl, (2009) "student laboratory work involves the following steps and procedures: student preparation for experiments; conducting experiments; analysis of results; submitting practical reports; assessment; evaluation and reflection" (p.4). Davies (2008) says that the procedure for delivery and assessment of the laboratory session can have these phases: preparation, introduction, the session, end of the lab session. The introduction of the session briefs the students about the laboratory session objectives and expectations, the laboratory equipment to be used, steps and procedures, safety measures to be observed, relationship of the experiment to the entire course programme and to the real-world experience. The instructor may also invite questions from the students (Davies, 2008; Naghavi, 2014).

Once the students are introduced to the session, they enter the lab session and the instructor facilitates. During the session the instructor must supervise the students by ensuring participation of all students, find out if they understand what they are doing, giving them opportunities to practice, continually relate laboratory work and the world of work, encourage team work in the laboratory, reminding them of expectations (Davies, 2008; Naghavi, 2014). While supervising laboratory work, the instructor must make sure that he/she is approachable and maintains a positive attitude (Davies, 2008).

At the end of the laboratory session, the instructor must summarize the session findings and assist in drawing conclusions, provide guidance on writing of the laboratory session report, respond to student questions and concerns arising from practical work, ask them to rearrange the laboratory to ensure equipment are put back to their right places and clean up any mess (Naghavi, 2014), relate the practical work to the real world of work (Davies, 2008).

The laboratory session also needs to be assessed. Assessment of the laboratory session is a very critical component to tell the instructor if any learning of the practical skills ever took place. With this the instructor may be able to tell if any learning ever took place. According to Davies (2008) the ways of assessing the laboratory learning processes include: direct observations of the practical skills the students are learning; reflection on how the students worked and any improvement to be incorporated the next time; the planning of the laboratory work and time management.

In a study carried out in Australia, Kostulski and Murray (2010) found out that the various methods used in the assessment of the effectiveness laboratory instruction. Among these methods, observation and student demonstrations were used to assess the students during the session while laboratory report was used to assess students after the laboratory session.

2.4.2.7 Industry collaboration and skill acquisition

Mulati (2019) points out that collaboration between colleges and industry has a lot of relevance in skill acquisition among trainees. The same view is advanced by Krivickas and Krivickas (2007) in a survey carried out in a polytechnic in Lithuana. The researchers assert that collaboration with industry enhances the success of technical training. The authors, further, point out that colleges and industry have symbiotic relationship where industry sources workers from the colleges and colleges are supposed to receive training support from the industry in terms of modernization of laboratory equipment through donation of laboratory training equipment. According to Kostulski and Murray (2010), one university pointed out that it had enough equipment for laboratory instruction because of donations received from the industry. In addition to equipment from the industry, Krivickas and Krivickas (2007) stress that the industry is also expected to offer industrial training opportunities for college students to “work in a real environment with modern instruments” (p.195).

However, according Dasmani (2011), it is unfortunate there is a weak link between the training institutions and the industry hence whatever skills trainees received were not relevant to the requirements of the industry. Sang, Muthaa, and Mbugua (2012) also points out that a weak link between TVET institutions and industries can lead to a disconnection between what is taught in colleges and what is needed in the industry. This shows the importance of a good collaboration between TVET institutions and the industry. Consequently, a strong link between them means higher level skill acquisition and vice versa.

2.4.3 Challenges in providing effective practical laboratory instruction

According to a study by the National Society of Professional Engineers, (1982) among 26 colleges cited in National Research Council (1986) pointed several challenges making the laboratory instruction difficult. These challenges include: decline in the amount of engineering instruction; large number of students stretching the facilities; less time available for instruction; physical facilities in a poor state; inadequate equipment; inability of the institutions to acquire laboratory equipment at the rate at which technology advances in the industry.

Other researchers have pointed out similar challenges. Ogbuanya, Akintonde, and Bakare (2017) in their study on the practical skill training among electrical and electronics trade students in Osun State, Nigeria found out that there was inadequate amount of time allocated for development of practical skills; inadequate equipment and facilities in TVET institutions; the teachers' lack experience in industrial and practical skills among the challenges. Gibbins and Perkin, (2013) on their part point out that the expense of running the laboratory as a challenge.

Davies (2008) in her book she mentioned technology; lack of specialized equipment needed in the laboratories; obsolete and limited space and equipment; large number of students; cost of running laboratories; difficult in scheduling as among the challenges.

2.4.4 Strategies and innovations for enhancing student learning during laboratory sessions

Several strategies have been proposed to enhance student learning of skills during laboratory sessions. According to the University of Michigan Guidebook (2016) there are several strategies that can be adopted for laboratory instruction. One of these strategies is the instructor's classroom attitude. The laboratory instructor is expected to have a positive classroom attitude to motivate students to have an interest in learning the subject by encouraging and supporting the students in their learning activities.

The other strategy in the guidebook is embracing classroom diversity of the students. This strategy can be employed by the instructor appreciating the fact that student have had diverse experiences and backgrounds. This can enable the instructor know how the students should treat each other; how he/she should treat them and how they should relate with him.

Timing of the session is another strategy. The laboratory instructor must ensure that the session starts and ends on time. This then requires that the instructor must time all the activities to ensure that by the end of the laboratory session every student will have finished performing their experiment. This means that the instructor must encourage punctuality so that sessions start on time.

Another strategy is to provide the laboratory overview. The instructor must begin the laboratory session with a brief introduction of the key concepts in the experiments, the procedures needed to complete the practical. The instructor must ensure that the overview must link the theory to the practical skills the students are going to practice. This will enable the students to be keen on the overview since they will be expected to work on their own.

The instructor must also engage in laboratory demonstrations as another important strategy. Before doing any demonstrations, it is advisable the instructor practice with the equipment to avoid making mistakes during the demonstration. During the demonstration, the instructor must ensure that students are close to him/ her so that they see and hear what the instructor is doing. In the demonstration, the instructor must focus only on the key concepts and functions that comprise the procedures. This will excite interest in the laboratory exercises and activities.

Using the board is another important for enhancing student learning. The instructor should try to write important information which the student will need during the laboratory session. This can aid the instructor in responding to the student questions and serve as a reference point for the students throughout the laboratory session.

Another strategy is maintaining an active role and continuous interaction during laboratory instruction. Getting fully involved during the laboratory session, makes it possible for the instructor to give instructions and information periodically to ensure students are paying attention to the laboratory activities. Taking an active role will involve responding to students' questions, moving around the laboratory to make sure he/ she is available, monitoring students' progress with the experiment.

Clarifying the roles during the laboratory session is yet another strategy. The instructor must clarify the roles of the students and that of the instructor. It must be made clear to the students that the responsibility of learning is theirs and the work of the instructor is basically to facilitate their learning.

Mathew and Earnest (2004) propose several innovations that have been purposefully designed and directed to improve laboratory practices. According to them, incorporating innovations into laboratory instruction can make practical work motivating both for the teacher and the student. In their conference paper, they have proposed seven approaches to laboratory innovation. One of the approaches to laboratory innovation is the application of the graded laboratory design concept which gradually and systematically moves the student from being dependent on the teacher to a level where the student is independent. This innovation is a five-step process that enables educational institutions to avoid a sudden jump from a conventional type of experiment to a project type of laboratory experiment as happens in many institutions. The five steps include: conventional type, structured-discovery type, investigation type, problem solving type and finally the project type. The conventional type is one that most engineering training institutions use and is a teacher centred experiment where the teacher designs the experiment and students are expected to follow the instructions the teacher has given. The next step is the structured-discovery type of laboratory experiment which is an inductive method of instruction where the students develop the experiment with the encouragement and guidance of a teacher in a structured way to enable them discover the phenomenon. The third step is the investigation type in which the students can decide what to do at various stages of the experiment. This type succeeds in making trainees self-starters. Problem solving type is the fourth type, where trainees are presented with problem solving experiments to enable them develop problem solving skills and gain self-confidence. All these types of laboratory experiments are graded or assessed gradually to enable the student develop the required competences.

The authors propose another approach to innovation which is the modification in the experimental set up. This approach requires several modifications to be made in the experiments that students undertake. These may include modifying equipment and experiment set-up, for instance, component values in circuits, materials to be tested, tools to be used in the experiments among others. In this approach, students may also be involved in the selection of equipment and other instruments and tools to be used for the laboratory exercises.

Incorporating variations in the experimental process is another approach used in laboratory innovation. According Mathew and Earnest (2004), this approach entails using different methods in conducting laboratory experiments. In utilizing this approach, different methods can be used for different groups of students and this is a good strategy for enhancing investigative skills.

Instructors can also employ a visual laboratory manual as another approach to laboratory innovation. This aid, according to Mathew and Earnest (2004), is a critical especially when an institution has many students when it is not possible to have students handle real equipment. This aid contains actual photographs of equipment that are used in the laboratory experiment. Sometimes when it is computerized, it makes it even more convenient to zoom in the pictures to have a clear view of them. This will help the students to learn on their own and be able to identify and become familiar with equipment before handling

The use of micro-demonstrations approach involves video recording the student performance and viewed later for obtaining feedback on how they performed (Mathew & Earnest, 2004). This will improve their skills when they do a similar experiment later. This approach can also be combined with classroom instruction to enhance effectiveness in instruction.

Improvement in assessment schemes is also another approach for use in laboratory innovativeness. As Mathew and Earnest (2004) explain this approach seeks to assess the skill acquired and not the results which the students observed and recorded in the laboratory reports. This assists in focusing on those skills that are considered important which must be developed by the students.

The last approach to laboratory innovation is project work. This approach has only been utilized by educational institutions in the final year of the course. However, institutions can utilize this approach by having mini-projects in various semesters to give students an opportunity to utilize and perfect the learned skills and competence (Mathew & Earnest, 2004)

Industry support to TVET institutions can be a good strategy to enhance laboratory instruction and learning. Krivickas and Krivickas (2007) in their evaluation of effectiveness of laboratory instruction at Kaunas Technical College also suggested that industry support of colleges through equipment donation. The US National Research Council (1986) gives a similar suggestion that government, industry and colleges collaborate so as to deal with the problem of inadequate equipment and also the replacement of aging equipment. Another strategy suggested by US National Research Council (1986) is the incorporation of technology in laboratory instruction.

2.5 Research on laboratory practices and research gap

Although there seems little research especially on the electronics laboratory training practices and their influence on skill acquisition among technician trainees, some studies have been done on some aspects. One of the studies that specifically focused on electronic laboratory practices was done by Salim, Puteh and Daud (2009) in Malaysia. The researchers investigated on how the knowledge and skills were acquired through laboratory practice and laboratory assessments. In their study, the authors reviewed the current laboratory practice at the Universiti Teknologi Malaysia's centre for diploma programmes called College of Science and Technology. Their analysis revealed several issues. On lab session attendance it was found that the students attended the lab sessions in groups of fifteen per session guided by one instructor. On the role of the instructor during the session, it was revealed that the instructor's role was to monitor trainees during the laboratory session and assist them in case they encountered any problem. This appears like the instructor played a passive role rather an active role.

Another important finding of the study was the practice at the beginning of the session. At the beginning of each laboratory session, the students were given laboratory manuals and laboratory sheets. The laboratory manuals were to guide the students on how carry out the laboratory experiments while the laboratory report sheets were to record the results and conclusions of the laboratory experiments.

The practice during the session was that students worked on the experiments on their own according to how they understood the instructions provided in laboratory manuals. The students also referred to the schematic diagrams in the laboratory manuals. Using the listed components and equipment, the students worked on the experiment. What the students were doing during the laboratory session was basically manipulating of components and equipment a situation that the authors found to be tricky especially for the first years, some of whom had difficulties “building the circuit onto the project board and connecting the measuring instrument correctly, particularly the oscilloscope” (n.p.).

On how the session was concluded, the authors don’t divulge much on what was done. However, the practice in relation to assessment, the authors found out that 2nd and 3rd year students were assessed using laboratory report sheets. First year students on the other hand were assessed based on mini projects they undertook.

The above study provides good insights in laboratory practices although its focus was on the laboratory session delivery and greater emphasis on the assessment. This is only one aspect of laboratory practices. There are other laboratory practices, among them: practices in relation to preparation for the session; role of industry in laboratory instruction; use of technology in laboratory instruction; laboratory work organization which the authors have not focused on.

Further, it is important to note that most of the studies on laboratory have also focused on laboratory instruction at the university level and very few studies have been done at diploma level. Even the ones done at diploma level have not focused on laboratory practices in their entirety. There is isolated mention of the laboratory practices while researching other areas. The one study that has focused on laboratory practices focused majorly on the instruction and assessment practices. Further, the study also did not relate it to skill acquisition and only pointed out the practices. This study is undertaken to fill this gap and provide a broader look at the laboratory instruction practices.

2.6 Summary of literature review

This chapter on literature review has presented relevant literature on electronics laboratory training practices and their influence on skill acquisition. The reviewed literature was done on the concept of skill acquisition and the role of laboratory practices in the acquisition of skills in electrical and electronics. From the literature review it was found that the researches have been done on a few aspects of laboratory practice and skill acquisition hence the need for this study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter covers the research design selected to guide the study on the influence of laboratory practices on skill acquisition by technician trainees in Nairobi County, Kenya. The chapter presents the philosophical worldview or paradigm adopted, identifies the target population and sampling procedures. Procedures of data collection and data analysis are identified. The validity and reliability of the data collection instruments is addressed. The chapter ends with ethical issues faced in the research study.

3.2 The research design

A research design is a plan or path to guide the researcher in investigating a research problem. Kumar (2014) defines a research design as "the roadmap that you decide to follow during your research journey to find answers to your research questions as validly, objectively, accurately and economically as possible" (p.122). According to Creswell (2009) the research design involves the "intersection of philosophical assumptions, strategies of inquiry, and specific methods" (p.233). There are three designs that can be adopted in carrying out research. Creswell (2009) identifies these designs as: quantitative, qualitative and mixed methods. The quantitative methods seek to examine the relationship that exists among or between variables under study. Qualitative methods, on the other hand, seek to explore an issue in a bid to gain an understanding of its various facets. Mixed methods combine the two methods in the same study in an effort to overcome the defects inherent in each of the two methods. In this study mixed methods design was adopted. The mixed methods design was appropriate because it exploits the advantages of both quantitative and qualitative research designs.

3.3 Area of the study

The area of study chosen for this research study was Nairobi County, Kenya. The area of study was chosen because it has the largest number of public TVET institutions. These institutions are from various ministries that is: four (4) from the Ministry of Education, Science and Technology (MoEST), two (2) from the Ministry of Transport and Infrastructure Development (MoTID), one (1) from the Ministry of Public Service, Youth and Gender Affairs (MoPSYGA) and one (1) from the Ministry of Information Communication and Technology (MoICT). The institutions have been given pseudonyms to protect their identity. They have been named as: College A, College B, College C, College D, College E, College F, College G and College H.

3.4 Research paradigm

A paradigm refers to the "basic set of beliefs that guides an action" (Opie, 2004, p.18). A paradigm is critical in defining a researcher's philosophical position and influences the methodologies and procedures adopted in the investigation of the research problem. A research paradigm clearly reveals the researcher's view regarding the nature of reality (ontological assumptions) and views on the nature of knowledge (epistemological assumptions).

Creswell (2009) identifies four (4) philosophical paradigms or worldviews that can be adopted in research namely: post-positivist, social construction, advocacy/ participatory and pragmatic worldviews. The research paradigm chosen to guide this study was pragmatic worldview or philosophy. This paradigm was appropriate for the study because it is not "committed to any one system of philosophy or reality" (Creswell, 2009, p.10). Leavy (2017) echoes Creswell's sentiments that pragmatic paradigm is not committed to any "particular set of rules or theories but rather suggests that different tools may be useful in different research contexts." The paradigm employs both qualitative and quantitative approaches to research in order to exploit the advantages of both approaches. Consequently, this philosophical paradigm does not focus on the methods employed in inquiry but rather lay emphasis on the problem being investigated and then employs all available approaches to investigate the problem. This philosophical paradigm was justified on the following grounds.

- Since the philosophy or worldview draws liberally from both quantitative and qualitative methods, it provides a deeper investigation into the problem. In this study, the problem under investigation, that is, 'electronic laboratory practices and the acquisition of skills', is a very dynamic issue that required deeper investigation in order to be understood.
- Since the conditions and environment existing in different TVET institutions were varied, there was need to choose research methods and procedures appropriate to the existing institutional circumstances and researcher needs.

- In this research, since the researcher was focusing on what was being done and how it was done, pragmatism was critical in explaining how the instruction practices were influencing the level of skill acquisition among students.

3.5 Research methods or approaches

The pragmatic philosophical paradigm adopted in this study required the use of mixed research methods in the study. According to Creswell (2009), when researchers employ mixed research methods, they "draw liberally from both quantitative and qualitative assumptions when they engage in their research" (p.10). This study, by employing the mixed research methods, tapped into the advantages of both qualitative and quantitative approaches to understand the influence electronic laboratory practices had on skill acquisition. This is because this relationship is an interplay of several factors that could not be captured adequately by one research approach.

3.6 Research strategy

In investigating the relationship between laboratory training practices and skill acquisition, this study employed concurrent triangulation strategy where both qualitative and quantitative data were collected simultaneously, that is, in one phase. Then the two were compared to determine any convergence, differences or any combinations.

3.7 Target population

The target population for this study was from electrical and electronics departments in eight (8) public TVET institutions in Nairobi County. It comprised of: eight (**8**) Heads of

Department, fifty-one (51) electronics trainers, three hundred and seventy-four (374) final year technician trainees, eight (8) electronic experts and eight (8) trainers in an electronics practical lesson, one from each institution for observation. The total population was four hundred and forty-nine (449). The population was distributed as shown in table 3.1 below.

Table 3.1: Target Population

TVET Institution	No. of experts	No. of HODs	No of trainers to observe	No. of Trainers	No. of Trainees	Total
College A	1	1	1	4	46	**53**
College B	1	1	1	5	43	**51**
College C	1	1	1	8	40	**51**
College D	1	1	1	9	68	**80**
College E	1	1	1	8	66	**77**
College F	1	1	1	7	73	**83**
College G	1	1	1	7	6	**16**
College H	1	1	1	3	32	**38**
Total	**8**	**8**	**8**	**51**	**374**	**449**

Source: Institutional Records.

3.8 Sampling procedure

This section deals with how the participants of the study were identified. In research, the whole population (census) can be used in the study when the target population is small and manageable. A census entails the "study of the entire group of elements or individuals in a population" (Shenoy & Pant, 1994, p.54). However, in instances when the target population is too large to manage, a portion of the target population (sample) is used in the study. In this study both census and sampling were used as discussed below.

3.8.1 Census method

The census method, in this study, was employed in obtaining participants for conducting a survey among technician trainees and electronics trainers and interviews among HODs. All members: technician trainees and electronics trainers participated in the survey as respondents while all HODs participated in the interview as respondents. The advantage of the census method is that it accords the researcher an opportunity to investigate the research problem extensively which in turn provides more detailed information on the research participants. Census is appropriate in a number of situations or conditions. Among these situations are: when the population is not vast (Kothari, 2004; Farooq, 2013, Bluman, 2009); when there is enough time and finance for data collection (Farooq, 2013); when high degree of accuracy is required (Farooq, 2013; Shenoy & Pant, 1994); when "there is much variability among elements of the population" (Shenoy & Pant, 1994, p.55) or when biasness is to be minimized.

Given that the number of technician trainees and electronics trainers was 425 participants and HODs were 8 participants, census method was the most ideal way instead of sampling. The major reason for using census was because the population of study was not vast but was located in the same area, Nairobi County. This made the research manageable in terms of time and finance needed to carry out the study. Also given the fact that the subject of study required in-depth information, the census became the most appropriate.

3.8.2 Purposive sampling

Purposive sampling is used in selecting a sample for a specific purpose (Cohen, Manion & Morrison, 2007). In this study, this technique was used to select the participants for focus group discussion (FGD). Since FGD require people with in-depth knowledge, the researcher employed purposive sampling to obtain respondents who had required in-depth knowledge because of their longer experience in teaching electronic laboratory courses. One (1) experienced trainer (expert) from each TVET institution was selected with the help of the HODs to make a total eight (8) participants in the focus group.

3.8.3 Convenience sampling

According to Cohen, Manion and Morrison, (2007), convenience sampling is used when the respondents are not readily available, hence referred to "opportunity sampling." This technique was to be used to select group participants for observation, at least one group from each TVET institution at their convenience. The reason for using this method to select the observation participants was because the laboratory practice was not scheduled separately in most institutions. This prompted the researcher to do the observations when the lab practice was undertaken.

3.9 Data collection techniques and procedures

The data utilized in this study was basically primary data. Data was collected using survey questionnaires, observation, focus group discussion, and interviews. Data collection entailed visiting the research sites. This involved visiting TVET institutions to administer the questionnaires to the trainers and trainees, to interview the HODs and observing practical sessions. To conduct a focus group discussion with the electronics training experts, the researcher organized a convenient and accessible venue within the Central Business District in Nairobi.

3.9.1 Quantitative data collection

3.9.1.1 Questionnaire design and administration

Quantitative data was collected using questionnaires. The questionnaires were prepared and distributed to the respondents to secure responses from them. The questionnaires were picked later after they had been answered. By leaving the questionnaire to be answered and picked later the researcher was able to collect data without having to be present when the respondents were answering the questions. The absence of the researcher when the respondents are answering the questions meant that there was “no personal influence of the researcher and embarrassing questions can be asked with a fair chance getting a true reply” (Walliman, 2011, p.97). The questionnaires had both structured and unstructured items. Structured questionnaire items were closed-ended scoring type that were readily analyzable using statistics. Un-structured questionnaire items were open-ended type. The questions were designed in a clear, simple and short way to make them easy to be answer by the respondents. This questionnaire was administered on final year technician trainees and electronic trainers.

Self-administered questionnaire mode was adopted. This mode of administration was selected because of two reasons. One was because “self-completion questionnaires are cost effective way of collecting data from large number of widely dispersed participants (Lewin, 2005, p.219). The other reason for using this mode of administration was because the respondents were literate hence were able to fill in their responses in the questionnaire by themselves. The questionnaires were personally delivered to the respondents and picked up when they had been filled. The advantage of personal delivery of questionnaire was that it ensured high response rate (Walliman, 2011). The questionnaire was divided into following sections: demographic (general) information, skill levels of technician trainees, management and utilization of equipment, tools and materials, laboratory practices and industry collaboration in electronic laboratory instruction practices.

3.9.2 Qualitative data collection

Qualitative data was collected using in-depth interviews, focus group discussion and observation.

3.9.2.1 In-depth Interview with HODs

Interviews are one way of collecting data and this method is very appropriate when collecting "in-depth information on people's opinions, thoughts, experiences, and feelings." (Easwaramoorthy & Zarinpoush, 2006, n.p.). Mugenda and Mugenda (2003) define "an interview is an oral administration of a questionnaire or an interview schedule" (p.83). An interview has advantages which, among others, include: flexibility, providing in-depth information which cannot be provided by a questionnaire, and giving clarification on unclear questions (Mugenda & Mugenda, 2003; Kombo & Tromp, 2009).

In this study, the researcher utilized a general semi-structured interview protocol format (Turner, 2010) which involved an outline of a set of issues to be explored with each of the respondents. An interview schedule was developed and administered face to face. The questions were open-ended (structured and non-structured). The interview was used to get information from HODs in electrical/electronic engineering departments. The reason for using these interviews was to get an in-depth understanding of the various aspects of laboratory practices. Feedback was recorded using an audio recorder. The use of a recorder enabled the researcher to obtain more information conveniently as opposed to note taking technique alone.

3.9.2.2 Focus group discussion with electronic training experts

This method was used to obtain in-depth information on management and utilization of equipment, tools and materials, laboratory practices and strategies on how to improve electronics laboratory instruction practice so as to help trainees acquire skills. One expert in electronics training from each institution under study was selected. Among the electronic trainers, the one with many years of teaching electronics in that institution was chosen as an expert for the FGD. The researcher facilitated the group discussion. The questions were open-ended to allow for in-depth discussion. Two research assistants were trained earlier to help in taking notes during the discussion. The session was also audio recorded to ensure no information was missed during the discussion.

3.9.2.3 Observation schedule for a lab practice session

In this study, observation schedule was used to obtain some information which could not be obtained using interviews or questionnaires. In this case observation was utilized to obtain information regarding lab training practices in the various institutions of the study. The researcher visited TVET institution during lab practice lesson to observe the activities that took place before, during and after the lab session. The observations focused on the various activities such as preparation by the teacher before the session, lab setting for the lab session, introduction to the day activity, the student behavior on the theoretical know-how, trainer's activities during the session, response to questions, the activity at the end of session, grading of work done/mark sheet, lab report. Data collection took the form of qualitative ethnographic note taking. This involved the researcher being there from the beginning to the end of the lesson taking note of what was taking place step by step using the observation guide. Data collection took the form of ethnomethodology where the researcher, an ethnographer, (Steven, Robert, & Marjorie, 2016) looked keenly at trainees and trainer's activities and how they work together for skill acquisition.

3.9.3 Instrument pilot study

Pilot test was done to finding out if the questionnaire provided the responses required by the researcher. A total of 19 respondents comprising of trainees and trainers were randomly selected from two institutions used for pilot study. One institution was from Kiambu county and the other from Kajiado county. This helped the researcher to make sure that everyone in the sample not only understood the questions but understood them in the same way. An interview was carried out with one HOD to help adjust questions to be clearer and achieve the required information. An observation was done on a class by the researcher to make sure that the instrument used during observation would capture the right information.

After the exercise, some questions were reframed, some added and some deleted. The pilot study was done when the institutions were in session so as to get the respondents to represent the various sub-groups within the intended sample. The instruments were piloted on respondents who were not part of the study but had similar characteristics. This helped the researcher to identify any vagueness in the questions so as to make them clear (Mugenda & Mugenda, 2003).

3.10 Validity and reliability of the questionnaire.

Since the study involves quantitative analysis, the issue of validity and reliability was addressed.

3.10.1 Validity

Thatcher (2010) defines validity as the “extent to which any measuring instrument measures what it is intended to measure” (p.125). Taherdoost (2016) identifies various forms of validity. These include: construct validity, face validity, criterion validity, and content validity. Construct validity concerns “how well you translated or transformed a concept, idea, or behavior that is a construct into a functioning and operating reality, the operationalization” (Taherdoost, 2016, p.31). Face validity refers the “extent to which a measure appears to be related to a specific construct, in the judgment of nonexperts such as test takers and representatives of the legal system” (Taherdoost, 2016, p.29). Criterion or concrete validity refers to “the extent to which a measure is related to an outcome” (Taherdoost, 2016, p.32). Content validity deals with “the extent to which an instrument measure adequately all facets of a concept,” (Singleton & Straits, 1999, p.121).

This study focused on content validity of the research instruments. Muijs (2004), points out that content validity refers to whether or not items in a questionnaire are the best to measure a concept at hand. Therefore, the instruments were developed and given to two electronic experts to check if they were to produce the required content of the study. The questionnaires were also piloted for the purpose of removing any ambiguity in the design. After the piloting, the responses were analyzed to determine whether the questions were well understood by the respondents. This confirmed the clarity of the questions in the instrument.

3.10.2 Reliability

According to Twycross and Shields (2004), reliability refers to the “consistency, stability and repeatability of results” (p.36). This means that same tool/instrument should produce same results when administered to same respondent over a period of time (Muijs, 2004). In this study, reliability of questionnaire was inferred through a second administration of the instrument with a same sub-sample that was not part of the study and a comparison of the responses between the first and second administration done to assess the consistency in the responses. Internal consistency reliability was also ensured by calculating the coefficient alpha (α). Cohen et al (2007) indicates that $\alpha > 0.90$ is very highly reliable, 0.80 - 0.90 highly reliable, 0.70 - 0.79 reliable, 0.60 - 0.69 marginally/minimally reliable and < 0.60 unacceptable. Piloted questionnaires data was coded in the SPSS and they attained a Cronbach's alpha of 0.862 as shown in table 3.2 below. This meant that the questionnaire was highly reliable for the study.

Table 3.2: Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.862	.878	78

3.11 Data analysis procedures and techniques

After the data was collected, it was summarized, analyzed and interpreted in the light of the objectives of the study. Qualitative data analysis techniques used thematic analysis. On the other hand, quantitative data analysis involved the use of both descriptive and inferential statistics. The coded items in the questionnaire were fed into and then analyzed with the aid of computer software for analyzing data, Statistical Package for Social Sciences (SPSS) Version 26. Descriptive statistics included the use of: percentages, frequencies, means and standard deviation. Inferential statistics involved the use of Spearman rank correlation (non-parametric) to determine the relationship between independent variables and dependent variable

3.12 Ethical issues and considerations

In this study, ethical issues were considered pertinent and as such the researcher addressed the various ethical issues as follows:

3.12.1 Confidentiality and privacy

The researcher made every effort to keep all information given by the respondents confidential. The respondents were assured that the information they gave was to be used for academic purposes only without referring to a particular institution or individual.

3.12.2 Anonymity

The researcher kept the names of individual respondents and their institution in the study unknown. This was because if the names were revealed, their responses were to be exposed hence the employment of some respondents could be at stake. The researcher, also, did not provide a slot for names of the respondents and their institution.

3.12.3 Physical and psychological harm

The study did not cause any physical harm as it was undertaken in the respondents' natural settings. The study did not investigate any embarrassing issue that could cause psychological harm to the respondents. The study focused on the experience of the respondents in teaching and learning electronic laboratory practice.

3.12.4 Informed consent

The researcher asked for the respondents' consent to participate in the study voluntarily. Since the study involved the use of questionnaires, interviews and non-participant observation, consent from the respondents was sought orally.

3.12.5 Source acknowledgement

In the study, all information obtained from published sources were well cited to avoid plagiarism. This demonstrated academic honesty on the part of the researcher.

3.12.6 Research permission

The researcher obtained a research permit/license from the National Commission for Science, Technology and Innovation (NACOSTI). The researcher also obtained written authority from the ministry of education to undertake the study.

3.13 Summary of chapter three

This chapter presents the design and methodology used in the research study. The research study adopted a mixed methods research design which exploited the advantages of both qualitative and quantitative methods. The research paradigm that guided this study was pragmatic worldview or philosophy. The population for this study comprised of: Heads of Department, TVET trainers and diploma (technician) trainees in Electrical and Electronic Engineering Department. The sampling procedures employed included: census method; purposive sampling and convenience sampling. Data was collected using self-administered questionnaire, interview schedules, focus group discussion guide and observation schedules. Data presentation and analysis employed the use of qualitative and quantitative techniques. Qualitative data analysis techniques involved the use of thematic analysis while quantitative data analysis involved the use of both descriptive and inferential statistics with the aid of a SPSS computer package version 26.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, INTEPRETATION AND DISCUSSION

4.1 Introduction

This chapter deals with data presentation, analysis, interpretation and discussion of the research findings. The findings are presented in the light of the objectives of this study. This was a mixed research study whose findings were obtained using quantitative and qualitative methods. This chapter comprises of four sections. The first section presents the response rate of the study respondents, the second presents the respondent characteristics, the third presents the study findings, interpretation and discussion as per the study objectives and finally the fourth gives the summary of the chapter.

4.2 Response rate

Response rate is very critical in research since it shows how successful a researcher was in obtaining responses using various research instruments from the sample respondents. This ultimately influences the credibility and validity of the final research results. Therefore, for credible results, it must be high enough for any meaningful research. The response rate for this research study was as follows:

Table 4.1: Response Rate

Respondent Type	Sample Size	Response	Response Rate
Trainees	374	337	90.1%
Trainers	51	47	92.2%
FGDs	8	8	100%
HODs	8	6	75%
Trainer Observation	8	5	62.5%
Total	**449**	**403**	**89.76%**

Source: Respondents Response Rate (2020)

Table 4.1 shows that the overall response rate was over 80% from the various research instruments used in the study. This response rate can be considered acceptable and satisfactory for credibility of the results. Evidence from social research literature asserts that a high response rate is preferred. In a 2007 research report, by the University of Texas at Austin Center for Teaching and Learning, (cited in Saldivar, (2012) shows that a good response rate should be between 80 – 85 %. The high return rate for questionnaire and FGD is attributed to efforts by the researcher to personally make frequent visits to the respondents in the institutions and encourage them to participate in the study. The slightly less than 80% response rate for interview was due to fact the respondents who were HODs were trying to sacrifice time from other duties create time for the interview. Also, the less that 80% response rate for the observation was attributed to the inconsistency in TVET institutions in offering practical sessions to students.

4.3 Respondents characteristics

4.3.1 Trainee characteristics

The trainee characteristics that were of interest in this study were age, gender, whether they attended electronic laboratory practice lesson since they joined first year and the approximate number of times they had attended since their first year in college. The responses are presented in table 4.2.

Table 4.2: Trainees Demographic Data

Variable	Details	Frequency	Percent
Age	Below 20	23	6.8
	21 – 25	281	83.4
	26 – 30	30	8.9
	Above 30	3	0.9
	Total	**337**	**100**
Gender	Male	301	89.3
	Female	36	10.7
	Total	**337**	**100**
Attended electronic laboratory Session	Yes	252	74.8
	No	85	25.2
	Total	**337**	**100**
Approximate number of times attended since their first year	1-10	223	88.5
	11-20	19	7.5
	Above 20	10	4
	Total	**252**	**100**

***Source:* Trainees Questionnaire Data (2020)**

From the table, majority of the trainees were young people aged 25 years and below. A great percentage of the respondents were males compared to females. This result show how the various gender participates in engineering courses. Research has shown that as compared to men, female trainees' numbers in engineering are usually low.

Results on whether trainees had attended laboratory sessions since they joined college indicate that majority of the trainees, over 70%, had attended laboratory sessions. Those who had not attended at all comprised of less than 30% which is quite a concern since they are about to graduate. What this means is that a number of trainees usually left college without attaining the requisite skills. This is quite worrying for a course that is skills-oriented. Of those trainees who had attended the laboratory sessions, it is evident that a majority of them had attended between 1 and 10 sessions only which is quite disturbing for trainees planning to be relevant in the world of work.

4.3.2 Trainer characteristics

The respondent characteristics for the trainers included: age, gender, whether they had taught electronic laboratory practice and approximately how many years they had taught since they were employed. The findings are presented in table 4.3

Table 4.3: Trainers Demographic Data

Variable	Details	Frequency	Percent
Age	Below 30	7	14.9
	31-40	14	29.8
	Above 41	26	55.3
	Total	**47**	**100**
Gender	Male	35	74.5
	Female	12	25.5
	Total	**47**	**100**
Whether taught electronic Laboratory Session	Yes	35	74.5
	No	12	25.5
	Total	**47**	**100**
Number of sessions taught since employed	1-10	25	71.4
	11-20	8	22.9
	Above 20	2	5.7
	Total	**35**	**100**

***Source:* Trainers Questionnaire Data (2020)**

The findings show that a majority of the trainers are aged above 41 years. These findings mean that many of the trainers had considerable experience in teaching in TVET colleges. Over 70% of the trainers were male while female trainers were less than 30 %. The reason for the under-representation of few female trainers is due to low enrollment of female trainees in engineering courses as compared to their male counterparts.

On whether trainers had taught electronic laboratory practice since they started teaching diploma level classes, the results indicate that over 70% of the trainers had taught laboratory practice while less than 30% had not. This shows that a greater number of trainers had experience in teaching laboratory sessions. However, looking at the percentage (30%) that had not taught laboratory practice shows that there is a reason to worry since this percentage was quite substantial. Interview responses by the HODs also revealed that they normally have electronic laboratory session for their trainees.

Among the trainers who had taught laboratory practice sessions, majority of them, over 70%, had taught between 1-10 years. This indicate that there were very few trainers with great experience in teaching laboratory practice as majority had taught for less than ten years. Further this demonstrates that either the trainers placed very little value on laboratory practice or there were certain challenges in the TVET institutions that made them teach very few sessions.

These few sessions taught by trainers could be explained from the HODs' and FGD participants' responses. It was clear that not much attention was paid to scheduling lab sessions. HODs pointed out that scheduling of laboratory practice was left at the discretion of the trainer to decide when to schedule it within the lecture hours. According to FGD participants, scheduling was not done on when the lab session was scheduled, no specific subject or trainer was assigned.

4.4 Findings, interpretation and discussion

4.4.1 Level of skills acquisition among technician trainees

To determine the skill levels of technician trainees, both trainees and trainers were first asked to rate the trainees' ability to identify basic electronic components and then their ability to use electronic equipment. Finally, both trainees and trainers were asked to rate the level of skills acquired by trainees in the performance of various electronic tasks. The ratings were on a five-level Likert scale from VL=Very Low, L=Low, M=Moderate, H=High and VH=Very High.

4.4.1.1 Ability to identify basic electronic components by physical look

Table 4.4 shows how trainees rated themselves on identification of basic components by physical look. A majority of the trainees rated themselves as having high ability to identify resistor, capacitor, inductor, diode, transistor and integrated circuit by physical look. A good number indicated that they had moderate ability to identify them by physical look. Those who indicated that they had very low and low abilities in identifying basic components by physical look formed a big number that cannot be ignored. This may mean that they had been to the laboratory a few times hence not good enough to know these components physically.

Table 4.4: Trainees' response to their ability to identify basic electronic components by physical look

NOTE: VL = Very low, L = Low, M = Moderate, H = High, VH = Very high, F = Frequency, and % = Percentage

Item	***Identification of***	**VL**		**L**		**M**		**H**		**VH**	
No.	***Components***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***
1	Resistor	55	21.8	32	12.7	65	25.8	96	38.1	4	1.6
2	Capacitor	58	23.0	25	9.9	65	25.8	96	38.1	8	3.2
3	Inductor	72	28.6	40	15.9	65	25.8	73	29.0	2	0.8
4	Diode	54	21.4	27	10.7	68	27.0	96	38.1	7	2.8
5	Transistor	67	26.6	28	11.1	67	26.6	89	35.3	1	0.4
6	Integrated circuits (IC)	80	31.7	38	15.1	57	22.7	74	29.4	3	1.2

Source: Questionnaire data (2020)

Table 4.5: Trainer responses on trainee ability to identify basic electronic components

Item	***Identification of***	**VL**		**L**		**M**		**H**		**VH**	
No.	***components***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***
1	Resistor	4	11.4	2	5.7	12	34.3	16	45.7	1	2.9
2	Capacitor	3	8.6	4	11.4	12	34.3	16	45.7	0	0.0
3	Inductor	5	14.3	3	8.6	14	40.0	13	37.1	0	0.0
4	Diode	4	11.4	3	8.6	10	28.6	18	51.4	0	0.0
5	Transistor	4	11.4	2	5.7	14	40.0	15	42.9	0	0.0
6	Integrated circuits (IC)	6	17.1	4	11.4	18	51.4	7	20.0	0	0.0

Source: Questionnaire data (2020)

Table 4.5 shows how trainers rated their trainees' ability to identify basic components by physical look. A majority of the trainers rated their trainees as having high ability to identify resistor, capacitor, inductor, diode, transistor and integrated circuit by physical look. A good number of the trainers indicated that they had moderate ability. Those who indicated that they had very low and low abilities in identifying resistor, capacitor, inductor, diode, transistor and integrated circuit by physical look, combined, formed a small number but cannot be ignored. These results show that many trainers had taken their trainees to the laboratory for practice since they rated them as having medium or high ability. This is in contrast to the few who had rated their trainees as having low or very low ability which meant, probably, either they never took or rarely took their trainees to the laboratory for practice.

From both the trainees and trainers' ratings, it can be seen that a substantial number of trainees had moderate and high skills in identifying basic components by physical outlook. However, also another substantial number of trainees had no or had a minimal ability in identifying the basic components by physical look.

The mean responses of trainees' ability to identify basic electronic components by physical look are shown in Table 4.6. The decision (D) on how the trainees and trainers rated identification of basic electronic components physically was given on lower and upper limits of the means as: Very High 4.5 - 5.00, High 3.5 - 4.49, Moderate 2.5 - 3.49, Low 1.5 - 2.49 and Very Low 0.5 - 1.49.

Table 4.6: Mean responses of trainees' ability to identify basic electronic components by physical look

NOTE: M=Moderate, SD=Standard Deviation and D=Decision

		Trainees N=252			Trainers N=35			Overall		
Item No.	**Identification by physical look**	**Mean**	**SD**	**D**	**Mean**	**SD**	**D**	**M**	**SD**	**Remarks**
1	Resistor	2.85	1.19	M	3.23	1.03	M	**3.039**	**1.113**	**M**
2	Capacitor	2.88	1.23	M	3.17	0.95	M	**3.028**	**1.094**	**M**
3	Inductor	2.58	1.20	M	3.00	1.03	M	**2.788**	**1.116**	**M**
4	Diode	2.90	1.21	M	3.20	1.02	M	**3.050**	**1.114**	**M**
5	Transistor	2.72	1.21	M	3.14	0.97	M	**2.931**	**1.093**	**M**
6	Integrated circuits (IC)	2.53	1.24	M	2.74	0.98	M	**2.637**	**1.112**	**M**
	Grand Mean/pull SD	**2.74**	**1.21**	**M**	**3.08**	**1.00**	**M**	**2.912**	**1.107**	**M**

Source: Questionnaire Data (2020)

The table 4.6 reveals that both trainees and trainers rating on the ability to identify the basic electronic components was moderate, (GM= 2.912, SD=1.107). This is inferred from the fact that mean responses of both the trainees and trainers and the grand means fall between 2.5 and 3.49. This demonstrates that the trainees were able to identify the basic electronic components by physical look.

4.4.1.2 Trainees' ability to use various electronic equipment, tools and materials

Table 4.7 shows how trainees rated themselves on the ability to use various electronic equipment, tools and materials. From this table, a majority of the trainees indicated that their ability to use the oscilloscope and signal generator to be low or very low compared to those that indicated moderate or high. On 4 items, (4, 5, 7 & 9), a majority of the trainees indicated that they had moderate or high ability to use them. On items (6 & 8), a good number of trainees had low ability and a good number moderate and high ability.

From the results, it is very evident that majority of the trainees were not able to use oscilloscope, signal generator, wattmeter and solder sucker. It is also evident that a majority of trainees could be able to use digital meter, ammeter, voltmeter, solder gun and solder wire.

Table 4.7: Trainees' ability to use various electronic equipment, tools and materials

NOTE: VL = Very low, L = Low, M = Moderate, H = High, VH = Very high, F = Frequency, and % = Percentage

Item		**VL**		**L**		**M**		**H**		**VH**	
No.	***Use of the following***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***
1	Oscilloscope	136	54.0	59	23.4	38	15.1	19	7.50	0	0.0
2	Signal generator	131	52.0	67	26.6	36	14.3	18	7.10	0	0.0
3	Digital multi-meter	60	23.8	33	13.1	61	24.4	95	37.7	3	1.2
4	Ammeter	55	21.8	26	10.3	62	24.6	107	42.5	2	0.8
5	Voltmeter	55	21.8	26	10.3	54	21.4	115	45.6	2	0.8
6	Wattmeter	75	29.8	35	13.9	51	20.2	89	35.3	2	0.8
7	Solder gun	58	23.0	30	11.9	57	22.6	104	41.3	3	1.2
8	Solder sucker	85	33.7	41	16.3	44	17.7	79	31.3	3	1.2
9	Solder wire	62	24.6	27	10.7	52	20.6	110	43.7	1	0.4

Source: **Questionnaire Data (2020)**

Table 4.8: Trainer responses on trainee ability to use electronic equipment, tools and materials

NOTE: VL = Very low, L = Low, M = Moderate, H = High, VH = Very high, F = Frequency, % = Percentage

Item		**VL**		**L**		**M**		**H**		**VH**	
No.	***Use of the following***	***F***	***%***	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
1	Oscilloscope	2	5.7	9	25.7	17	48.6	7	20.0	0	0.0
2	Signal generator	5	14.3	4	11.4	21	60.0	5	14.3	0	0.0
3	Digital multi-meter	3	8.6	1	2.9	13	37.1	17	48.6	1	2.9
4	Ammeter	4	11.4	2	5.7	9	25.7	20	57.1	0	0.0
5	Voltmeter	4	11.4	1	2.9	10	28.6	20	57.1	0	0.0
6	Wattmeter	5	14.3	3	8.6	18	51.4	9	25.7	0	0.0
7	Solder gun	3	8.6	4	11.4	11	31.4	17	48.6	0	0.0
8	Solder sucker	3	8.6	2	5.7	13	37.1	17	48.6	0	0.0
9	Solder wire	4	11.4	3	8.6	10	28.6	18	51.4	0	0.0

Source: Questionnaire Data (2020)

Table 4.8 shows how trainers rated their trainees on the ability to use various electronic equipment, tools and materials. From the table it is evident that a majority of the trainers indicated that their trainees had moderate or high ability in using electronic equipment, tools and materials listed in the table. Only a few of the trainer indicated that their trainees had low or very low ability in using equipment, tools, materials and measuring instruments listed in the table.

The mean responses of trainees' ability to use electronic equipment, tools and materials are shown in table 4.9 below. The decision (D) on how the trainees and trainers rated the ability to use electronic equipment, tools and materials was given on lower and upper limits of the means as: Very High 4.5 - 5.00, High 3.5 - 4.49, Moderate 2.5 - 3.49, Low 1.5 - 2.49 and Very Low 0.5 - 1.49.

Table 4.9: Mean responses on trainees' ability to use equipment, tools, materials and measuring instruments

NOTE: L=Low, M=Moderate, M=Mean, SD=Standard Deviation and D=Decision

Item No.		**Trainees N=252**			**Trainers N=35**			**Overall**		
	Ability to Use	**M**	**SD**	**D**	**M**	**SD**	**D**	**GM**	**GSD**	**Remarks**
1	Oscilloscope	1.76	0.97	L	2.83	0.82	M	**2.295**	**0.896**	**L**
2	Signal generator	1.77	0.95	L	2.74	0.89	M	**2.254**	**0.917**	**L**
3	Digital multi-meter	2.79	1.21	M	3.34	0.94	M	**3.068**	**1.075**	**M**
4	Ammeter	2.90	1.20	M	3.29	1.02	M	**3.093**	**1.106**	**M**
5	Voltmeter	2.93	1.21	M	3.31	0.99	M	**3.123**	**1.102**	**M**
6	Wattmeter	2.63	1.26	M	2.89	0.96	M	**2.760**	**1.112**	**M**
7	Solder gun	2.86	1.22	M	3.20	0.96	M	**3.029**	**1.091**	**M**
8	Solder sucker	2.50	1.28	M	3.26	0.92	M	**2.879**	**1.098**	**M**
9	Solder wire	2.85	1.24	M	3.20	1.02	M	**3.023**	**1.129**	**M**
	Grand mean/pull SD	**2.55**	**1.17**	**M**	**3.12**	**0.95**	**M**	**2.836**	**1.058**	**M**

Source: Questionnaire Data (2020)

Table 4.9 shows that the ability of the trainees to use items 1&2 was low since the overall means fell between 1.5 and 2.49. The ability of the trainees to use item 3,4,5,6,7,8&9 was considered moderate since the mean responses of both the trainees and trainers and the overall means fell between 2.5 and 3.49. However, the grand mean/ pull standard deviation (M=2.836, SD=1.058) suggested that the ability of trainees to use electronic equipment, tools and materials was moderate.

4.4.1.3 Trainees' skill levels on various electronic tasks.

The trainees were also asked to rate their abilities in doing certain electronic laboratory tasks. Table 4.10 shows how trainees rated themselves on various areas of skill attainment. On analyzing the table, items 1, 2, 5, 6, 7 & 9 revealed that a majority of the trainees indicated that they had very low and low skills compared to those that indicated moderate and high abilities. On item 3, a majority of trainees had moderate or high abilities compared to those that indicated low and very low. On items 4 & 8, the number that indicated very low and low compared to those who indicated moderate and high seem to be almost similar.

Table 4.10: Trainees' rating on their level of skill attained on various electronic tasks

NOTE: VL =Very low, L = Low, M = Moderate, H = High, VH = Very high, F = Frequency and % = Percentage

Item No.	Area of Skill Attainment	VL F	VL %	L F	L %	M F	M %	H F	H %	VH F	VH %
1	Design and develop an electronic circuit	166	65.9	44	17.5	33	13.1	9	3.6	0	0.0
2	Read and interpret an already designed circuit	34	13.5	125	49.6	52	20.6	39	15.5	2	0.8
3	Identify components, materials, tools and Measuring instruments to use for the designed circuit	5	2.0	91	36.1	64	25.4	87	34.5	5	2.0
4	Mount the electronic circuit on a PCB, BB and Strip board	10	4.0	113	44.8	61	24.2	67	26.6	1	0.4
5	Connect measuring instruments to the circuit	5	2.0	136	54.0	61	24.2	49	19.4	1	0.4
6	Set measuring instruments to the require value	47	18.7	88	34.9	68	27.0	49	19.4	0	0.0
7	Use the instruments to measure the required values and waveforms	52	20.6	119	47.2	54	21.4	27	10.7	0	0.0

8	Read and record the required values and waveforms	18	7.1	91	36.1	52	20.6	85	33.7	6	2.4
9	Write a lab report	120	47.6	62	24.6	44	17.5	26	10.3	0	0.0

Source: Questionnaire Data (2020)

From the results, it can be interpretation that many trainees were unable to design and develop an electronic circuit and read and interpret an already designed circuit. A considerable number of trainees could be able to identify components, materials, tools and measuring instruments to use for an already designed circuit. Also, a considerable number was able to mount the electronic circuit on a PCB, BB and Strip board. Another considerable number also was not. A majority of the trainees could not connect measuring instruments to the circuit. From item 6, it can be inferred that trainees' ability to set measuring instruments to the require value/ranges was low as well as item 7 where a majority had indicated that they had low skill on how to use the instruments to measure the required values and waveforms. On item 8 a majority of the trainees had the ability to read and record the required values and waveforms while another majority had no ability to write a lab report.

Table 4.11 shows how trainers rated their trainees on various areas of skill attainment. The trainers also rated the trainees on the use of the instruments to measure the required values and waveforms, to read and record the required values and waveforms and writing a lab report, a majority of the trainers indicated that their trainees have moderate or high ability in comparison to those that indicated otherwise. These results can be interpreted that trainees had the ability to perform the various tasks as indicated by trainers.

Table 4.11: Trainers' rating of trainees' level of skill attained on various electronic tasks

NOTE: VL =Very low, L = Low, M = Moderate, H = High, VH = Very high, F = Frequency and % = Percentage

		Level of Skill Attainment									
Item No.	**Area of skill attainment**	**VL**		**L**		**M**		**H**		**VH**	
		F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
1	Design and develop an electronic circuit	8	22.9	7	20.0	11	31.4	9	25.7	0	0.0
2	Read and interpret an already designed circuit	2	5.7	2	5.7	13	37.1	18	51.4	0	0.0
3	Identify components, materials, tools and measuring instruments to use for the designed circuit	0	0.0	1	2.9	11	31.4	19	54.3	4	11.4
4	Mount/solder the electronic circuit on a PCB, BB and Strip board	0	0.0	0	0.0	17	48.6	15	42.9	3	6.4
5	Connect measuring instruments to the circuit	3	6.4	3	6.4	19	54.3	9	25.7	1	2.9
6	Set measuring instruments to the require value	3	6.4	9	25.7	16	45.7	7	20.0	0	0.0
7	Use the instruments to measure the required values and waveforms	4	11.4	4	11.4	16	45.7	11	31.4	0	0.0

8	Read and record the required values and waveforms	0	0.0	0	0.0	17	48.6	12	34.3	6	17.1
9	Write a lab report	0	0.0	3	6.4	22	62.9	5	14.3	5	14.3

Source: Questionnaire Data (2020)

Table 4.12: Mean responses of trainees and trainers on the level of skill attained on various electronic tasks.

NOTE: SD=Standard Deviation, D=Decision, GM=Grand Mean, PSD=Pull Standard Deviation, M=Moderate, L=Low

		Trainees N=252			**Trainers N=35**					
Item No.	**Area of Skill Attainment**	**Mean**	**SD**	**D**	**Mean**	**SD**	**D**	**GM**	**PSD**	**Remarks**
1	Design and develop an electronic circuit	1.54	0.853	L	2.60	1.117	M	**2.072**	**0.985**	**L**
2	Read and interpret an already designed circuit	2.40	0.933	L	3.34	0.838	M	**2.874**	**0.886**	**M**
3	Identify components, materials, tools and measuring instruments to use for the designed circuit	2.98	0.932	M	3.74	0.701	H	**3.363**	**0.816**	**M**
4	Mount the electronic circuit on a PCB, BB and Strip board	2.75	0.910	M	3.60	0.651	H	**3.173**	**0.780**	**M**
5	Connect measuring instruments to the circuit	2.62	0.831	M	3.06	0.906	M	**2.840**	**0.868**	**M**
6	Set measuring instruments to the require value	2.47	1.008	L	2.77	0.877	M	**2.622**	**0.942**	**M**
7	Use the instruments to measure the required values and waveforms	2.22	0.896	L	2.97	0.954	M	**2.597**	**0.925**	**M**

8	Read and record the required values and waveforms	2.88	1.034	M	3.69	0.758	H	**3.283**	**0.896**	**M**
9	Write a lab report	1.90	1.029	L	3.34	0.838	M	**2.624**	**0.934**	**M**
	Grand Mean/ Pull SD	**2.42**	**0.936**	**L**	**3.23**	**0.849**	**M**	**2.828**	**0.892**	**M**

***Source:* Questionnaire data (2020)**

Mean responses of trainees and trainers on the level of skill attained on various electronic tasks are shown in table 4.12. The decision (D) on how the trainees and trainers rated trainees' skill attainment on the ability to perform various electronic tasks was given on lower and upper limits of the means as: Very High 4.5 - 5.00, High 3.5 - 4.49, Moderate 2.5 - 3.49, Low 1.5 - 2.49 and Very Low 0.5 - 1.49.

From the table, the trainees rated item 1, 2, 6, 7, and 9 as low while the trainers rated them as moderate. These results reveal that the ability of the trainees to design and develop an electronic circuit, read and interpret an already designed circuit, set measuring instruments to the require value/range, use the instruments to measure the required values and waveforms and write a lab report was considered low. The mean responses of the trainees fell between 1.5 and 2.49 which means the ability was rated low. The mean responses of the trainers fell between 2.5 and 3.49 meaning that rating was moderate. The grand means fell between 2.5 to 3.49 which mean overall rating was moderate. This can be interpreted that most of the trainees had low skills in the areas stated above as indicated by them. The grand mean of item 1 which was 2.072 shows that the ability of the trainees to design and develop a circuit was low. For items 3, 4 and 8, the trainees indicated that their ability was moderate and the trainers differed with them by indicating that they had high ability. Though the trainers indicated that the trainees had high ability, the grand means conquer with those of the trainees that they had moderate abilities. Both trainees and trainers scored a mean between 2.5 and 3.49 for item 5, which means that trainees had moderate ability. However, grand mean/standard deviation (M=2.828, SD=0.892) suggests that the skill attained on various areas was moderate.

In this study the findings show that both the trainees and trainees perceived the skills attained by trainees as moderate. This shows that the attainment is not high enough to make them face the world of work with confidence. This is consistent with other findings. A study carried out in Malaysia on electronic engineering diploma students showed that many of the students could identify the basic electronic components but there was no confidence when it came to skills related to the circuit construction, instrument operation and recording and interpretation of recorded values (Salim, Puteh, & Daud, 2009).

4.4.2 Management and utilization of equipment, tools, and materials

In this section the study looks at the various aspects of management and utilization of electronic laboratory equipment, tools and materials. Then the influence of management and utilization of equipment, tools, and materials on skill acquisition is explored. The respondents for the survey (who comprised both trainees and trainers) were asked a number of questions and the findings were as presented below.

4.4.2.1 Laboratory space and equipment for laboratory practices

The space of the electronic laboratory determines how many trainees can be accommodated during lab practice. Regarding how spacious the electronic laboratories were, table 4.14 presents the responses of the trainees and trainers on what they thought. These findings show that both the trainees and trainers considered the laboratory space and equipment for electronic laboratory practices to be slightly spacious. This is evident from their responses where over 50% said the laboratories were slightly adequate.

Table 4.14: Adequacy of laboratory space and equipment for laboratory practices

	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Not adequate at all	84	33.3	7	20
Slightly adequate	137	54.4	19	54.3
Moderately adequate	28	11.1	8	22.9
Adequate	3	1.2	1	2.9
Very adequate	0	0	0	0
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire Data (2020)**

The survey results agreed with the findings of the interviews, observation and focus group discussion. From the interviews with HODS, it was revealed that the laboratory space and equipment were not quite adequate because of high student population. The HODs indicated that in their laboratories, working areas were fewer, space was squeezed and congested and hence posed a challenge of safety which was not guaranteed due to limited space and congestion. Equipment in the laboratories were also being shared by many students.

From the FGD, the participants said that the laboratories and equipment had remained the same yet the number of trainees admitted had continued to increase over the years. This was due to the government directive of 100% transition from primary school to secondary school to tertiary institutions. What this meant was that the laboratory space and equipment were adequate for the student population that were there before the transition directive. Some FGD participants also said that some laboratories were used as classrooms in some institutions.

From the observation made by the researcher, the laboratory space and equipment were not adequate. This is because the number of trainees present at the time of observation was more than available space would accommodate. The laboratories were congested and few trainees were seated while many of them standing during laboratory sessions. Equipment was also limited. Sessions comprised of big groups which could not allow some trainees to even touch the equipment or do any practice for the entire session.

These findings on electronic laboratory space are consistent with the findings of Okolie and Ogbaekirigwe (2014) in which the researchers found out that TVET institutions in Nigeria did not have enough laboratory or workshop space for training skill. Ogbuanya, Akintonde and Bakare (2017) also found out that most TVET institutions had inadequate equipment available to train trainees on electronic skills, a demonstration that laboratories did not have adequate equipment for training.

4.4.2.2 Safety and proper use of equipment

Safety and proper use of any equipment is paramount since it allows the equipment to be available for use when needed. Figure 4.1 shows the responses of trainees and trainers on how well students are guided on the safety and proper use of equipment. From the results, it is evident that a majority of the trainees and trainers rated the guidance students were given on the safety and proper use of equipment to be good.

Figure 4.1: Rating on how well students were guided on the safety and proper use of equipment.

4.4.2.3 Measures employed to safeguard laboratory equipment and tools.

The results seen in table 4.15, reveals that both the trainees and trainers considered the measures employed to safeguard laboratory equipment and tools to be moderately effective. From the table over 45% of the trainees and over 50% of trainers considered measures employed as moderately effective. This means that the measures need to be put in place to safeguard equipment and tools.

Table 4.15: Rating on the measures employed to safeguard laboratory equipment and tools.

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Not effective	33	13.1	4	11.4
Slightly effective	73	29	2	5.7
Moderately effective	118	46.8	19	54.3
Highly effective	25	9.9	10	28.6
Very highly effective	3	1.2	0	0
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

FGD responses agreed with the survey results. The participants indicated that the measures were not very effective as there were a number of times when equipment and tools got lost. However, interview responses from HODs on the measures employed to safeguard laboratory equipment and tools from being lost indicated that the measures were effective because there were procedures for issuing equipment to students during practice and receiving equipment from the student once the laboratory session was over.

From observation findings, the researcher observed that measures put in place to safeguard equipment, and tools from getting lost or misused there were not very effective. A common practice observed in most of TVET institutions under study was trainer asking the trainees to return equipment after the session without confirming that all had been returned. It was only in one institution that the trainer confirmed that all equipment and tools issued had been returned.

4.4.2.4 Acquisition of modern electronic laboratory equipment

From table 4.16, a majority of the trainees, indicated that acquisition of new equipment to be rare while a majority of the trainers, indicated that acquisition of modern electronic laboratory equipment to be somehow frequent.

Table 4.16: How frequently modern electronic laboratory equipment were acquired.

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Rarely	135	53.6	15	42.9
Somehow frequent	90	35.7	16	45.7
Frequently	24	9.5	2	5.7
Very frequently	3	1.2	2	5.7
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

Findings of the focus group discussion revealed that many TVET institutions did not have plans for regular acquiring of modern equipment or replacing old ones. In an event they are bought, they were not enough to serve the number of students admitted. Participants also indicated that sometimes equipment were bought that were not in line with the syllabus requirements. This is because, at times, management proceeded to buy equipment without involving the trainers, the end users.

Interview responses on frequency of acquisition of modern equipment or replacement of old ones revealed different practices in TVET colleges. While almost all the HODs agreed that equipment was not acquired or replaced frequently, one HOD said that in their college equipment were acquired on need. Another HOD said they had a procurement plan where some equipment were acquired at least yearly.

These findings agreed with the findings of Ogbuanya and Okoli (2014). The researchers found out that acquisition of modern equipment was a challenge to most TVET institutions which the authors attributed to lack of funds available for the purchase of new equipment.

4.4.2.5 Repair and maintenance of electronic laboratory equipment

Regarding the repair and maintenance of electronic laboratory equipment, it was apparent that the equipment were rarely repaired and maintained. This was evident from the responses of the trainees and trainers presented in figure 4.2. Data reveals that a great number of trainees and trainers indicated that the equipment were rarely repaired and maintained.

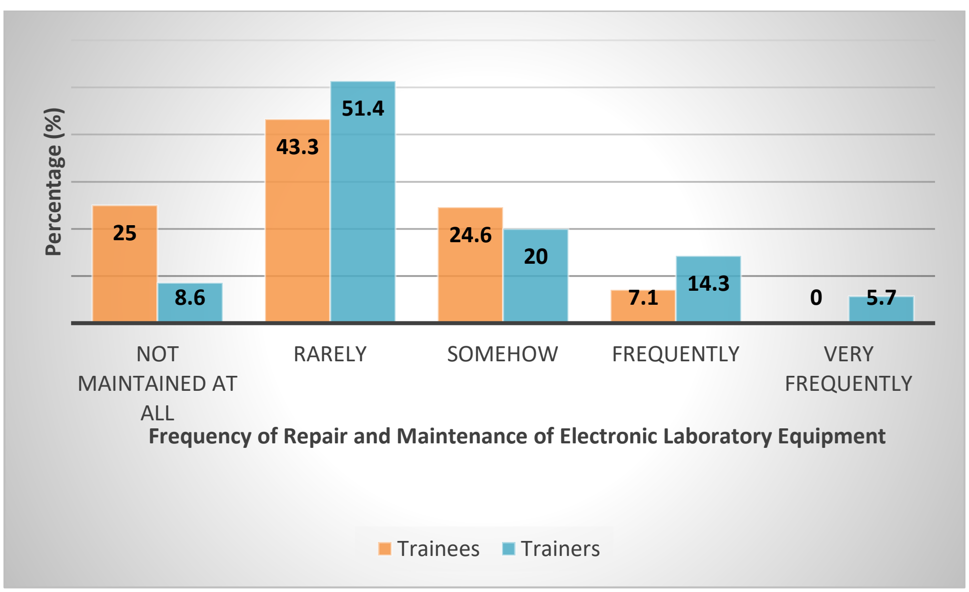


Figure 4.2: How frequently electronic laboratory equipment were repaired /maintained.

Focus group discussion participants' responses indicated that equipment were rarely repaired. The participants further revealed that repairs and maintenance were difficult because of unavailability of spare parts. The unavailability of spare parts was as a result of equipment sometimes procured from different countries or from different companies which made it harder to obtain spare parts for purposes of repairs and maintenance. Sometimes, it was because the same equipment was no longer being manufactured due to upgrade in technology. Also, the process of obtaining money in many institutions for repair and maintenance took a long time to be released. As such, the equipment was in unusable condition.

From the HODs interview responses, the repair and maintenance of laboratory equipment used for training was rarely done. The HODs attributed this practice to lack of maintenance schedule, lack of staff to maintain the equipment, and lack of funds to buy spares or parts that need replacement. However, one HOD said that they had developed a maintenance schedule which was about to be implemented. Observation results concurred with the above findings. Many institutions visited had unrepaired heaps of equipment within the laboratory space hence reducing the space available. This also signifies that maintenance was rarely or not done at all when the equipment breaks. These findings agreed with Kemevor and Kassah (2015) who found that in most TVET institutions, infrastructure and training facilities were in a deplorable state which affected the acquisition of the relevant skills for the world of work.

4.4.2.6 Management and utilization of equipment, tools and materials for skill acquisition

Table 4.17 shows that both trainees and trainers viewed the management and utilization of equipment, tools and materials as moderately effective.

Table 4.17: Effectiveness of management and utilization of equipment, tools and materials.

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Not effective	20	7.9	2	5.7
Somehow effective	57	22.6	1	2.9
Moderately effective	133	52.8	16	45.7
Very effective	41	16.3	12	34.3
Highly effective	1	0.4	4	11.4
Total	**252**	**100.0**	**35**	**100.0**

Source: **Questionnaire data (2020)**

From the FGD participants, it was pointed out that the management and utilization of laboratory equipment and tools was not very proper because their institutions lacked laboratory technicians who have direct responsibility for managing the laboratory resources. The FGD participants also revealed that the labs themselves were poorly managed since sometimes they were used as classrooms.

HODs said that management and utilization of laboratory equipment, tools and materials for skill acquisition was somehow effective. Efforts were made by the institutions to ensure laboratory equipment, tools and materials were in good working condition.

From observation, except for one electronic laboratory, most laboratories seemed not conducive for practice as they were dusty (seemed rarely used), not well lit, not well ventilated. They were also not well organized as the work stations were not complete, equipment and tools were not adequately taken care of. Other observations were: sockets were dismantled with exposed live wires in some places, training kits were old and the facilities were sub-standard, and some were also storing mal-functional gadgets, equipment and tools, an evidence of improper management and utilization and a don’t care attitude. This showed ineffective management and utilization of equipment, tools and materials for skill acquisition.

4.4.2.7 Influence of management and utilization of equipment, tools, and materials on skill acquisition.

Spearman’s rank correlation was run to determine whether there was a relationship between management and utilization of equipment, tools and materials and skills acquired by technician trainees. Table 4.18 shows that there was a strong positive relationship between management and utilization of equipment, tools and materials and skills attained by technician trainees in Nairobi Kenya $(r_s[287] = .568, p < .001)$. This positive relationship implies that there is strong influence of management and utilization of equipment, tools and materials on skill acquisition. If this were improved further, then the influence on skill acquisition will be very strong.

Table 4.18: Spearman's rho correlations between management and utilization of equipment, tools, and materials and the skills attained.

		Skills Attained	Management and utilization of equipment
Skills Attained	Correlation Coefficient	1.000	.568**
	Sig. (2-tailed)	.	.000
	N	287	287
Management and utilization of equipment	Correlation Coefficient	.568**	1.000
	Sig. (2-tailed)	.000	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.3 Electronic laboratory instruction practices in TVET institutions

This section addressed each of the laboratory instruction practices in TVET institutions and their influence on skill acquisition.

4.4.3.1 Technology incorporation in laboratory instruction

This section deals with technology incorporation in laboratory instruction. In this aspect the following were explored: whether TVET colleges had incorporated the use of technology in electronics laboratory instruction; various technologies incorporated in laboratory instruction; laboratory tasks for which the various technologies were used in instruction and opinion on the use of technology in laboratory instruction for skill acquisition.

4.4.3.1.1 Technology incorporation in laboratory instruction

Figure 4.3 shows a greater number of both trainees and trainers indicated that technology had not been incorporated in laboratory instruction.

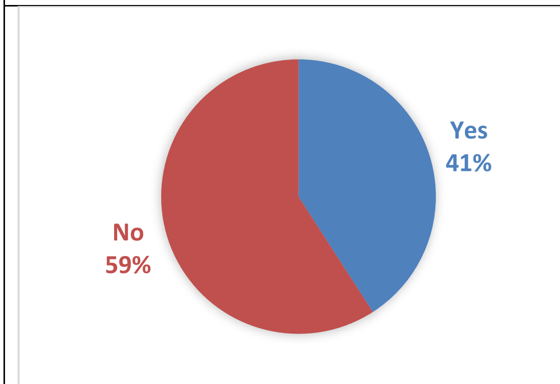
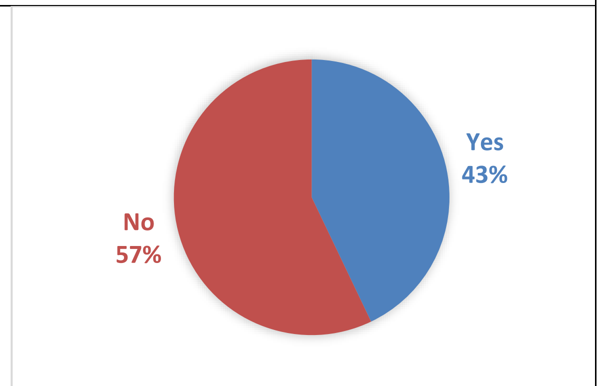
Trainees	Trainers
	

Figure 4.3: Whether TVET colleges had incorporated the use of technology in lab instruction

Since majority of the respondents asserted that their colleges had not incorporated the use of technology, we can deduce that use of modern technology in laboratory instruction is yet to be embraced in TVET colleges. From observation, most of the equipment in the laboratories were old utilizing old technology which had already been phased out of the market.

The findings from FGD participants and interview with HODs showed that most colleges mostly used physical laboratory in electronics laboratory instruction and rarely do they make use of modern technologies. HODs said occasionally they used internet to show trainees some aspects of laboratory practice. Some FGD participants indicated that occasionally they employ animations and downloaded digital videos to show some skills.

4.4.3.1.2 Technologies incorporated in laboratory instruction

From the survey, interview responses and focus group discussion a number of technologies were incorporated. These technologies included: smart classroom technology, use of digital video, Bluetooth technology, internet where trainees could watch lab sessions on YouTube.

4.4.3.1.3 Laboratory tasks for which the various technologies are used in instruction

The technologies mentioned above were used for a number of laboratory tasks which included: showing the physical look of various electronic components, demonstration of simple exercises, designing of simple projects, using and setting of various measuring instruments, how to use a bread board, how to use a strip board, and how to soldering.

4.4.3.1.4 Opinion on the use of technology in laboratory instruction for skill acquisition.

From table 4.19 most of the trainees and trainers opined that the use of technology in laboratory instruction for skill acquisition was fair. These results indicated that efforts had been made to employ technology in laboratory instruction for skill acquisition, although the use was low.

Table 4.19: Opinion on the use of technology in laboratory instruction for skill acquisition

	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Poor	40	15.9	9	25.7
Fair	119	47.2	13	37.1
Good	71	28.2	11	31.4
Very good	21	8.3	2	5.7
Excellent	1	0.4	0.0	0.0
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

4.4.3.1.5 Influence of technology use on skill acquisition

Results of the Spearman correlation indicated that there was a moderate significant positive relationship between the use of technology in laboratory instruction practice and skill acquisition($r_s[287] = .355, p < .001$). What this implies is that although the use of technology influences skill acquisition, the influence may not be great probably because technology plays a facilitative role in laboratory instruction.

Table 4.20: Spearman's rho correlations between technology use and the skills attained.

		Skills Attained	Use of Technology
Skills Attained	Correlation Coefficient	1.000	.355**
	Sig. (2-tailed)	.	.000
	N	287	287
Use of Technology	Correlation Coefficient	.355**	1.000
	Sig. (2-tailed)	.000	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.3.2 Scheduling of laboratory sessions

This section dealt with the extent to which scheduling of electronic laboratory sessions influenced skill acquisition among technician trainees. To answer this question, the respondents who comprised both trainees and trainers were asked a number of questions relating to scheduling. The results were as follows.

4.4.3.2.1 Electronic laboratory sessions scheduling in the timetable

From figure 4.4, a great number of the trainees and trainers confirmed that laboratory sessions are scheduled within the lecture hours in the timetable. This is in comparison to a small number who said that their laboratory sessions were scheduled separately in the timetable. What these findings show is that electronic laboratory sessions are given a raw deal in the scheduling of the learning activities in colleges.

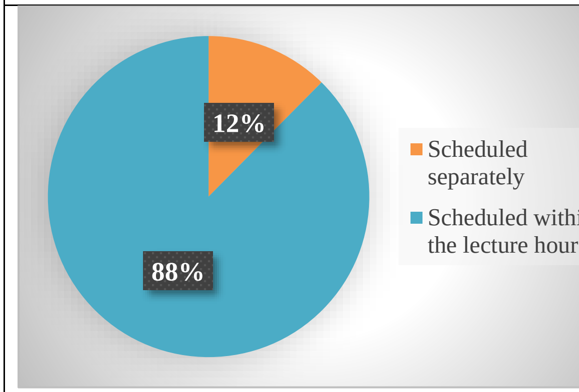
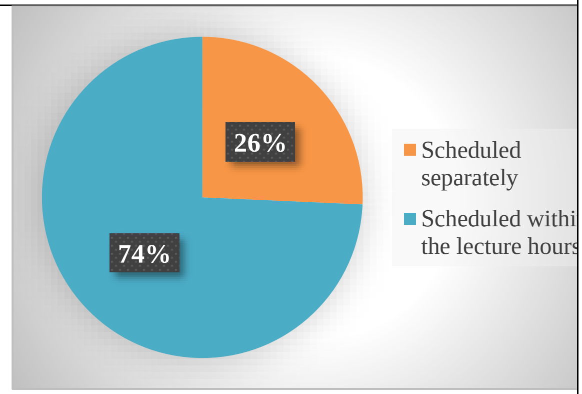
Trainees	Trainers
	

Figure 4.4: How lab practical sessions are scheduled in the timetable in your institution

FGD responses concurred with survey findings. From the responses of FGD participants, it was found that laboratory practice is not scheduled. It is the trainer who had to plan for a laboratory activity within the teaching hours given. HODs agreed with FGD participants in that the laboratory practice was left at the discretion of the trainer to decide when to schedule it within the lecture hours.

These findings are consistent with Krivickas and Krivickas (2007) who found out that theory and laboratory lessons are not scheduled separately instead the hours for theory and laboratory practice are distributed accordingly depending on the nature of the course.

4.4.3.2.2 How often the electronics laboratory practice schedule followed.

From table 4.21, trainers concurred with the trainees that the schedule is sometimes followed. This implies that though the sessions were scheduled separately or within lecture hours, the schedule was not always followed as expected which means laboratory practice was handled ad hoc.

Table 4:21: How often the electronics laboratory practice schedule was followed

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Never	0	0.0	0	0.0
Rarely	24	9.5	3	8.6
Sometimes	163	64.7	23	65.7
Often	65	25.8	9	25.7
Always	0	0.0	0	0.0
Total	**252**	**100**	**35**	**100**

***Source:* Questionnaire data (2020)**

HODs interviewed revealed that laboratory practice was not scheduled separately from theory session. It was left at the discretion of the trainer to decided when to have the laboratory practice. They reported that when they scheduled separately, some trainers could decide to teach theory even on a scheduled lab practice lesson. FGD revealed that some institutions had general time allocated for laboratory practice but no specific subject and trainer were assigned. Laboratory practice session, most of the time, was taken as a free time for trainees. Also, a number of times many trainers substituted practical sessions for theory lessons. What this means is that the trainers preferred teaching theory lessons to cover the theory syllabus that is examined. Since laboratory practice was not examined by any examining body, trainers seemed not to attach great importance to it which implied that whatever the trainees were supposed to cover in laboratory practice within the specified period of time could not be covered.

From the observation, it appeared like the schedules were not followed since the lab sessions seemed impromptu and not planned for. This was deduced from the way a number of trainees seemed unprepared for the sessions, trainees and trainers not having the PPEs, and the required tools. Except for two institutions, trainers also seemed unprepared as they did not have lab sheets and they seemed not to have done the exercise earlier. In most institutions, laboratory equipment, materials and tools were not set up during the session.

4.4.3.2.3 Time scheduled for electronics laboratory practice.

Table 4.22 shows that over 50% of the trainers and over 70% of the trainees indicated that time scheduled for laboratory activities was somehow sufficient. What these results mean is that the time scheduled for electronic laboratory practice was not very sufficient, hence trainees could not get enough time to practice the needed skills.

Table 4.22: Sufficiency of time scheduled for electronics laboratory practice

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Not sufficient at all	25	9.9	4	11.4
Somehow sufficient	179	71.0	19	54.3
Sufficient	33	13.1	12	34.3
Very sufficient	15	6.0	0	0.0
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

From interview with HODs, time allocation for laboratory practice was technically limited since the subjects were many and trainees' numbers were many. The HODs also pointed out that the number of hours per week are few and the laboratories could accommodate very few trainees comfortably at ago. Therefore, laboratory practice was not given much attention.

From FGD responses, it emerged that the time allocated for electronic laboratory practice was very limited. This made it difficult for trainers to do any meaningful work. This was because the theoretical part of the course was so massive to cover and was given more time since it was the one that was examined by Kenya National Examinations Council (KNEC). Therefore, trainers opted to utilize all the allocated time for theory lessons. These findings agreed with Ogbuanya Akintonde, and Bakare (2017) who found that time allocated for skill learning was inadequate. This implied that trainees were not getting enough opportunities for skills practice.

4.4.3.2.4 Synchronization of the scheduling of theory and laboratory practice topics

From table 4.23, over 40% of the trainees and over 50% of the trainers indicated that the scheduling of theory sessions and laboratory practice topics were not synchronized at all. These results may mean that it was difficult for the trainees to see the link between what they studied in the theory lessons and laboratory practice they undertook.

Table 4.23: Synchronization of the scheduling of theory and laboratory practice topics.

	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Not synchronized at all	106	42.1	19	54.3
Somehow synchronized	98	38.9	12	34.3
Synchronized	48	19.0	4	11.4
Highly synchronized	0	0.0	0	0.0
Total	**252**	**100.0**	**35**	**100.0**

Source: **Questionnaire data (2020)**

The findings of the FGDs and interview with HODs also concurred with the survey responses of trainees and trainers that the scheduling of theory sessions and laboratory practice topics were not synchronized. From the observations made, the laboratory sessions did not seem to follow the syllabus. The trainees observed seemed to be doing a basic topic yet they were diploma final year trainees.

4.4.3.2.5 Satisfaction with the scheduling of laboratory sessions

Figure 4.5 shows the responses of trainees and trainers on how satisfactory the scheduling of laboratory sessions was. It can be observed from the table that over 40% of the trainees indicated that they were moderately satisfied with the way scheduling of laboratory sessions was done., while over 50% of the trainers indicated that they were somehow satisfied with the way scheduling of laboratory sessions was done. This means that the scheduling for electronic laboratory sessions was a big challenge in most TVET institutions.

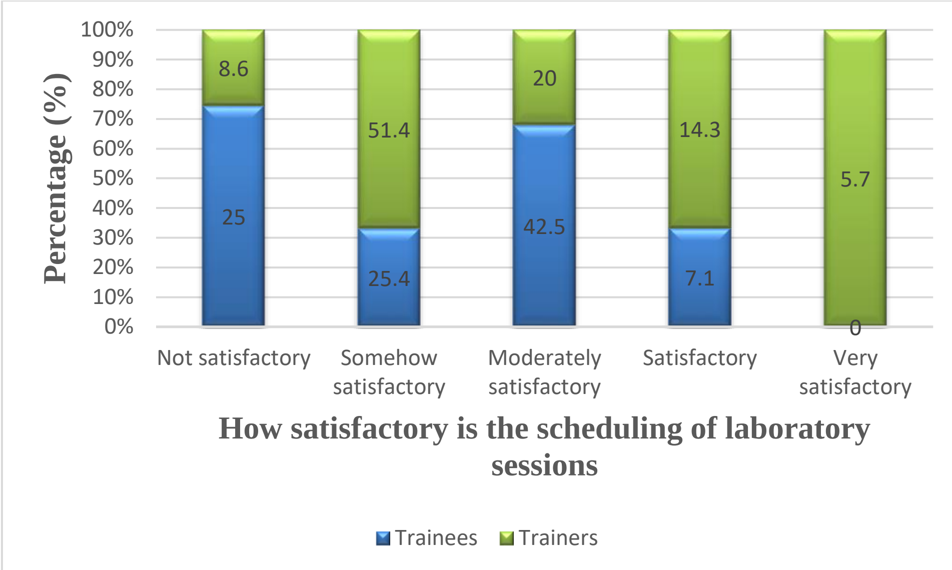


Figure 4.5: Satisfaction with scheduling of laboratory sessions

From the interview findings, the HODs indicated that the scheduling of laboratory practice was satisfactory given the fact that the trainers were at liberty to distribute the hours between theory and practice. However, the FGD participants indicated that the way scheduling of laboratory practice was done was not very satisfactory because of the heavy workload the trainers had. This made the trainers overlook laboratory practice as they focused on theory. Many of the FGD participants felt that laboratory practice be scheduled separately for maximum benefit to the trainees. Some indicated that the curriculum needed to be reviewed to reduce theory content to enable them increase laboratory practice sessions.

4.4.3.2.6 Influence of scheduling of laboratory sessions and skill acquisition

From table 4.24, Spearman correlation results indicated that there was a moderate significant relationship between scheduling of laboratory sessions and skill acquisition by technician trainees ($r_s[287] = .438, p < .001$). This means that although the scheduling of the laboratory sessions have an influence on skill acquisition, the influence is moderate.

Table 4.24: Spearman's rho correlations between technology use and the skills attained.

		Skills Attained	Scheduling of lab sessions
Skills Attained	Correlation Coefficient	1.000	.438**
	Sig. (2-tailed)	.	.000
	N	287	287
Scheduling of Lab sessions	Correlation Coefficient	.438**	1.000
	Sig. (2-tailed)	.000	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.3.3 Approaches employed in laboratory instruction

This section looks at the approaches employed in electronic laboratory practice instruction and how effective they are in helping trainees acquire skills.

4.4.3.3.1 Approaches employed in laboratory instruction

Table 4.25 presents trainees' and trainers' responses on the approaches used for laboratory instruction. 0ver 50% of the trainees and trainers indicated that the most used instruction approach employed for lab instruction was exercise approach followed by demonstration approach. The other approaches were rarely used.

Table 4.25: Approaches mostly employed in electronic laboratory practice

	Trainees		Trainer	
	Frequency	**Percent**	**Frequency**	**Percent**
Demonstration	82	32.5	13	37.1
Exercise	141	56.0	19	54.3
Structured inquiry	0	0.0	0	0.0
Open-ended inquiry	0	0.0	0	0.0
Project method	29	11.5	3	8.6
Total	**252**	**100.0**	**35**	**100.0**

Source: **Questionnaire data (2020)**

Findings from FGD revealed that the trainees were given an exercise to perform during a laboratory session by the trainers. From observation made by the researcher it was clear that most trainers used exercise method in laboratory instruction. It was also observed that trainers rarely demonstrated the experiment at the beginning of the session. However, during the laboratory session, the trainers could demonstrate how the exercise was supposed to be done to some groups when there was need.

4.4.3.3.2 Effectiveness of the laboratory approaches employed mostly by trainers in skill acquisition

Table 4.26 shows that over 40% of trainees indicated that the laboratory approaches mostly employed by trainers were slightly effective while over 40% of the trainers indicated that they were moderately effective. These results show that the trainees were not satisfied with approaches used while the trainers are moderately satisfied. These findings implied that the trainees were not gaining the required skills as the training approaches were not very effective as the results showed.

Table 4.26: Effectiveness the laboratory approaches mostly employed by trainers in skill acquisition

	TRAINEES		TRAINERS	
	Frequency	**Percent**	**Frequency**	**Percent**
Not effective at all	53	21.0	4	11.4
Slightly Effective	104	41.3	6	17.1
Moderately Effective	79	31.3	15	42.9
Effective	12	4.8	10	28.6
Very Effective	4	1.6	0	0.0
Total	**252**	**100.0**	**35**	**100**

Source: **Questionnaire data (2020)**

4.4.3.3.3 Influence of laboratory approaches used by trainers on skill acquisition

Results of the Spearman correlation in table 4.27 showed that there was a very strong significant positive relationship between laboratory instruction approaches used by trainers and skills acquired by technician trainees ($r_s[287] = .811, p < .001$). This implies that the laboratory instruction approaches employed by the trainers have a great impact on the skills acquired by students. Thus, if appropriate teaching methods are used, there will be greater skill acquisition.

Table 4.27: Spearman's rho correlations between laboratory approaches employed and the skills attained.

		Skills Attained	Laboratory teaching methods
Skills Attained	Correlation Coefficient	1.000	.811**
	Sig. (2-tailed)	.	.000
	N	287	287
Laboratory teaching methods	Correlation Coefficient	.811**	1.000
	Sig. (2-tailed)	.000	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.3.4 Organization of laboratory session activities

This section focused on how trainees mostly carried out the laboratory work. The results were as follows:

4.4.3.4.1 How trainees mostly carried out the laboratory activities.

As can be seen from figure 4.6, trainees in TVET institutions mostly undertook laboratory activities in groups. This is evident from the results that over 80% of the respondents indicated that the trainees undertake lab activities in groups.

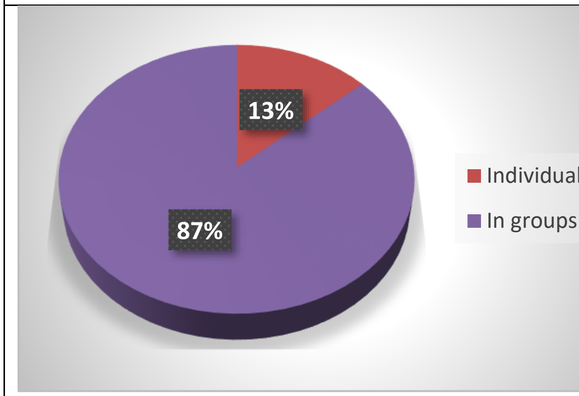
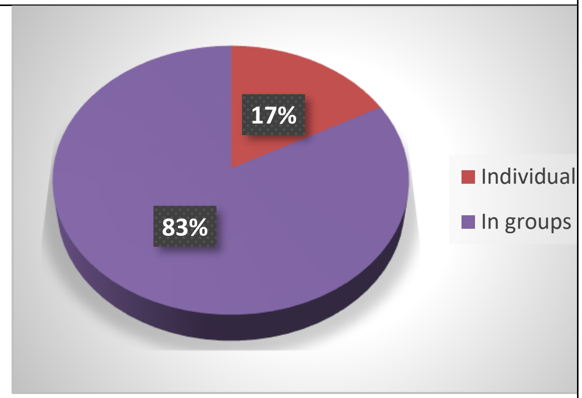
Trainers	Trainers
	

Figure 4.6: How trainees mostly carry out the laboratory work.

The responses from the interview with HODs and FGD participants showed that trainees usually worked in groups during laboratory sessions. This was due to the limited facilities, equipment, tools and materials which necessitated that they share the resources available. From observation, trainees were put in groups because of the large numbers and lack of enough equipment, tools and materials. The implication of these findings was that working in groups would not permit trainees to develop required skills as there was limited time for each to handle the equipment especially for those that are not very active and aggressive.

4.4.3.4.2 Opportunities for trainees to undertake laboratory practice during their own time.

From figure 4.7 it is evident that over 90% of trainees and trainers said that there were no opportunities for trainees to undertake electronics laboratory practice during their own time while a small percentage indicated that they could undertake laboratory practice during their own time. These results imply that there were minimal opportunities to undertake laboratory activities on their own. This meant that trainees who had an interest in perfecting their skills could not get an opportunity to do so. They had to depend on the trainer's or lab technician availability and the college schedule.

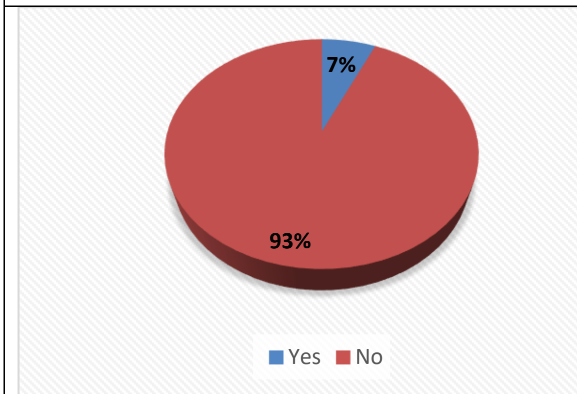
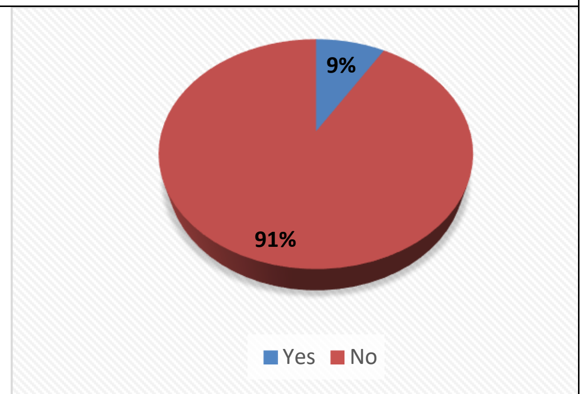
Trainees	Trainers
	

Figure 4.7: Opportunity for trainees to undertake laboratory practice during their own time.

HODs and FGD participants agreed with survey respondents that trainees did not have an opportunity to visit the laboratory to undertake laboratory activities on their own. The reason for this was due to administrative and logistical problems which included lack of a laboratory technician in some institutions and even lack of time due to lot of theory lessons.

4.4.3.4.3 Number of trainees who attended the laboratory practical during a single session

From figure 4.8, 80% of the trainees and 70% of the trainers said that the number of trainees who attended the laboratory practical session at once were more than 20 while a small percentage of respondents indicated that those who attended at once were less than 20. These results can be interpreted that the institutions admitted a big number of trainees who were more than what their laboratory space could accommodate.

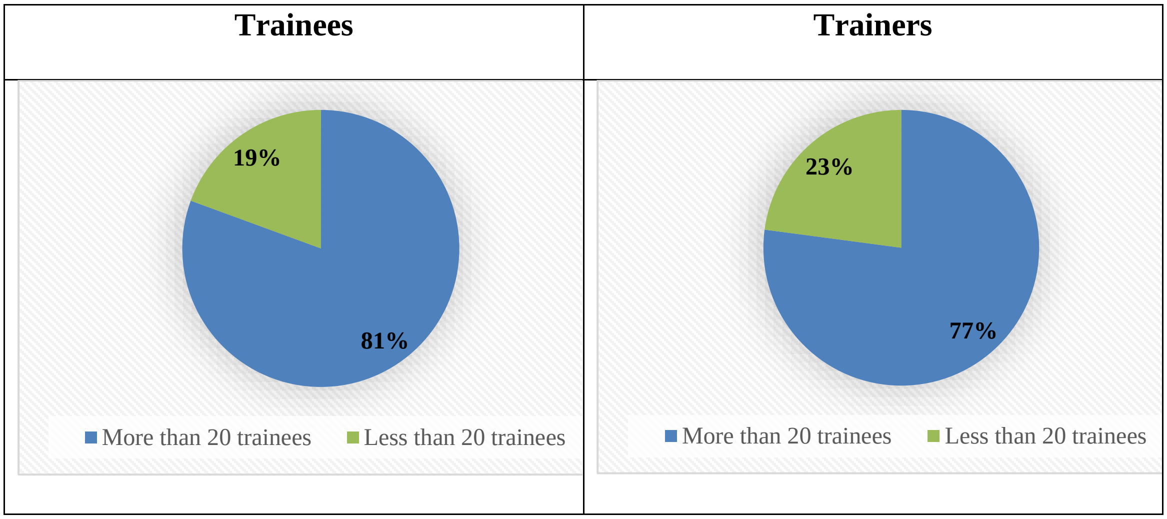


Figure 4.8: Number of trainees who attended the laboratory practical during a single session

The researcher observed that less than 20 trainees were attending a single laboratory session. This was an indication that the laboratory sessions were congested. This was because most of the laboratories were designed to accommodate approximately 20 as per the findings from the interviews with the HODs.

4.4.3.4.4 Who normally guides trainees during laboratory practice sessions

Table 4.28 below shows that 50% of trainees revealed that their laboratory practice sessions were mostly guided by trainers over 40% said they were guided by both the trainer and the lab technician. Over 50% of trainers indicated that it was both the trainer and technician who guides the trainees during the laboratory sessions while 35% said that it was the trainers who guide the laboratory sessions. These results, imply that whenever there was a laboratory activity in TVET institutions, trainers and lab technicians were involved to enhance skill instruction.

Table 4.28: Who normally guided trainees during laboratory practice sessions?

	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Lab Technicians	13	5.2	4	11.4
Trainers	126	50.0	13	37.2
Both Trainers and technicians	113	44.8	18	51.4
Total	**252**	**100.0**	**35**	**100.0**

***Source:* Questionnaire Data (2020)**

HODs in an interview indicated that most electronic laboratory sessions were guided by the trainers assisted by the laboratory technicians. However, in some cases the trainer gave an exercise and left the technicians to supervise the trainees. The FGD participants also indicated that it was the trainers who guided the trainees on laboratory activities assisted by laboratory technician. These findings reveal that laboratory practice was not given adequate attention.

4.4.3.4.5 Satisfaction with the way laboratory activities were organized in the institutions.

Table 4.29 shows that a majority of the trainees indicated that they were moderately satisfied with the way laboratory activities are organized, while a majority of trainers indicated that they were slightly satisfied with the way laboratory activities are organized.

Table 4.29: Satisfaction with the way laboratory activities were organized in your institutions

	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Not satisfied at all	58	23.0	15	42.9
Slightly satisfied	70	27.8	16	45.7
Moderately satisfied	107	42.5	2	5.7
Satisfied	13	5.2	2	5.7
Very satisfied	4	1.6	0	0.0
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

From the results, trainees seemed moderately satisfied with the way laboratory activities were organized while trainers were slightly satisfied. The response from the trainers shows that they really faced great challenges in terms of laboratory practice.

4.4.3.4.6 Influence of organization of laboratory activities on skill acquisition.

Results of the Spearman correlation indicates that there was a strong significant positive relationship between organization of laboratory activities and skill acquisition by technician trainees, $(r_s[287] = .646, p < .001)$. What this strong positive relationship means if that better organization of laboratory activities will lead to high influence on skill acquisition among trainees.

Table 4.30: Spearman's rho correlations between organization of laboratory activities and the skills attained.

		Skills Attained	Organization of Laboratory activities
Skills Attained	Correlation Coefficient	1.000	.646**
	Sig. (2-tailed)	.	.000
	N	287	287
Organization of Laboratory activities	Correlation Coefficient	.646**	1.000
	Sig. (2-tailed)	.000	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.3.5 Laboratory Preparation Practices

This section presents information on whether lab manuals were made available to trainees in TVET institutions; how often trainees were encouraged to read the laboratory experiment in the lab manual and other related textbook material in preparation for the laboratory session; whether the trainees were encouraged to consult with the trainer before, in preparation for the laboratory practice session; whether trainee class size was considered when preparing for a laboratory practice session; whether electronic laboratory equipment, tools and materials were set before the trainees arrived in the laboratory; and opinion on the adequacy of preparation for laboratory learning sessions.

4.4.3.5.1 Availability of laboratory manuals to trainees in TVET institutions

A great percentage of trainees were not aware whether lab manuals are available. Figure 4.9 shows that over 70% of the trainers indicated that laboratory manuals were not made available to trainees. A small percentage of the trainers indicated that laboratory manuals were made available to trainees. What this implied was that laboratory manuals were not available in a number of TVET institutions. Also, failure to avail laboratory manuals to trainees may mean that laboratory practice was not being handled systematically but ad hoc.

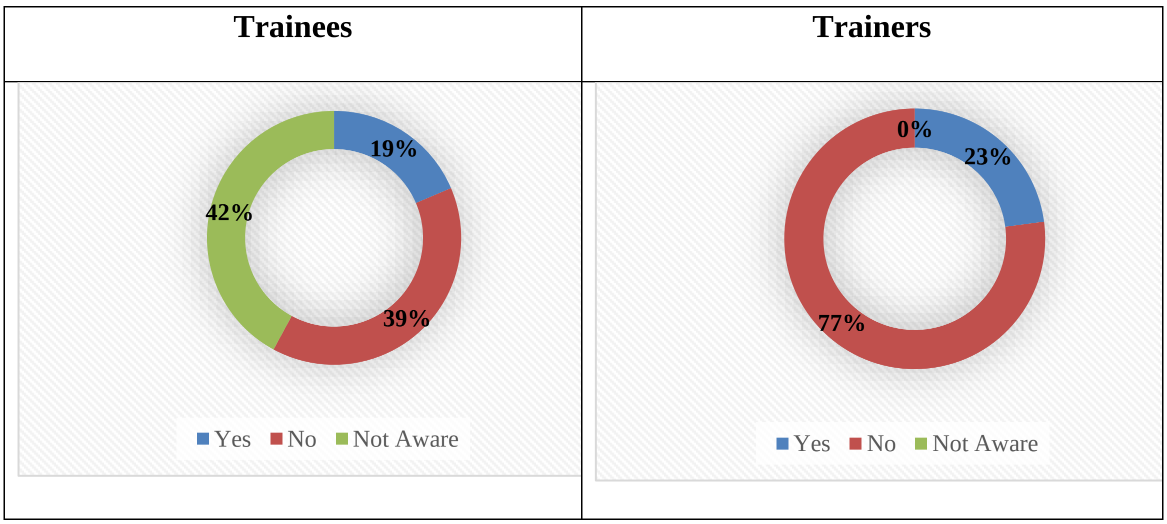


Figure 4.9: Whether laboratory manuals were made available to trainees in their institution

From observation, except one institution, all other institutions observed did not have laboratory manuals or even laboratory sheets. This made the laboratory exercises un-systematic. At some point it seemed like trainees did not seem to know what was expected of them during the laboratory session especially after mounting the circuits. This was deduced from the questions the trainees were asking which could have been answered by the provision of laboratory a manual or laboratory sheet.

4.4.3.5.2 How often trainees were encouraged to read on the laboratory experiment and other related material

As table 4.31 shows, over 50% of the trainees and trainers indicated that trainees were rarely encouraged to read the laboratory experiment in the lab manual and other related textbook material in preparation for the laboratory session. This shows that the trainees rarely or never adequately prepared for the experiment. And this could also be due to lack of lab manuals as indicated in the earlier section.

Table 4.31: How often trainees were encouraged to read the laboratory experiment and related material

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Never	23	9.1	1	2.9
Rarely	133	52.8	19	54.3
Often	57	22.6	12	34.3
Very often	39	15.5	3	8.5
Always	0	0	0	0
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

From HODs and FGD participants, it was apparent that the trainees rarely made any preparation before the laboratory sessions as they were rarely encouraged to read the laboratory experiment in the laboratory manual and other related textbook material in preparation for the laboratory session. Findings from observation agreed with the FGD and

HODs interview results. This was because lab sessions seemed impromptu, unplanned for, and they did not seem to follow the syllabus topic. Also, the trainees, did not seem prepared for the sessions well with right tools and the PPEs.

4.4.3.5.3 Whether the trainees were encouraged to consult with the trainer before the laboratory practice session.

Regarding whether the trainees were encouraged to consult with the trainer before, in preparation for the laboratory practice session, majority of the respondents indicated that they were not as evident from figure 4.10. These results indicate that trainees did not consult with the trainers to familiarize themselves with the experiment of the laboratory practice before the session.

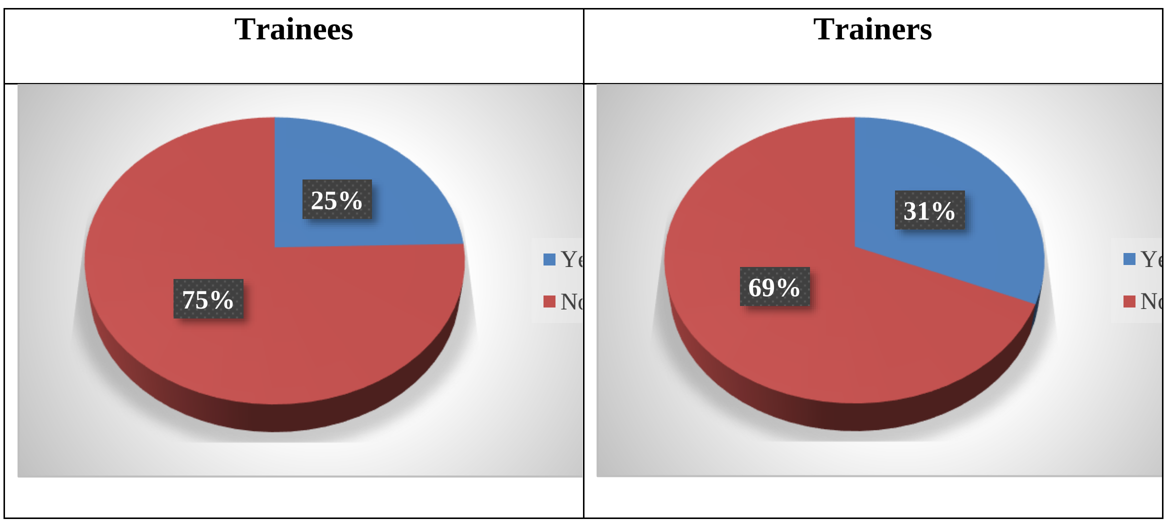


Figure 4.10: Whether trainees were encouraged to consult with the trainer before the laboratory sessions.

These results may mean that there was no prior laboratory preparation hence laboratory topics and sessions were handled impromptu, that is, when the trainer was free.

4.4.3.5.4 Whether trainee class size was considered when preparing for a laboratory practice session.

In preparing for laboratory practice session, it is prudent that class size be taken into consideration to ensure no overcrowding and that each trainee is engaged appropriately in laboratory activities. Figure 4.11 below shows that over 50% of the trainees indicated that no consideration was made on class size. This means that the issue of class size was not taken seriously in laboratory practice, which led to overcrowding in the laboratories. On the other hand, over 50% of the trainers indicated that class size was considered in the preparation for laboratory practice.

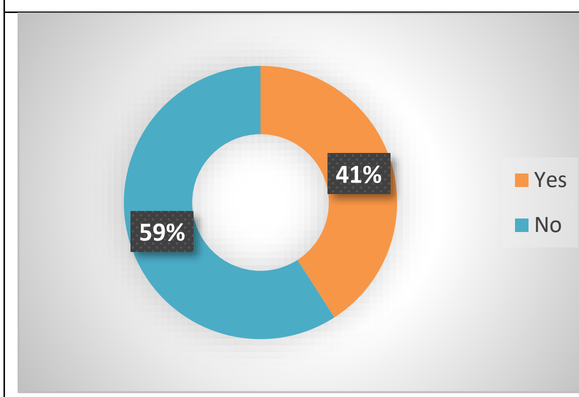
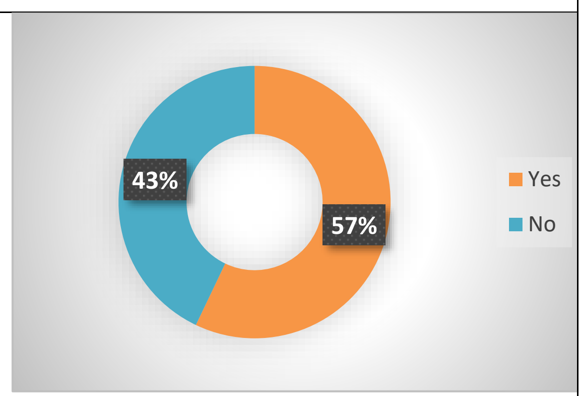
Trainees	Trainers
	

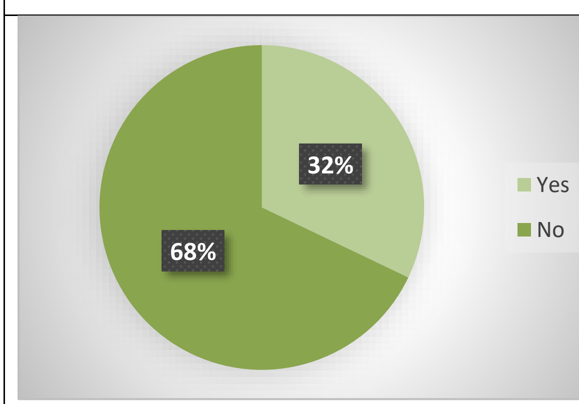
Figure 4.11: Whether trainee class size was considered when preparing for a laboratory practice session

From observation, it was evident that trainee class size was not considered when preparing for a laboratory practice session. This is because in most institutions the laboratories were designed to accommodate about 20 trainees, but now accommodating more than 20 trainees. From interviews with the HODs, most labs were designed for 20 trainees but overstretched to accommodate the larger number of students admitted. The focus group discussion participants also concurred with HODs and observation findings that there were more students than the laboratory capacity can accommodate. Mohammed & Inuwa, (2016) recommends a limit of 24 students per session and not more than 28 in case there were many students however, this was not considered.

4.4.3.5.5 Setting electronics laboratory equipment, tools and materials before the trainees arrived

On whether the electronics laboratory equipment, tools and materials were set before the trainees arrived for laboratory activities, figure 4.12 shows that over 60% of the trainees indicated that no set-up was done before they arrived in the laboratory while 60% of the trainers indicated that the set-up was done before the trainees arrived. These two responses differ and seems like the trainers were trying to cover their shortcomings in preparation for laboratory practice. The implication of these is that, most of the set up was done when the trainees arrive in the laboratory in some institutions. In other institutions, it was done before they arrived in the lab for a session.

Trainees



Trainers

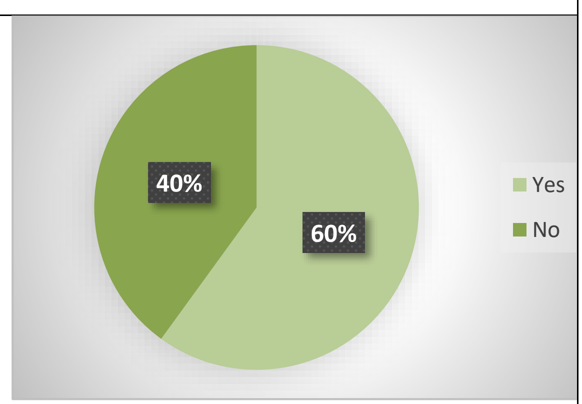


Figure 4.12: Whether electronic laboratory equipment, tools and materials were set before the trainees arrived in the laboratory.

From the FGD responses, the participants pointed out that in most cases equipment was not set up before students arrived in the laboratory for their sessions. From observation by the researcher, most of the laboratories were set when the trainees have arrived. This took a lot of their learning time hence by the time they settled to go through the lessons work, time was over and they needed to go to another lesson.

4.4.3.5.6 Opinion on the adequacy of preparation for laboratory learning sessions

Table 4.32 shows the opinion of the trainees and trainers on the adequacy of preparation for laboratory learning sessions. A majority of the trainees and trainers opined that the preparation for laboratory learning sessions was slightly and moderately adequate respectively. Nevertheless, generally, the total number of trainees and trainers that fell on the lower end was more than the upper end revealing that preparation for laboratory learning sessions was not adequate. This implies that the trainees could not gain many skills in their laboratory practice since the trainers did not prepare them and the session adequately.

Table 4.32: Opinion on the Adequacy of Preparation for Laboratory Learning Sessions

	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Not adequate at all	46	18.3	2	5.7
Slightly adequate	158	62.7	9	25.7
Moderately adequate	38	15.1	13	37.1
Adequate	6	2.3	10	28.6
Very adequate	4	1.6	1	2.9
Total	**252**	**100.0**	**35**	**100.0**

Source: **Questionnaire data (2020)**

Generally, from observation, preparation for laboratory practice was not adequate on the part of both the trainee and trainer judging from the way the students appeared during the lab session and the way the teachers handled the sessions. Also lack of adequate preparation was evident from the kind of experiments the trainers were tackling and the way the laboratory appeared.

4.4.3.5.7 Influence of laboratory preparation practices on skill acquisition

Results of the Spearman correlation shows that there was a strong significant positive relationship between adequacy of preparation for laboratory learning sessions and skill acquisition by technician trainees, $(r_s[287] = .542, p < .001)$. This indicates that preparation for laboratory practices are critical in influencing skill acquisition among trainees.

Table 4.33: Spearman's rho correlations between preparation for laboratory learning sessions and the skills attained.

		Skills Attained	Laboratory preparation practices
Skills Attained	Correlation Coefficient	1.000	.542**
	Sig. (2-tailed)	.	.000
	N	287	287
Laboratory preparation practices	Correlation Coefficient	.542**	1.000
	Sig. (2-tailed)	.000	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.3.6 Laboratory Instruction Delivery and Assessment Practices

4.4.3.6.1 Laboratory instruction delivery

Regarding how the electronic laboratory sessions were conducted, the researcher looked at three sections of delivery, thus: how trainers introduce the electronic practical lesson, how they carry on with the lesson, and how they conclude the lesson. The ratings were on a five-level Likert scale which comprised of: NA = Not at all, RA = rarely, OF = Often, VO = Very often, AL = Always. Mean responses of trainees and trainers on the lab instruction delivery process are shown in table 4.34. The decision (D) on how the trainees and trainers rated lab instruction delivery process was given on lower and upper limits of the means as:

Very High 4.5 - 5.00, High 3.5 - 4.49, Moderate 2.5 - 3.49, Low 1.5 - 2.49 and Very Low 0.5 - 1.49.

Table 4.34: Laboratory Instruction Delivery Activities

Item No.	Activities carried out by the trainers during	TRAINEES N=252 M	SD	Remarks	TRAINERS N=35 M	SD	Remarks	GM	MSD	Decision
	INTRODUCTION									
1	Gives trainees the lab-sheet	1.55	1.07	RA	3.00	0.77	OF	**2.27**	**0.92**	**RA**
2	Briefs trainees on what the laboratory session is all about	4.74	0.62	AL	4.74	0.74	AL	**4.74**	**0.68**	**AL**
3	Highlights safety procedures and rules to be followed	3.85	0.45	VO	4.86	0.60	AL	**4.35**	**0.52**	**VO**
4	Briefs trainees on the topic for the lab practical	1.88	0.43	RA	3.83	0.62	VO	**2.86**	**0.52**	**OF**
5	Clearly states objectives of the lab practical	3.16	0.50	OF	3.40	0.74	OF	**3.28**	**0.62**	**OF**
6	Relates the lab activity and the theory concept covered in class	2.70	1.19	OF	2.91	0.37	OF	**2.81**	**0.78**	**OF**

7	Briefs trainees on the skill to attain from the lab practical	2.64	1.11	OF	4.00	0.24	VO	**3.32**	**0.68**	**OF**
8	Introduces components, tools, material, and equipment to be used in the lab activity	4.04	0.35	VO	4.03	0.17	VO	**4.04**	**0.26**	**VO**
9	Demonstrates how to carry out the lab activity before we start working on it	4.16	0.48	VO	4.83	0.51	AL	**4.49**	**0.50**	**VO**
10	Emphasizes equal level of participation in the lab activity	2.08	0.85	RA	3.14	0.55	OF	**2.61**	**0.70**	**OF**
11	Invites questions to seeking clarification	3.23	0.57	OF	3.06	0.24	OF	**3.15**	**0.40**	**OF**
12	Shows trainees how to record findings from the exercise.	1.72	0.52	RA	2.94	0.24	OF	**2.33**	**0.38**	**RA**

	DURING THE SESSION									
13	Moves around the lab to be available to anyone in need	4.60	0.92	AL	4.97	0.17	AL	**4.79**	**0.54**	**AL**
14	Supervises the lab activity being done	3.52	0.90	VO	4.97	0.17	AL	**4.25**	**0.53**	**VO**
15	Encourages each trainee to participate actively in the lab activity	3.72	0.62	VO	3.37	0.77	OF	**3.55**	**0.70**	**VO**
16	Recognizes those who have difficult and assist them	2.16	1.03	RA	3.00	0.24	OF	**2.58**	**0.63**	**OF**
17	Encourages autonomy(freedom) where we practice skills and learn from our successes and failures	3.37	0.77	OF	4.80	0.53	AL	**4.08**	**0.65**	**VO**
18	Evaluates our work step by step as the session is going on	1.25	0.48	NA	4.51	0.82	AL	**2.88**	**0.65**	**OF**

19	Relates the lab activities with what we will be doing in the industry	2.08	0.69	RA	4.11	0.32	VO	**3.10**	**0.51**	**OF**
	ENDING THE SESSION									
20	Reviews and allows questions at the end of the session	2.77	0.57	OF	4.91	0.28	AL	**3.84**	**0.42**	**VO**
21	Encourages trainees to reflect on what we have accomplished in the lab exercise	2.60	0.76	OF	3.97	0.296	VO	**3.29**	**0.53**	**OF**
22	Links the lab activity to other subjects and the industry	2.00	0.65	RA	4.89	0.404	AL	**3.44**	**0.53**	**OF**
23	Explains to trainees how to write a lab report in the accepted format and submit for marking.	1.44	0.71	NA	2.26	0.701	RA	**1.85**	**0.71**	**RA**
24	Asks trainees to clean the lab, return tools and equipment before we leave	4.70	0.52	AL	5.00	0	AL	**4.85**	**0.26**	**AL**

Source: Questionnaire data (2020)

Table 4.34 shows the findings on how instruction delivery was conducted. The trainees revealed the items (18&23) were not done at all by the trainers, items (1,4,10,12,16,19&22) were rarely done, items (5,6,7,11,17,20&21) were often done, items (3,8,9,14&15) were very often done and items (2,13&24) were always done. The trainers indicated that item (23) was rarely done, 8 items (1,5,6,10,11,12,15&16) were often done, 5 items (4,7,8,19&21) were very often done and 10 items (2,3,9,13,14,17,18,20,22&24) were always done.

Overall, from the grand mean, out of the total 24 items, 3 items (1, 12&23) were rarely undertaken by the trainers during an electronics laboratory practice session. There were 11 items (4, 5, 6, 7, 10, 11, 16, 18, 19, 21&22) that were carried out often (sometimes) by the trainers. Those activities that were carried out very often (many times) were 7 items (3, 8, 9,14,15,17 &20). Lastly, only 3 items (2, 13&24) were always undertaken by the trainers during a laboratory session.

The FGD participants indicated that they gave the trainees lab sheets, briefed them on what is expected of them during the practical, the trainer demonstrated how the experiment was to be done, supervised the trainees as they carried out the experiment to see whether they were doing the right thing, then concluded the practical session by summarizing what the trainees had learnt and applied the lesson to the everyday life and work place.

Observation findings revealed in the introduction, four activities were not done by the most trainers. These were: giving trainees a lab sheet, emphasizing equal level of participation by trainees in the laboratory activity, inviting questions from trainees seeking clarification, and showing trainees how to record findings from the exercise. All the other activities carried out during the introduction of the session included: briefing trainees on what the laboratory session is all about, highlighting safety procedures and rules to be followed, briefing trainees on the topic for the lab practical, clearly stating objectives of the lab practical. Also done was: relating the lab activity and the theory concept covered, briefs trainees on the skill to attain from the lab practical, introducing components, tools, material, and equipment to be used in the lab activity, demonstrating how to carry out the lab activity before we start working on it.

During the session, two activities were never carried out by the trainers. These were: evaluating the trainees' work step by step as the session is going on, relating the lab activities with what they will be doing in the industry. However, all the other session activities were carried out and they included: moving around the lab to be available to anyone in need, supervising the lab activity being done, encouraging each trainee to participate actively in the lab activity, recognizing those who had difficult and assist them, encouraging autonomy (freedom) in practicing skills and learning from their successes and failures.

After the session the trainers never carried out two activities which included: linking the laboratory activity to other subjects and the industry; explaining to trainees how to write a lab report in the accepted format and submit for marking. However, the other activities were carried out and these included: reviewing and allowing questions at the end of the session, encouraging trainees to reflect on what they had accomplished in the lab exercise, asking trainees to clean the lab, returning tools and equipment before they left.

From the observation findings above, the researcher noted that in as much as the trainees were grouped, even as the trainer did his/her best to move around instructing the trainees, because of large number of students, it was difficult to tell who had learnt and who had not. The trainers moved round just checking what each group had done. Only in one college was the trainer handling trainees individually. But since they were many, not all were attended to within the scheduled time. It was also noted that most trainees were not well versed with laboratory practice exercises. It was further noted that most of the trainees appeared lowly skilled on the basis of the quality of work they did. Most of them did not know how to use, the PCB, BB, and measuring instruments. Some of the trainees even had a problem identifying components to use for the experiment.

4.4.3.6.2 Laboratory assessment practices

Table 4.35 shows the responses on how often the trainee performance on laboratory activities were assessed. A majority of the trainees, over 70%, indicated that the assessment of laboratory activities was done often. On the part of the trainers, over 70% indicated that the assessment of laboratory activities was done very often.

Table 4.35: How often the performance of laboratory activities was assessed

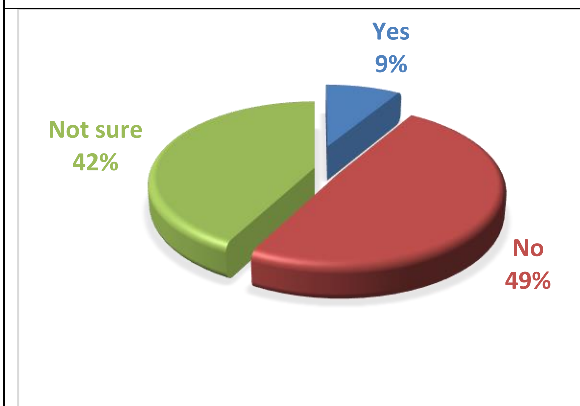
	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Never	4	1.6	0	0
Rarely	54	21.4	0	0
Often	191	75.8	7	20
Very often	3	1.2	25	71.4
Always	0	0	3	8.6
Total	**252**	**100**	**35**	**100**

Source: Questionnaire data (2020)

4.4.3.6.3 Assessment form/sheet used in the assessment of the laboratory activities

Figure 4.13 shows that a majority of the trainees and trainers indicated that there is no assessment form used in the assessment of the laboratory activities.

Trainees



Trainers

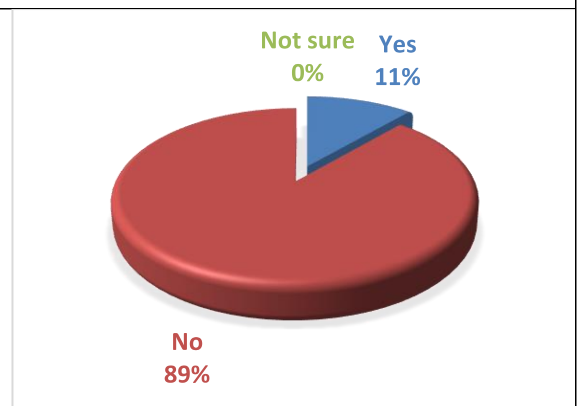


Figure 4.13: Whether there was an assessment form used in the assessment of the laboratory activities.

The observation findings were the same as the survey results, that is, there was no assessment form used for laboratory activities.

4.4.3.6.4 Methods of assessment of laboratory activities employed

Table 4.36 shows that a majority of the trainees indicated that direct observation of trainees' work as a method of laboratory assessment was used more often, a majority also indicated that assessment of laboratory reports as a method was never employed at all and all trainees (100%) indicated that the use laboratory examination as a method of assessing laboratory activities, was never employed. This leads us to a conclusion that the common method used to assess trainees' achievement in laboratory practice is direct observation.

Also, it can be concluded that lack of electronic laboratory practical examinations may lead to laxity on the part of the trainers to focus on the syllabus (what the trainees need to cover by the end of the final year). This was noted during observation that the content or topic for practical handled in almost all the institutions observed were basic which need to have been handled at diploma module I (first Year) not at the level of diploma Module III (final year) trainees.

Table 4.36: Trainees' response on how often each of the methods of assessment of laboratory activities was employed

Item No.	***Method of Laboratory assessment***	**Never**		**Rarely**		**Often**		**Very often**		**Always**	
		F	***%***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***
1	Direct observation of student activities	0	0.0	36	14.3	72	28.6	123	48.8	21	8.3
2	Assessment of laboratory reports	151	60.0	87	34.5	14	5.5	0	0	0	0.0
3	Laboratory practical examination	252	100.0	0	0.0	0	0.0	0	0.0	0	0.0

Source: **Questionnaire data (2020)**

Table 4.37: Trainers' response on how often each of the methods of assessment of laboratory activities was employed

Item No.	***Method of Laboratory assessment***	**Never**		**Rarely**		**Often**		**Very often**		**Always**	
		F	***%***	***F***	***%***	***F***	***%***	***F***	***%***	***F***	***%***
1	Direct observation of student activities	0	0.0	0	0.0	28	80.0	5	14.3	2	5.7
2	Assessment of laboratory reports	30	85.7	2	5.7	2	5.7	1	2.9	0	0.0
3	Laboratory practical examination	35	100.0	0	0.0	0	0.0	0	0.0	0	0.0

Source: **Questionnaire data (2020)**

Table 4.37 presents the trainers' responses on how often the methods of assessment of laboratory activities were employed. On using direct observation as a method of assessing trainees' laboratory activities, 80% of the trainers said that this method was often used. Regarding the assessment of laboratory reports as a method of assessing laboratory activities, over 80% of the trainers said that the method was never employed at all. Regarding the use electronic laboratory examination as a method of assessing laboratory activities, all, 100%, of the trainers indicated that the method was never employed. Just like the trainees, the trainers indicated that the common method used was direct observation of students work as they undertook laboratory practical exercise.

From the responses of the FGD, the participants indicated that there was no serious assessment of the laboratory exercises. What they did was observe what the students had done and they corrected them if they have made a mistake. They indicated that since the examination covered the theory only, they laid much emphasis on theory than the practice.

From observation, the assessment was done by direct observation onto the trainees' work, a verdict given and no recording of marks during and after the exercise. The trainer proceeded as follows. As the groups completed the exercise given, they called the trainer to check on their work. If it had any mistakes, he/she would explain to them and they could go back to re-do it. Also, it was observed that there was no assessment form used in assessing what the trainees did. Instead, most trainers used direct observation of student activities for the assessment of lab activities. It was noted too that the trainers did not ask trainees to write a lab report.

4.4.3.6.5 Satisfaction with the way laboratory sessions were delivered and assessed.

Table 4.38 below shows that over 40% of the trainees and over 50% of the trainers were moderately satisfied with the way laboratory sessions were delivered and assessed. These results mean that the way practice was delivered and assessed was satisfactory.

Table 4.38: Satisfaction with the way laboratory sessions were delivered and assessed

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Not satisfied at all	37	14.7	2	5.7
Slightly satisfied	91	36.1	9	25.7
Moderately satisfied	107	42.5	19	54.3
Satisfied	13	5.2	4	11.4
Very Satisfied	4	1.6	1	2.9
Total	**252**	**100**	**35**	**100**

***Source:* Questionnaire data (2020)**

4.4.3.6.6 Influence of laboratory instruction delivery and assessment practices on skill acquisition

Spearman's correlation results indicate that there is a very strong significant positive relationship between laboratory delivery and assessment practices and skill acquisition among technician trainees, ($r_s[287] = .836, p < .001$). This demonstrates that laboratory instruction delivery and assessment practices are critical component in influencing skill acquisition among technician trainees. Thus, if the trainers' delivery and assessment activities were done well for the sessions they had attended, the level of skills acquired among trainees will be indeed high.

Table 4.39: Spearman's rho correlations between laboratory instruction delivery and assessment practices and the skills attained.

		Skills Attained	Laboratory delivery and assessment
Skills Attained	Correlation Coefficient	1.000	.836**
	Sig. (2-tailed)	.	.000
	N	287	287
Laboratory delivery and assessment	Correlation Coefficient	.836**	1.000
	Sig. (2-tailed)	.000	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.4 Industry collaborative practices

This section focuses on four aspects which are: whether TVET colleges were aware of the skills needed by the industry; how they knew about the industry skills needed; how the industry skills are incorporated in laboratory instruction; and whether TVET colleges collaborated with industry in laboratory training.

4.4.4.1 Whether TVET colleges were aware of the skills needed by the industry

On whether TVET colleges are aware of the skills needed by the industry, the HODs were interviewed. In their responses, they indicated that they were aware of the skills needed by the industry.

4.4.4.2 How they knew about the industry skills needed

When trainers went to assess trainees on attachment, they saw what students went through and what relevant skills they needed to possess. The trainees also had conversations with the trainees' supervisors who would point out what skills were critical in the industry. The institutions also got to know the skills needed by the industry through getting feedback from the industry on weak and strong areas of the trainees which points out what the industry needs.

4.4.4.3 How the industry skills were incorporated in laboratory instruction

Incorporation of industry skills in laboratory instruction was a big challenge as many HODs indicated. This was because, although the trainers are aware of the needed skills, the syllabus used was obsolete and static which did not allow for dynamism in training. Many trainers followed curriculum for exam purposes. This was in contrast to the industry which was dynamic and already had automated their operations and also incorporated new technologies. However, as one of the HODs pointed out, that "some teachers try to prepare trainees for what they will find out there in the industry." These they did by engaging the trainees outside the normal teaching when they trainers are free.

4.4.4.4 Whether TVET colleges collaborated with industry in electronic laboratory training

Interview with HODs revealed that TVET colleges and industries did not have any collaboration between them. As such trainers rarely had a chance to upgrade their skills on new equipment and latest technology in the industry. Except during attachment, trainees never have any other opportunity to get training in the industry. Also, trainees only got a chance for exposure to latest equipment and use of electronic equipment and tools during occasional educational field trips when they visit industries. However, this could not help much as they could only view the equipment and not operate them.

Equally, it was found out that because of lack of collaboration, there was no donation of equipment from the industry to TVET colleges. However, it is worth noting that some HODs pointed out that, although there was equipment donation to some colleges, it was in other specialty areas like automotive but not in electrical and electronics departments.

The FGD responses revealed that TVET colleges did not have any collaboration with the industry hence there was no partnership in training. This resulted in TVET institutions trainees acquiring skills not relevant with the industry needs. They also indicated that skills acquired by trainees were just basics while the industries needed real hands-on, problem-solving skills.

These findings are consistent with Dasmani (2011), who found out that there is a weak link between the training institutions and the industry hence whatever skills trainees received were not relevant to the requirements of the industry. This shows the importance of a good collaboration between TVET institutions and the industry. Consequently, a strong link between them means higher level skill acquisition and vice versa.

4.4.5 Laboratory instruction strategies

In this section the researcher asked both trainees and trainers whether they encountered any challenges during laboratory instruction and learning sessions. They were also asked to identify the specific challenges they had faced and strategies employed to overcome them. Finally, the respondents were asked to propose other strategies that can be embraced to enhance skill acquisition among technician trainees.

4.4.5.1 Whether trainees and trainers had faced any challenges in laboratory instruction practice

From figure 4.14, both trainees and trainers have faced challenges. It is evident that over 90% of both the trainees and trainers agreed that there were challenges faced in electronic laboratory practice. From this we can deduce that training the required skills in TVET institutions is not an easy exercise.

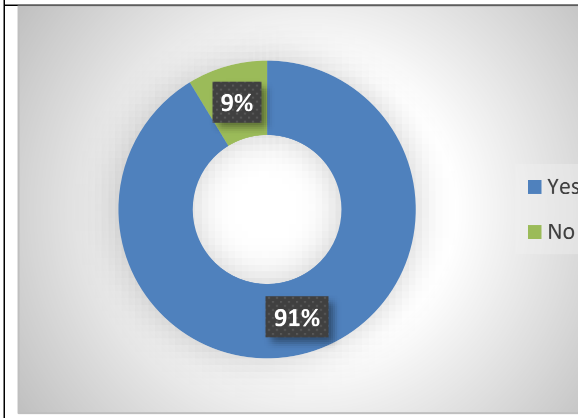
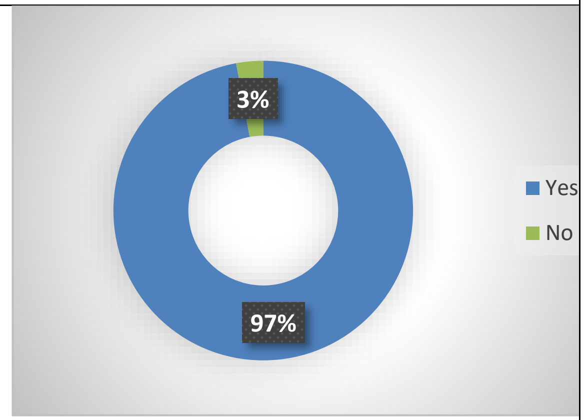
Trainees	Trainers
	

Figure 4.14: Whether trainers and trainees faced challenges during electronic laboratory practice

4.4.5.2 Specific challenges faced by respondents in electronic laboratory practice.

Both trainees and trainers cited the various challenges that they had encounter during laboratory instruction practice.

Limited time. There was lack of enough time to engage in laboratory practice because of other classes using the laboratory facility. There was also a lot theory content that needed to be covered. This meant that there was lack of serious adequate time for laboratory practice and the trainees were taught more theory content compared to laboratory. The end result of this was that fewer practical skills were gained among the trainees.

Inadequate equipment, tools and materials for use in laboratory instruction. There was inadequate equipment in the laboratory in the institutions. Also, in some institutions, most equipment were lacking all together.

Old and obsolete equipment. There is a big variance between the obsolete equipment found in the TVET institutions' laboratories and the modern equipment found in the industry.

Poor maintenance of equipment. Most equipment found in TVET institutions electronic laboratory were not only old but it was rarely repaired and maintained well. This made laboratory instruction difficult.

Bureaucracy in the provision of needed materials. The materials used for training were not provided in timely manner to facilitate training. The delay in the acquisition of laboratory training materials was as a result of lot of bureaucracy. The procedures of requisitioning equipment and electronic devices were unnecessarily long. This led to materials arriving in colleges late to be of help to the trainees use in learning skill.

Curriculum that focuses on theory and not practice. Respondents stated that curriculum was rigid. They claimed that it was not dynamic enough to accommodate the changes taking place in society, economy and technology. Further the curriculum was very wide which made trainers focus on teaching theory content. Only the theory part of the curriculum was examined by KNEC. There were no electronic practical examinations for trainees, hence practice was given a raw deal in the institutions.

Inadequate laboratory space to accommodate all the students in the class. There was lack of enough space in the laboratories to cater for the number of students in class. According to the respondents the labs were designed for small number of trainees but over the years and with the increase of the student population, there was overcrowding in these laboratories in the institutions. As a result of inadequate space, working areas were fewer and congested which made it tedious to carry out experiment demonstrations for trainees. Lack of space, had led to trainees working in groups instead of individuals.

Lack of laboratory technicians. Some colleges lacked laboratory technicians to assist the trainers during laboratory practice. One reason for the lack of the electronic technicians in some TVET institutions was poaching by the industries making it difficult for trainers to undertake laboratory practice effectively. This was a great setback for institutions because when these critical people are lacking in a college, it was practically impossible to set up the laboratory prior to the session. This hinders the effectiveness of the trainer in his/her laboratory instruction delivery.

Large number of students. Over the years, there had been an increase in the number of students admitted to TVET institutions. According to the respondents this large student population made it difficult to offer personal attention to trainees to enable them acquire the required skills effectively.

Indiscipline and lack of seriousness among students. The other issue was class attendance where the trainers said that there were a number of trainees who had the habit of being absent from the few laboratory sessions held. There was also the issue of over-excited and enthusiastic trainees who could damage the equipment and tools. Finally, some trainees lacked seriousness and were careless in their work.

Understaffing. It was revealed that the colleges were understaffed. This meant that the trainers have a heavy workload which could not allow them to have enough time to carry out laboratory practice.

Skills upgrading. The trainers lamented that there was lack of a structured skill upgrading program to make them conversant with best practices in training electronic practical.

Rapid technological changes. The respondents said that there were frequent technological changes and institutions were not keeping pace with technological changes. This makes trainers train on very old equipment hence giving trainees obsolete content.

Inadequate funding from government towards laboratory activities. A number of trainers pointed out that there was inadequate of funding for the purchase of required equipment, tools and materials. The funding also affected the expansion of laboratories space to accommodate more students.

Trainers' ad hoc handling of laboratory practice. Laboratory sessions were fewer and were not scheduled regularly or well organized. A number of trainers did not have a proper schedule for laboratory practice and could surprise trainees that they were going to have a practical session. Some trainers failed to attend practical sessions. In most colleges there were no laboratory sessions at all.

These findings agree with the findings of Dasmani (2011) and Kailani, Gyallesu and Yaro (2017). Dasmani (2011) in his study of the challenges found out the following: inadequate instructional materials hence limited practical; larger number of students in classes; lack of emphasis on industrial attachment and inappropriate instructional techniques. Kailani, Gyallesu and Yaro (2017) in their study included: students did not have a good technical background, large class sizes and obsolete equipment in the laboratories.

4.4.5.3 Strategies trainers used in the electronic laboratory practice to enable their trainees gain skill

Despite the above challenges faced in teaching electronic laboratory practice, trainers had employed various strategies to enable their trainees gain the required skill. Although nothing much could be done about some challenges like curriculum, lack of funding, nature and condition of facilities and equipment, trainers adopted the following strategies.

Management of student high population. To deal with the challenge of large number of students and inadequate equipment, some trainers divided the trainees in manageable groups, created some free time for trainees, requested for more time for practice during workload distribution, and did practical exercises in shifts.

Establishing laboratory session rules. Responses from trainers, HODs and FGD participants, showed that they had established laboratory session attendance rules. The students were also required to sign the attendance registers. This strategy enabled trainers to deal with student indiscipline.

Use of bin-cards. To prevent stealing of materials by students, the trainers did inventory of equipment and materials frequently and introduced bin-card when issuing equipment.

Innovation and creativity. On the lack of materials, trainers employed creativity and innovation to enhance skill acquisition among trainees. The trainers, where possible, creatively improvised some material from the previous ones, recycled and reused old materials. The trainers also engaged themselves in personal research that enabled them modify the experiment to suit the equipment and materials available.

Use of technology. There are some trainers who employed technology to enable their trainees acquire the required skills. Some of the technologies included: use of digital video, Bluetooth technology, internet where trainees could watch laboratory sessions on YouTube. This enabled the institutions overcome several challenges including lack of enough time, inadequate equipment, tools and materials.

Creating extra sessions out class schedule. To overcome the limitations of inadequate time available for laboratory practice, some trainers put in place measures to ensure trainees did more practice. These measures included: allowing the students to visit the laboratory to do more practice on their own with the help of a laboratory technician; putting more hours for laboratory practice and to be done in the morning hours; giving trainees more exercises to practice on their own; extended practice of lab skills by some more time; created extra lessons; maximizing available laboratory time and sessions.

Trainer personal effort. On some occasions some trainers bought some materials for use in demonstrating of concepts to the trainees.

Trainer personal development. Since most of the TVET institutions did not have frequent capacity building programs, some trainers made personal effort to go for skills upgrading so as to be up-to-date with current technology.

Advance planning. The trainers used this strategy for dealing with the challenge of bureaucracy. The trainers did requests for the purchase of laboratory training materials in time. This ensured that even if the materials requisition process took long, at least, the materials would arrive at the time they are needed. This strategy also ensured everything needed for the laboratory sessions was made available.

4.4.5.4 Proposed strategies to be adopted by TVET Institutions to help trainees gain required Skills

Regarding the strategies that were to be embraced to make laboratory instruction effective, the respondents proposed the following:

Proper scheduling of laboratory practice sessions. The respondents suggested that laboratory instruction sessions be appropriately scheduled as per the curriculum/syllabus hours.

Investment in the use of technology in instruction. Another strategy was for institutions to invest in technology in laboratory instruction particularly virtual laboratory instruction and other internet technologies like YouTube.

Appropriate equipment and tools. It was proposed that colleges fully equip the laboratories with modern equipment, and acquire enough training tools. This meant that trainees would not be inconvenienced in training for lack of training equipment and tools.

Staffing. Another strategy that was to be employed was to recruit more staff both trainers and laboratory technicians to ensure a right ratio of staff to trainee.

Capacity building. Since equipment, tools and materials keep on changing because of rapid technological changes, it was proposed that colleges and government to invest on capacity building to ensure that training of staff is done to enable them update or acquire new skills.

Laboratory instruction technique. To ensure that trainees gain maximum skills before they graduate from the institution, is to employ project-based learning where trainees are given a project to work on step by step until they produce a working gadget.

Proper management of student numbers. Colleges ensure that they maintain small class sizes. In case of large admission of trainees, the colleges to split large numbers into small groups or classes. Also, student admissions be pegged on available training facilities and equipment.

Attachment and internship. To enhance skill acquisition, trainers proposed that there should be industrial attachment placement and make sure that all trainees are attached to a busy workshop after their course or module.

Collaboration with industry. TVET institutions initiate and establish collaboration with the industry to assist in capacity building of staff, mentoring of the technician trainees and equipment donation assistance.

Syllabus and curriculum. On this strategy trainers proposed the review of the curriculum and syllabus by putting more emphasis on practical instead of theory. This could be achieved by reducing the syllabus content to allow more time for practice by embracing CBET curriculum.

Educational visits. Trainers, also, proposed that taking trainees for educational visits to the industries and even to other places which had modern laboratories could enhance their skill acquisition. This was to provide the trainees with an opportunity to familiarize themselves with the modern equipment and technologies.

Trainee personal effort. Trainees to be encouraged to buy their own tools and materials which could enable them during laboratory practice. The trainees could also be encouraged to do a lot of research by themselves on the laboratory practice.

Government funding. Since most of the colleges were not very equipped, trainers proposed that government enhance funding to assist TVET institutions in the acquisition of enough training equipment, tools and materials.

Mentorship programs. TVET colleges to initiate mentorship programs for students by industry professionals or former students.

The findings above are not very different from strategies that have been suggested by other researchers and authors. Kailani, Gyallesu and Yaro (2017) suggested the following strategies: ensuring workshops and laboratories are adequately equipped; undertaking proper maintenance of facilities, tools, and equipment; having back up power supply to guarantee continuous power supply; regular retraining of lecturers to enhance their competency.

Ogbuanya, Akintonde, and Barake (2017) proposed that more trainers teaching electronics courses be recruited; government to ensure sufficient facilities and equipment are available in electrical and electronics departments of the TVET institutions; government sponsor training of newly recruited trainers for some three months in the industry. Other strategies the authors included government to develop a policy where frequent field trips can be undertaken to make trainees familiarize themselves with facilities and equipment in the industry; frequent courses and seminars on effective instruction methods in TVET institutions; allocate more time for learning practical sessions, at least 65% of the total study time; TVET institutions ensure that trainers are competent in the operation of tools and equipment.

Kailani (2014) recommends that: government provide adequate facilities and equipment as per the needs of the TVET institutions; partnerships between TVET institutions and the industry and various stakeholders in the provision of training facilities and equipment; introduction of laboratory fees where students pay to support in the procurement of training equipment and facilities.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The purpose of this study was to find the influence of electronics laboratory practices on skill acquisition among electrical and electronic engineering technician trainees in TVET institutions in Nairobi County. Hence, this chapter presents the summary of the findings of the study carried out, conclusions arrived at on the basis of the findings, recommendations to be actioned and suggestions for further research.

5.2 Summary of findings

In this section of chapter five, the findings of the study were summarized as follows.

The level of skills acquired by final year technician trainees was inadequate. The rating of the trainee skills by both trainees and trainers as moderate is a demonstration that the trainees would not perform as expected in the work place. This is an indication that their exposure to laboratory practice was wanting. This was evidenced from the number of laboratory sessions attended in the entire period of study.

The effective management and utilization of laboratory equipment, tools, and materials for skill acquisition was neglected. Furthermore, there were very few measures employed to safeguard laboratory equipment and tools from loss or misuse. This was because most TVET institutions under study had no technicians to issue equipment and countercheck when they return equipment hence trainers were overwhelmed. This also affected repair and maintenance of equipment. Acquisition of modern equipment was rarely done to replace damaged equipment or to increase the number of equipment for training.

It was found that electronics laboratory instruction practices as embraced could not effectively facilitate skills acquisition among technician trainees. This is because majority of the students had attended very few sessions of between 1 and 10 in their three years of study. This was alarming since these few sessions attended could not enable them gain required skills. The laboratory practice sessions were not scheduled in the timetable hence the trainers were left to plan on how to share time between theory sessions and the laboratory sessions. This led most trainers to hold very few or no lab practices at all. Even for the sessions held, there was inadequate preparation and organization. The electronic laboratory sessions rarely had objectives and hence assessment was rarely done. Further, the trainers rarely linked sessions to theory content and industry expectations.

There were no deliberate collaborations existing between TVET colleges and industry on electronic laboratory instruction. Although, trainees did go for educational trips and attachment to various industries, the institutions never had links with the industry especially on the area of electronic laboratory practice. Due to lack of collaboration, the colleges had never received donations of equipment from the industry or even offers for training of staff on modern equipment and new technology.

Trainers employed some strategies in laboratory practice enhance learning among technician trainees owing to the challenges faced in laboratory instruction. The challenges faced included: overloaded curriculum; obsolete and inadequate equipment and facilities; the large number of students; rapid technological changes; inadequate time and space for laboratory practice, lack of enough laboratory technicians and trainers; unscheduled laboratory sessions; and lack of funding from government towards laboratory equipment acquisition. To overcome these challenges the trainers made effort to employ some strategies to impart skills to the trainees. Some of the strategies they employed in electronic laboratory instruction practice included: reusing or improvising materials, using technology like videos, YouTube; creating extra lessons, and dividing the students into manageable groups.

5.3 Conclusions

From the above findings the following conclusions were made. First, level of skills acquired by final year technician trainees was inadequate as preparation for the place of work. Second, TVET institutions lacked proper and adequate training laboratories, equipment, tools, and materials. This impaired instruction delivery by trainers and learning of skills by the trainees. Third, the influence of electronic laboratory instruction practices on skill acquisition could not be strongly established although there appeared to be a relationship between the two variables. Fourth, the institutions had little interest in seeking out partnerships with the industry which would have been a great support in laboratory training of the trainees. Finally, the trainers made an extra effort by employing strategies to enhance the skill acquisition by technician trainees.

5.4 Recommendations

From the findings of the study, it was recommended that:

1. TVET institutions with the support of the government should invest in adequate and quality laboratory facilities and equipment by requesting funds for acquisition of new equipment.
2. Trainers should pay attention to effective laboratory instruction delivery by employing appropriate instruction methods; preparing adequately; and organizing the trainees into manageable groups.
3. TVET institutions should place equal emphasis on the delivery of both electronics theory and laboratory practice by developing regular schedules for laboratory practice sessions as per the curriculum requirements.
4. TVET institutions should develop collaborations with specific industries for purposes of supporting laboratory instruction.
5. The KNEC should make electronics laboratory practice examinable at diploma level.
6. Trainers to consider experiential learning to make technician trainees consider experiential learning to make technician trainees' laboratory learning more effective.

5.5 Recommendations for further research

This study focused on the influence of laboratory instruction practices on skill acquisition among technician trainees in TVET institutions. Out of the findings of the study the following were suggested for further research.

1. Investigation should be conducted on how laboratory facilities can be effectively managed and utilized to enhance skill acquisition in TVET institutions.
2. Research on how laboratory instruction practices can be enhanced to improve skill acquisition among technician trainees in TVET institutions.
3. Investigate on how the industry and TVET institutions can collaborate in laboratory training to enable technician trainees acquire the skills needed in the industry.
4. A replication of this study can be done to see if there are any change in the results of this study.

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APPENDICES

APPENDIX I: QUESTIONNAIRE FOR THE TRAINEES

THE INFLUENCE OF ELECTRONICS LABORATORY PRACTICES ON SKILL ACQUISITION AMONG TECHNICIAN TRAINEES IN NAIROBI COUNTY, KENYA.

QUESTIONNAIRE FOR THE TECHNICIAN TRAINEES

Dear Respondent,

My name is Stella Kwamboka Okemwa, a PHD student at University of Eldoret. I wish to thank you for accepting to participate in this study. The aim of this research is to explore the influence of Electronics Laboratory Practices on Skill Acquisition by Technician Trainees in Kenya. This questionnaire has been designed to collect the required information. The data collected will strictly be used for academic purposes and will be treated with strict confidence. Your identity will **NOT** be revealed. Kindly provide the information requested to the best of your knowledge.

Section 1: Demographic (General) Information

1. Age: □$_1$Below 20 ( ) □$_2$21-25 ( ) □$_3$ 26-30 ( ) □$_4$ Above 30 ( )
2. Gender: □$_1$Male ( ) □$_2$Female ( )

Section 2: Lab Attendance

3. Have you ever attended any electronic laboratory session since you joined the diploma programme? □$_1$Yes ( ) □$_2$No ( )

4. If yes, approximately, how many times have you attended electronic lab session since you joined the diploma programme? □1 1-10 ( ) □2 11-20 ( ) □3 20 and above ( )

NOTE: IF YES, PROCEED TO ANSWER THE QUESTIONNAIRE.

Section 3: Skill Levels of Technician Trainees

5. Please rate yourself on the skills attained on the items and tasks listed below. Use the following key: Indicate: ***1=Very Lowly Skilled (VL); 2=Lowly Skilled (L); 3=Moderately skilled (M); 4=Highly skilled (H); 5=Very Highly Skilled (VH)*** in the respective boxes.

a. Ability to identification the following basic electronic components by physical look.

Item No.	***Identification of components***	**VL**	**L**	**M**	**H**	**VH**
1	Resistor					
2	Capacitor					
3	Inductor					
4	Diode					
5	Transistor					
6	Integrated circuits (IC)					

b. Ability to use the following electronic equipment, tools and materials

Item No.	*Ability to Use the following*	VL	L	M	H	VH
1	Oscilloscope					
2	Signal generator					
3	Digital multi-meter					
4	Ammeter					
5	Voltmeter					
6	Wattmeter					
7	Solder gun					
8	Solder sucker					
9	Solder wire					

c. Level of your skill attainment on the following electronic tasks

Item No.	**Area of Skill Attainment**	**VL**	**L**	**M**	**H**	**VH**
1	Design and develop an electronic circuit					
2	Read and interpret an already designed circuit					
3	Identify components, materials, tools and measuring instruments to use for the designed circuit					
4	Mount the electronic circuit on a PCB, BB and Strip board					
5	Connect measuring instruments to the circuit					

6	Set measuring instruments to the require value					
7	Use the instruments to measure the required values and waveforms					
8	Read and record the required values and waveforms					
9	Write a lab report					

Section 4: Management and Utilization of Laboratory Equipment, Tools and Materials for Skill Acquisition

6. How Adequate is laboratory space and equipment for electronic laboratory practices? □$_1$Not adequate at all ( ) □$_2$Slightly adequate ( ) □$_3$Moderately adequate ( ) □$_4$Adequate ( ) □$_5$Very adequate ( )
7. How well are you guided on the safe and proper use of equipment? □$_1$Poorly ( ) □$_2$fairly ( ) □$_3$Good ( ) □$_4$Very good ( ) □$_5$Excellent ( )
8. How effective are the measures employed to safeguard laboratory equipment and tools from loss or misuse? □$_1$Not effective ( ) □$_2$Slightly effective ( ) □$_3$Moderately effective ( ) □$_4$Highly effective ( ) □$_5$Very highly effective ( )
9. How frequently are modern electronic laboratory equipment acquired? □$_1$Rarely ( ) □$_2$Somehow frequent ( ) □$_3$Frequently ( ) □$_4$Very frequently ( )
10. How frequently are your electronic laboratory equipment repaired/maintained? □$_1$Not maintained at all ( ) □$_2$Rarely ( ) □$_3$Somehow ( ) □$_4$Frequently ( ) □$_5$Very frequently ( )

11. In general, how effectively are laboratory equipment, tools and materials managed and utilized for skill acquisition? □$_1$Not effective ( ) □$_2$Somehow effective ( ) □$_3$Moderately effective ( ) □$_4$Highly effective ( ) □$_5$Very highly effective ( )

Section 5: Electronic Laboratory instruction practices in TVET institutions

a) Technology Incorporation in Laboratory Instruction

12. Has your college incorporated the use of technology in electronic lab instruction practices? □$_1$Yes ( ) □$_2$No ( )

    If yes, which technologies have been incorporated in electronics laboratory instruction?

    ____

13. Which laboratory tasks are utilized by the technologies mentioned above?

    ____

    ____

14. What is your opinion on the use of technology in trainee's skill acquisition?

    □$_1$Very Low ( ) □$_2$Low ( ) □$_3$Moderate ( ) □$_4$High ( ) □$_5$Ver High ( )

b) Laboratory Session Scheduling Practices

15. How are electronic laboratory practice sessions scheduled in the timetable in your institution? □$_1$Scheduled separately ( ) □$_2$Scheduled within the lecture hours ( )
16. How often is the electronics laboratory practice schedule followed by your trainers?□$_1$Never ( ) □$_2$Rarely ( ) □$_3$Sometimes ( ) □$_4$Often ( ) □$_5$Always ( )
17. How sufficient is the time scheduled/allocated for electronics laboratory practice? □$_1$Not sufficient at all ( ) □$_2$Somehow sufficient ( ) □$_3$Sufficient ( ) □$_4$Very sufficient

18. How synchronized is the scheduling of theory sessions and laboratory practice topics? □1Not synchronized at all ( ) □2Somehow synchronized ( ) □3 synchronized ( ) □4Highly synchronized
19. In your view, how satisfactory is the scheduling of laboratory sessions in your institution? □1Not satisfactory at all ( ) □2Somehow satisfactory ( ) □3Moderately satisfactory ( ) □4Satisfactory ( ) □5Very satisfactory ( )

c) Approaches Used in Laboratory Instruction Practices.

20. Which is the mostly used method in laboratory practice session? □1Demonstration ( ) □2Exercise ( ) □3Structured inquiry ( )□4Open-ended inquiry ( ) □5Project method ( )
21. In your opinion, how effective is the laboratory teaching method employed by your trainers? □1Not Effective at all ( ) □2Slightly Effective ( ) □3Moderately Effective ( ) □4Effective ( ) □5Very Effective( )

d) Organization of Laboratory Session Activities

22. How do you carry out electronic laboratory practice exercises? □1Individually ( ) □2In groups ( )
23. Are there opportunities for you to undertake laboratory practice during your own time? □1Yes ( ) □2 No ( )
24. What is the number of trainees who can attend the laboratory practical per session? □1More than 20 ( ) □2Less than 20 ( )
25. Who normally guides you as they undertake the activities during laboratory practice sessions? □1Lab technician ( ) □2Trainer ( ) □3Both ( )

26. In general, how satisfied are you with the way laboratory activities are organized in your institutions? □$_1$Not Satisfied at all ( ) □$_2$Slightly Satisfied ( ) □$_3$Moderately Satisfied ( ) □$_4$Satisfied ( ) □$_5$Very satisfied ( )

e) Laboratory Session Preparation Practices.

27. Are lab manuals made available to you in your institution? □$_1$Yes ( ) □$_2$No ( ) □$_3$Not Aware ( )
28. How often are you encouraged to read the electronics laboratory experiment in the lab manual and other related textbook material in preparation for the laboratory session? □$_1$Never ( ) □$_2$Rarely ( ) □$_3$Sometimes ( ) □$_4$Often ( ) □$_5$Always ( )
29. Are you encouraged to consult with your trainer for any clarification on the topic of laboratory practice before the session? □$_1$Yes ( ) □$_2$No ( )
30. Does your trainer consider trainees class size when preparing for a laboratory practice session? □$_1$Yes ( ) □$_2$No ( )
31. Are the electronic laboratory equipment, tools and materials set before you arrive in the laboratory? □$_1$Yes ( ) □$_2$No ( )
32. In view of the above questions, what is your opinion on the adequacy of preparation for lab learning sessions by your trainers? □$_1$Not Adequate at all ( ) □$_2$Slightly Adequate ( ) □$_3$Moderately adequate ( ) □$_4$Adequate ( ) □$_5$Very adequate ( )

f) Lab Instruction Delivery and Assessment Practices.

33. Please tick the correct rating in relation to each of the following aspects of electronic laboratory instruction delivery practice by your trainers in the box provided. Note**:**

1=Not at all (NA), 2 = Rarely (RA), 3 = Often (OF), 4 = Very often (VO), 5 = Always (AL)

Lab activities before, during and after the lab session						
No.		**NA**	**RA**	**OF**	**VO**	**AL**
1	Gives out a lab-sheet					
2	Briefs on what the laboratory session is all about					
3	Highlights safety procedures and rules to be followed					
4	Prepares on the topic for the lab practical					
5	Clearly states objectives of the lab practical					
6	Relates the lab activity and the theory concept covered					
7	Briefs on the skill to attain from the lab practical					
8	Introduces components, tools, material, and equipment to be used in the lab activity					
9	Demonstrates how to carry out the lab activity before they start working on it					
10	Emphasizes equal level of participation in the lab activity					
11	Invites questions from trainees to seeking clarification					
12	Shows how to record findings from the exercise					
13	Moves around the lab to be available for the trainees					
14	Supervises the lab activity being done					

15	Encourages each trainee to participate actively in the lab activity					
16	Recognizes those who have difficult and assist them					
17	Encourages autonomy(freedom) as they practice skills and learn from their successes and failures					
18	Evaluates trainees' work step by step and record down as the session is going on					
19	Relates the lab activities with what they will be doing in the industry					
20	Reviews and allow questions at the end of the session					
21	Encourages trainees to reflect on what they have accomplished in the lab exercise					
22	Links the lab activity to other subjects and the industry					
23	Explains how to write a lab report in the accepted format and submit for marking.					
24	Asks trainees to clean the lab, return tools and equipment before they leave.					

34. How often are you assessed on laboratory activities during the session? □$_1$Never ( ) □$_2$Rarely ( ) □$_3$Sometimes ( ) □$_4$Often ( ) □$_5$Always ( )

35. Is there an assessment form used by your trainer in the assessment of your electronic laboratory exercises? □$_1$Yes ( ) □$_2$No ( ) □$_3$ Not Sure ( )

36. How often are the following methods of assessment employed in electronic laboratory activities during your lab sessions? Please tick the correct rating in the box provided.

Note: ***1 = Not at all (NA), 2 = Rarely (RA), 3 = Often (OF), 4 = Very often (VO), 5 = Always (AL)***

Item No.	**Method of Laboratory assessment**	**NA**	**RA**	**OF**	**VO**	**AL**
1	Direct observation of student activities					
2	Assessment of laboratory reports					
3	Laboratory practical examination					

37. In general, how satisfied are you with the way assessment and delivery of laboratory activities is done in your institution? □1Not Satisfied at all ( ) □2Somehow Satisfied ( ) □3Moderately Satisfied ( ) □4Satisfied ( ) □5Very satisfied ( )

Section 6: Laboratory Training Strategies

38. Have you faced any challenges in learning electronics lab Practice? □1Yes ( ) □2No ()
39. If yes, what specific challenges have you faced? ______________________________
40. What strategies have your trainers employed to enhance your skill acquisition? ____
41. What strategies can you proposed to your institution to adopt to help trainees acquire maximum skills? ____

END

APPENDIX II: QUESTIONNAIRE FOR THE TRAINERS

THE INFLUENCE OF ELECTRONICS LABORATORY PRACTICES ON SKILL ACQUISITION AMONG TECHNICIAN TRAINEES IN NAIROBI COUNTY, KENYA.

QUESTIONNAIRE FOR THE TECHNICIAN TRAINERS

Dear Respondent,

My name is Stella Kwamboka Okemwa, a PHD student at University of Eldoret. I wish to thank you for accepting to participate in this study. The aim of this research is to explore the influence of Electronics Laboratory Practices on Skill Acquisition by Technician Trainees in Kenya. This questionnaire has been designed to collect the required information. The data collected will strictly be used for academic purposes and will be treated with strict confidence. Your identity will **NOT** be revealed.

Please provide the answers to the questions by selecting the relevant answer and filling in the required information as requested.

Section 1: Demographic (General) Information

1. Age: □$_1$Below 30 ( ) □$_2$31-40 ( ) □$_3$Above 41 ( )
2. Gender: □$_1$Male ( ) □$_2$Female ( )

Section 2: Lab Attendance

3. Have you ever taught an electronic laboratory learning session since you were employed? □$_1$Yes ( ) □$_2$No ( )

NOTE: IF YES, PROCEED TO ANSWER THE QUESTIONNAIRE.

4. If yes, approximately, how many times have you taught electronic lab session since you were employed? □1 1-10 ( ) □2 11-20 ( ) □3 20 and above ( )

Section 3: Skill Levels of Technician Trainees

5. Please rate your trainees on the skills attained on the items and tasks listed below. Use the following key. Note: ***1=Very Lowly Skilled (VL); 2=Lowly Skilled (L); 3=Moderately skilled (M); 4=Highly skilled (H); 5=Very Highly Skilled (VH)*** in the respective boxes.

a. Trainees ability to identification the following basic electronic components by physical look.

Item No.	***Identification of components***	**VL**	**L**	**M**	**H**	**VH**
1	Resistor					
2	Capacitor					
3	Inductor					
4	Diode					
5	Transistor					
6	Integrated circuits (IC)					

b. Trainees ability to use the following electronic equipment, tools and materials

Item No.	***Ability to Use the following***	**VL**	**L**	**M**	**H**	**VH**
1	Oscilloscope					
2	Signal generator					
3	Digital multi-meter					
4	Ammeter					
5	Voltmeter					
6	Wattmeter					
7	Solder gun					
8	Solder sucker					
9	Solder wire					

c. Level of your trainees' skill attained on the following electronic tasks

Item No.	**Area of Skill Attainment**	**VL**	**L**	**M**	**H**	**VH**
1	Design and develop an electronic circuit					
2	Read and interpret an already designed circuit					
3	Identify components, materials, tools and measuring instruments to use for the designed circuit					
4	Mount the electronic circuit on a PCB, BB and Strip board					

5	Connect measuring instruments to the circuit					
6	Set measuring instruments to the require value					
7	Use the instruments to measure the required values and waveforms					
8	Read and record the required values and waveforms					
9	Write a lab report					

Section 4: Management and Utilization of Laboratory Equipment, Tools and Materials for Skill Acquisition

6. How Adequate is laboratory space and equipment for electronic laboratory practices? □1Not adequate at all ( ) □$_2$Slightly adequate ( ) □$_3$Moderately adequate ( ) □$_4$Adequate ( ) □$_5$Very adequate ( )
7. How well are trainees guided on the safe and proper use of equipment? □$_1$Poorly ( ) □$_2$fairly ( ) □$_3$Good ( ) □$_4$Very good ( ) □$_5$Excellent ( )
8. How effective are the measures employed to safeguard laboratory equipment and tools from loss or misuse? □$_1$Not effective ( ) □$_2$Slightly effective ( ) □$_3$Moderately effective ( ) □$_4$Highly effective ( ) □$_5$Very highly effective ( )
9. How frequently are modern electronic laboratory equipment acquired? □$_1$Rarely ( ) □$_2$Somehow frequent ( ) □$_3$Frequently ( ) □$_4$Very frequently ( )
10. How frequently are your electronic laboratory equipment repaired/maintained? □$_1$Not maintained at all ( ) □$_2$Rarely ( ) □$_3$Somehow ( ) □$_4$Frequently ( ) □$_5$Very frequently ( )

11. In general, how effective are laboratory equipment, tools and materials managed and utilized for skill acquisition? □1Not effective ( ) □2Somehow effective ( ) □3Moderately effective ( ) □4Highly effective ( ) □5Very highly effective ( )

Section 5: Electronic Laboratory instruction practices in TVET institutions

a) Technology Incorporation in Laboratory Instruction

12. Has your college incorporated the use of technology in electronic lab instruction practices? □1Yes ( ) □2No ( )
13. If yes, which technologies have been incorporated in electronics laboratory instruction?

    ____

14. Which laboratory tasks are utilized by the technologies mentioned above?

    ____

15. What is your opinion on the use of technology in trainee's skill acquisition?

    □1Very Low ( ) □2Low ( ) □3Moderate ( ) □4High ( ) □5Ver High ( )

b) Laboratory Session Scheduling Practices

16. How are electronic laboratory practice sessions scheduled in the timetable in your institution? □1Scheduled separately ( ) □2Scheduled within the lecture hours ( )
17. How often do you follow the electronics laboratory practice schedule?□1Never ( ) □2Rarely ( ) □3Sometimes ( ) □4Often ( ) □5Always ( )
18. How sufficient is the time scheduled/allocated for electronics laboratory practice? □1Not sufficient at all ( ) □2Somehow sufficient ( ) □3Sufficient ( ) □4Very sufficient ( )

19. How synchronized is the scheduling of theory sessions and laboratory practice topics? □1Not synchronized at all ( ) □2Somehow synchronized ( ) □3 synchronized ( ) □4Highly synchronized ( )
20. In your view, how satisfactory is the scheduling of laboratory sessions in your institution? □1Not satisfactory at all ( ) □2Somehow satisfactory ( ) □3Moderately satisfactory ( ) □4Satisfactory ( ) □5Very satisfactory ( )

c) Approaches Used in Laboratory Instruction Practices.

21. Which of the following approaches do you employed mostly in the laboratory practice session? □1Demonstration ( ) □2Exercise ( ) □3Structured inquiry ( )□4Open-ended inquiry ( ) □5Project method ( )
22. In your opinion, how effective is the laboratory teaching method you employ? □1Not Effective at all ( ) □2Slightly Effective ( ) □3Moderately Effective ( ) □4Effective ( ) □5Very Effective( )

d) Organization of Laboratory Session Activities

23. How do your trainees carry out the electronic laboratory practice exercises? □1Individually ( ) □2In groups ( )
24. Are there opportunities for them to undertake laboratory practice during their own time? □1Yes ( ) □2 No ( )
25. What is the number of trainees who can attend the laboratory practical per session? □1More than 20 ( ) □2Less than 20 ( )
26. Who normally guides your trainees as they undertake the activities during laboratory practice sessions? □1Lab technician ( ) □2Trainer ( ) □3Both ( )

27. In general, how satisfied are you with the way laboratory activities are organized in your institutions? □1Not Satisfied at all ( ) □2Slightly Satisfied ( ) □3Moderately Satisfied ( ) □4Satisfied ( ) □5Very satisfied ( )

e) Laboratory Session Preparation Practices.

28. Are lab manuals made available to trainees in your institution? □1Yes ( ) □2No ( ) □3Not Aware ( )
29. How often do you encourage trainees to read the electronics laboratory experiment in the lab manual and other related textbook material in preparation for the laboratory session? □1Never ( ) □2Rarely ( ) □3Sometimes ( ) □4Often ( ) □5Always ( )
30. Do you encourage trainees to consult with you for any clarification on the topic of laboratory practice before the session? □1Yes ( ) □2No ( )
31. Do you consider trainees class size when preparing for a laboratory practice session? □1Yes ( ) □2No ( )
32. Are the electronic laboratory equipment, tools and materials set before trainees arrive in the laboratory? □1Yes ( ) □2No ( )
33. In view of the above questions, what is your opinion on the adequacy of preparation for lab learning sessions by trainer? □1Not Adequate at all ( ) □2Slightly Adequate ( ) □3Moderately adequate ( ) □4Adequate ( ) □5Very adequate ( )

f) Lab Instruction Delivery and Assessment Practices.

34. Please tick the correct rating in relation to each of the following aspects of electronic laboratory instruction delivery practice on the trainees. Note**:**

1=Not at all (NA), 2 = Rarely (RA), 3 = Often (OF), 4 = Very often (VO), 5 = Always (AL)

Lab activities before, during and after the lab session						
No.		**NA**	**RA**	**OF**	**VO**	**AL**
1	Gives out a lab-sheet					
2	Briefs them on what the laboratory session is all about					
3	Highlights safety procedures and rules to be followed					
4	Prepares them on the topic for the lab practical					
5	Clearly states objectives of the lab practical					
6	Relates the lab activity and the theory concept covered					
7	Briefs them on the skill to attain from the lab practical					
8	Introduces components, tools, material, and equipment to be used in the lab activity					
9	Demonstrates how to carry out the lab activity before they start working on it					
10	Emphasizes equal level of participation in the lab activity					
11	Invites questions from trainees to seeking clarification					
12	Shows them how to record findings from the exercise					
13	Moves around the lab to be available for the trainees					
14	Supervises the lab activity being done					

15	Encourages each to participate actively in the lab activity					
16	Recognizes those who have difficult and assist them					
17	Encourages autonomy(freedom) as they practice skills and learn from their successes and failures					
18	Evaluates their work step by step and record down as the session is going on					
19	Relates the lab activities with what they will be doing in the industry					
20	Reviews and allow questions at the end of the session					
21	Encourages trainees to reflect on what they have accomplished in the lab exercise					
22	Links the lab activity to other subjects and the industry					
23	Explains to them how to write a lab report in the accepted format and submit for marking.					
24	Asks them to clean the lab, return tools and equipment before they leave.					

35. How often do you assess laboratory activities during the session? □1Never ( ) □2Rarely ( ) □3Sometimes ( ) □4Often ( ) □5Always ( )
36. Is there an assessment form you use in the assessment of your electronic laboratory exercises? □1Yes ( ) □2No ( ) □3 Not Sure ( )
37. How often do you employ the following methods of assessment in electronic laboratory activities during your lab sessions? Please tick the correct rating in the box provided.

Note: ***1 = Not at all (NA), 2 = Rarely (RA), 3 = Often (OF), 4 = Very often (VO), 5 = Always (AL)***

Item No.	**Method of Laboratory assessment**	**NA**	**RA**	**OF**	**VO**	**AL**
1	Direct observation of student activities					
2	Assessment of laboratory reports					
3	Laboratory practical examination					

38. In general, how satisfied are you with the way you assess and deliver laboratory activities in your institution? □1Not Satisfied at all ( ) □2Somehow Satisfied ( ) □3Moderately Satisfied ( ) □4Satisfied ( ) □5Very satisfied ( )

Section 6: Laboratory Training Strategies

39. Have you faced any challenges in teaching electronics laboratory Practice? □1Yes () □2No

    If yes, what Specific Challenges have you Faced? ___________________________________

40. What strategies have you employed to enhance your trainees' skill acquisition? ____

41. What strategies can you proposed to your institution to adopt to help your trainees acquire maximum skills? ____

END

APPENDIX III: OBSERVATION SCHEDULE

Management and Utilization of Laboratory Equipment, Tools and Materials for Skill Acquisition

No.	OBSERVATION ASPECT	OBSERVATION MADE
1	Workstations set up	
2	Handling and issuing of equipment	
3	State of equipment in the labs	

Influence of Scheduling of Laboratory Sessions on Skill Acquisition

No.	OBSERVATION ASPECT	OBSERVATION MADE
1	Laboratory schedule adherence	
2	Synchronization of theory sessions and laboratory practice	

Approaches mostly employed in laboratory instruction

No.	OBSERVATION ASPECT	OBSERVATION MADE
1	Approaches employed during laboratory instruction	

Organization of Laboratory Session Activities?

No.	OBSERVATION ASPECT	OBSERVATION MADE
1	How the lab activities are carried out	
2	Number of trainees attending the laboratory practical per session	

Laboratory Preparation Practices

No.	OBSERVATION ASPECT	OBSERVATION MADE
1	Availability of lab manuals	
2	Experiment information preparation made for the laboratory session	
3	Adequacy of Preparation for Laboratory Learning Sessions	

Laboratory delivery practices

No.	OBSERVATION ASPECT	OBSERVATION MADE
INTRODUCTION		
1	Gives trainees the lab-sheet	
2	Briefs trainees on what the laboratory session is all about	
3	Highlights safety procedures and rules to be followed	
4	Briefs trainees on the topic for the lab practical	
5	Clearly states objectives of the lab practical	
6	Relates the lab activity and the theory concept covered in class	

7	Briefs trainees on the skill to attain from the lab practical	
8	Introduces components, tools, material, and equipment to be used in the lab activity	
9	Demonstrates how to carry out the lab activity before we start working on it	
10	Emphasizes equal level of participation in the lab activity	
11	Invites questions to seeking clarification	
12	Shows trainees how to record findings from the exercise.	
DURING THE SESSION		
13	Moves around the lab to be available to anyone in need	
14	Supervises the lab activity being done	
15	Encourages each trainee to participate actively in the lab activity	
16	Recognizes those who have difficult and assist them	
17	Encourages autonomy(freedom) where we practice skills and learn from our successes and failures	

18	Evaluates our work step by step as the session is going on	
19	Relates the lab activities with what we will be doing in the industry	
ENDING THE SESSION		
20	Reviews and allows questions at the end of the session	
21	Encourages trainees to reflect on what we have accomplished in the lab exercise	
22	Links the lab activity to other subjects and the industry	
23	Explains to trainees how to write a lab report	
24	Asks trainees to clean the lab, return tools and equipment before we leave	
ASSESSMENT OF LABORATORY ACTIVITIES		
25	Kind of assessment done	

END

APPENDIX IV: INTERVIEW SCHEDULE FOR HEADS OF DEPARTMENT

My name is Stella Kwamboka Okemwa, a PHD student at University of Eldoret. I wish to thank you for accepting to participate in this study. The aim of this research is to explore the influence of Electronics Laboratory Practices on Skill Acquisition by Technician Trainees in Kenya. You are invited to participate in this interview in which you are requested to share views on the above topic. I would like to assure you that all the information you provide will be treated confidentially and will be used for academic purposes only. Thank you and welcome.

1. **How is Laboratory Equipment, Tools and Materials Managed and Utilized for Skill Acquisition? Probe for:**

   - *Adequacy of lab space training equipment to student*
   - *Measures employed to safeguard laboratory equipment and tools*
   - *Frequency of acquisition of equipment and replacement of old ones*
   - *Frequency of repair and maintenance of laboratory equipment*
   - *Effectively managed and utilized for imparting skills to the trainees.*

2. **How do you incorporate any technology in electronic Laboratory Instruction? Probe for:**

   - *Technology incorporated*
   - *Tasks utilized by these technologies*

3. **How are electronic laboratory sessions scheduled? Probe for:**

   - *How they are scheduled*

- *Whether schedule is followed*
- *Sufficiency of time allocated*
- *How lab and theory lessons are synchronized*
- *Satisfactory is the scheduling of laboratory sessions in your institution*

4. **How are laboratory activities Organized? Probe for:**

   Individual or group

   Opportunity for trainees to practice on their own in the lab

   Staff guiding of laboratory activities

5. **What are the trainer Laboratory preparation practices? Probe for:**

   Lab manuals

   Class size consideration

6. **Do you have Industry collaborations in electronic laboratory practice?**
   - *Knowledge of skills needed in industry*
   - *How the industry skills are incorporated in the lab instruction*
   - *Institution collaboration with industry in training*
7. **What are Laboratory Training Strategies employed to ensure maximum skill acquisition?**
   - *Challenges faced in laboratory training*
   - *Strategies employed to overcome challenges*

END

APPENDIX V: FOCUS GROUP DISCUSSION GUIDE

My name is Stella Kwamboka Okemwa, a PHD student at University of Eldoret. I wish to thank you for accepting to participate in this study. The aim of this research is to explore the influence of Electronics Laboratory Practices on Skill Acquisition by Technician Trainees in Kenya. You are invited to participate in this focus group discussion in which you will share views on the above topic. I would like to assure you that all the information you provide will be treated confidentially and will be used for academic purposes only. Thank you and welcome.

Focus Group Discussion guiding questions

1. How can you describe the effectiveness of how laboratory equipment is managed and utilized for training in skill acquisition?

<u>Points of discussion</u>

- *Adequacy of laboratory space and equipment*
- *Measures put in place to safeguard equipment, tools from getting lost or misused.*
- *Acquiring modern equipment or replacing old ones*
- *Repair and maintenance of laboratory equipment*
- *Effective management and utilization of laboratory equipment and tools*

2. How have you handled technology in electronic laboratory instruction?

Points of discussion

- *Technologies incorporated*
- *Tasks utilized by these technologies*

3. How are electronic laboratory sessions scheduled?

Points of discussion

- *How they are scheduled*
- *Whether schedule is followed*
- *Sufficiency of time allocated*
- *How lab and theory lessons are synchronized*

4. How are laboratory activities organized?

Points of discussion

- *Individual or group*
- *Opportunity for trainees to practice on their own in the lab*
- *Number of students handled in a session*
- *Staff guiding of laboratory activities*

5. Which approaches do you use in teaching laboratory practice
6. How is laboratory preparation practiced in your institutions?

Points of discussion

- *Use of Lab manuals*

- *Academic preparation*
- *Class size consideration*
- *Setting of the lab*

7. How do the trainers undertake laboratory instruction delivery and assessment?

Points of discussion

- *Laboratory session delivery*
- *Assessment of the laboratory exercise.*

8. Do you have Industry collaborations in electronic laboratory practice?

Points of discussion

- *Knowledge of skills needed in industry*
- *How the industry skills are incorporated in the lab instruction*
- *Institution collaboration with industry efforts*

9. **What are Laboratory Training Strategies employed to ensure maximum skill acquisition?**

   Points of discussion

- *Challenges in laboratory instruction*
- *Strategies employed to overcome challenges*

END

APPENDIX VI: LETTER FROM UNIVERSITY OF ELDORET

University of Eldoret

P.O. Box 1125-30100,
ELDORET, Kenya
Tel: 053-2063111 Ext. 242
Fax No. 20-2141257

Our Ref: UOE/SEDU/TED/13

20th February, 2019

The Executive Secretary,
National Council for Science Technology & Innovation
P.O. BOX 30623-00100,
NAIROBI.

Dear Sir/Madam,

SUBJECT: RESEARCH PERMIT FOR- STELLA KWAMBOKA OKEMWA EDU/PHD/TE/001/14

This is to confirm that the above named Postgraduate Student has completed Course work of her Doctor of Philosophy in the Department of Technology Education.

She is currently preparing for a field research work on her thesis entitled: ***"Electronics laboratory instruction practices for skill acquisition among technician trainees in Kenya." A Case of Nairobi County.*** The proposal has been approved by this Institution.

Any assistance accorded to her to facilitate successful conduct of the research and the publication will be highly appreciated.

Yours faithfully,

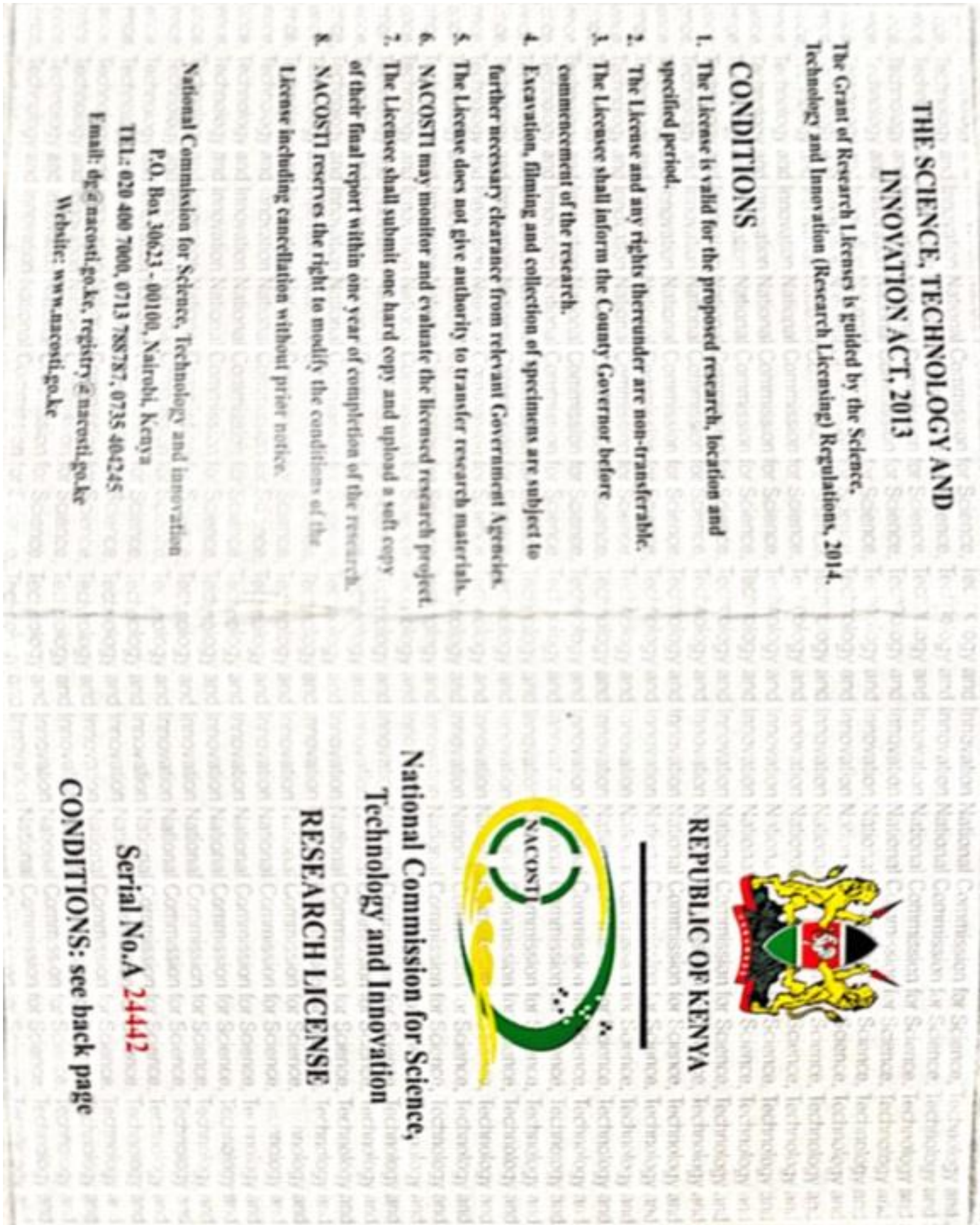
UNIVERSITY OF ELDORET
Technology Education
1125 Eldoret-30100.

DR. HOSEAH KIPLAGAT
HEAD, TECHNOLOGY EDUCATION DEPARTMENT

Copy to: Permanent Secretary,
Ministry of Higher Education, Science & Technology,
P.O. Box 9583-00200,
NAIROBI.

University of Eldoret is ISO 9001: 2015 Certified

APPENDIX VII: RESEARCH LICENSE



THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. The License is valid for the proposed research, location and specified period.
2. The License and any rights thereunder are non-transferable.
3. The Licensee shall inform the County Governor before commencement of the research.
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
5. The License does not give authority to transfer research materials.
6. NACOSTI may monitor and evaluate the licensed research project.
7. The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.

National Commission for Science, Technology and innovation
P.O. Box 30623 - 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 24442

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:
MS. STELLA KWAMBOKA OKEMWA
of UNIVERSITY OF ELDORET, 18702-100
Nairobi,has been permitted to conduct
research in *Nairobi County*

on the topic: *ELECTRONICS LABORATORY INSTRUCTION PRACTICES FOR SKILL ACQUISITION AMONG TECHNICIAN TRAINEES IN KENYA: A CASE OF NAIROBI COUNTY.*

for the period ending:
30th April,2020

Permit No : NACOSTI/P/19/13092/28538
Date Of Issue : 2nd May,2019
Fee Recieved :Ksh 2000

....
Applicant's Signature

....
Director General
National Commission for Science, Technology & Innovation

APPENDIX VIII: LETTER FROM NACOSTI

NATIONAL COMMISSION FOR SCIENCE,
TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349,3310571,2219420
Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/19/13092/28538**

Date: **2nd May 2019**

Stella Kwamboka Okemwa
University of Eldoret
P.O. Box 1125- 30100
ELDORET.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "***Electronics laboratory instruction practices for skill acquisition among Technician trainees in Kenya: A case of Nairobi County.***" I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for the period ending **30th April, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, Nairobi** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nairobi County

14/6/2019

The County Director of Education
Nairobi County

COUNTY COMMISSIONER
NAIROBI COUNTY
P. O. Box 30124-00100, NBI
TEL: 341666

National Commission for Science, Technology and Innovation is ISO9001: 2008 Certified

APPENDIX IX: LETTER FROM MINISTRY OF EDUCATION

Republic of Kenya
MINISTRY OF EDUCATION
STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

Telegrams: "SCHOOLING", Nairobi
Telephone; Nairobi 020 2453699
Email: rcenairobi@gmail.com
cdenairobi@gmail.com

When replying please quote

REGIONAL DIRECTOR OF EDUCATION
NAIROBI REGION
NYAYO HOUSE
P.O. Box 74629 – 00200
NAIROBI

Ref: RCE/NRB/RESEARCH/1/64/VOL.I

Date: 14th June, 2019

Stella Kwamboka Okemwa
University of Eldoret
P. O. Box 1125-30100
ELDORET

RE: RESEARCH AUTHORIZATION

We are in receipt of a letter from the National Commission for Science, Technology and Innovation regarding research authorization in Nairobi County on *"Electronics laboratory instruction practices for skill acquisition among Technician trainees in Kenya: A case of Nairobi County".*

This office has no objection and authority is hereby granted for a period ending **30th April, 2020** as indicated in the request letter.

Kindly inform the Sub County Director of Education of the Sub County you intend to visit.

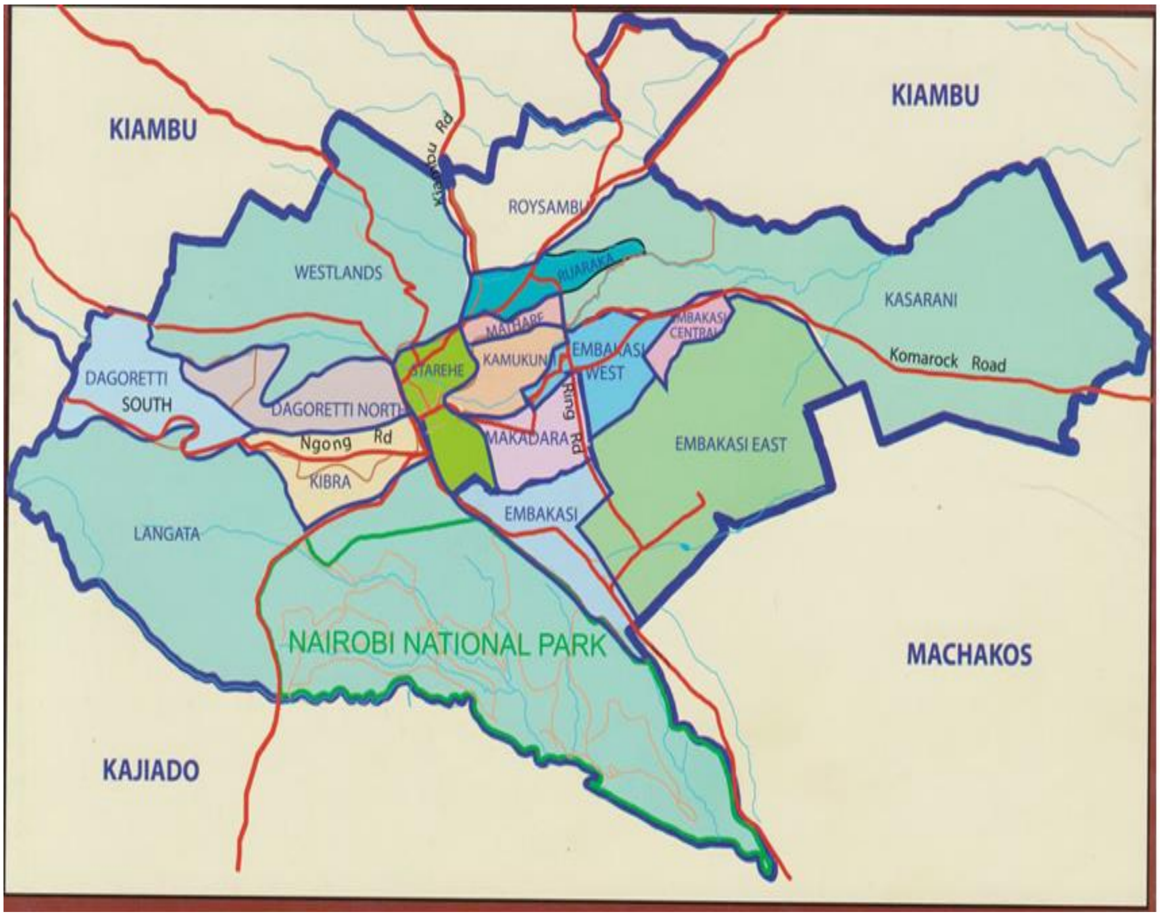
REGIONAL DIRECTOR OF EDUCATION
NAIROBI
14 JUN 2019
MINISTRY OF EDUCATION
P. O. Box 74629, NAIROBI

DRUSCILLA MOSIORI
FOR: REGIONAL DIRECTOR OF EDUCATION
NAIROBI

Copy to: Director General/CEO
National Commission for Science, Technology and Innovation
NAIROBI

APPENDIX X: RECORDER USED FOR INTERVIEW AND FGD

APPENDIX XI: NAIROBI COUNTY MAP



Source: https://textbookcentre.com/catalogue/map-of-nairobi-city-county_12846/

APPENDIX XII - SIMILARITY REPORT

Turnitin Originality Report

THE INFLUENCE OF ELECTRONICS LABORATORY PRACTICES ON SKILL ACQUISITION BY TECHNICIAN TRAINEES INNAIROBI COUNTY, KENYA. by Stella Okemwa

From Theses (Theses)

- Processed on 14-Nov-2022 12:15 EAT
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6. < 1% match (Internet from 06-Jul-2022)
   http://erepository.uoeld.ac.ke/bitstream/handle/123456789/1594/ALUOCH%20JOHN%20RAYS%20JEREMY.pdf?isAllowed=y&sequence=1
7. < 1% match (Internet from 27-Sep-2022)
   http://erepository.uoeld.ac.ke/bitstream/handle/123456789/1443/PAUL%20MACHOCHO%20WANYEKI.pdf?isAllowed=y&sequence=1