INVESTIGATING INTEGRATION OF DIGITAL LITERACY IN THE TEACHING OF AUTOMOTIVE ENGINEERING IN TVET INSTITUTIONS IN BUNGOMA COUNTY, KENYA.

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E60/90011/2016

A research project submitted in partial fulfillment of the requirements for award of the degree of Master of Educational Technology in the School of Education, College of Education and External Studies, department of Educational Communication and Technology, University of Nairobi.

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DECLARATION

This research project is my original work and has not been presented to any other university.

Sign 

Date 13/08/2020

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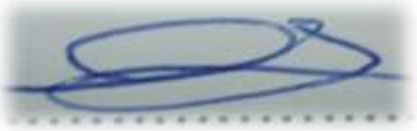
This project has been submitted for examination with our approval as University supervisors:

Sign 

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DEDICATION

This work is dedicated to my loving wife, Nancy A.Makokha for the patience, sacrifice, encouragement, moral and financial support. Our daughter Natalya Nafula (Nana) who fought through illness throughout the period of this study and triumphed. My mum Florence Chonge for her sacrifice and selflessness. Without them I would not be the Son, husband and the father I am today. It is through their love, understanding and support that I have become a better person than I ever was before.

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ABBREVIATIONS AND ACRONYMS

CAD - Computer Aided Design

CAN - Control Area Network

ECU - Electronic Control Unit

GPS - Global Positioning System.

HTML - Hypertext Markup Language

ICT - Information Communication and Technology

KPMG - Klynveld Peat Marwick Goerdeler

LCD - Liquid crystal Display

LED - Light Emitting Diode

LAN - Local Area Network

NACOSTI - National Commission for Science, Technology & Innovation

PLN - Personal Learning Network

SPSS - Statistical Package for Social Sciences

STEM - Science Technology Engineering and Mathematics

TAM - Technology Advancement Model

TVET - Technical Vocational and Education Training

TVETA - Technical Vocational and Education Training Authority

UNESCO - United Nations Educational Scientific and Cultural Organization

UNEVOC - United Nations Educational Vocational Organization Conference

UNCTAD - United Nation Conference on Trade and Development

ABSTRACT

With increasing global demand of institutions for higher learning to produce skilled graduates who are market ready with creative, technical and functional digital skills that could add value to any initiative, the study set out to investigate the integration of digital literacy in the teaching of automotive engineering in public and private at both levels of study in diploma and certificate in Technical Vocational and Education Training institutions in Bungoma County**,** Kenya**.** Guided by Technological Acceptance Model and Diffusion of Innovation theory**,** the study focused on four objectives of integrating digital tools, digital infrastructure, and digital literacy skills of students, digital elements and in teaching of automotive engineering**.** Sample size was 200 students and 30 trainers. The study employed descriptive research design approach where the researcher sought to systematically measure and quantify elements of digital literacy in relation to a discipline in TVET**.** The data collected was analyzed based on the responses from the completed research instruments in the study. The collected data for the four objectives of this study was analyzed quantitatively using SPSS statistical package (version 21).This was significant for descriptive statistics. This involved the use of frequencies, percentages and total scores. While tables, pie-charts, bar and column charts were used to present the analyzed results. The study found out that trainers and students in public TVET institutions in Bungoma County have integrated digital literacy in teaching and learning more than their counterparts from Private TVET. This is because of government support in laying digital infrastructure. That students' level of study whether certificate or diploma and age have a bearing on integration of digital literacy skills, tools and application of digital elements in the teaching of automotive engineering**.** Study recommended the review of automotive engineering curriculum on new digital technologies, upgrade of digital infrastructure by TVET institutions, capacity building for trainers on new technologies, need for a study to be done on digital literacy tools for other subjects and a further study on digital devices influence of student performance in institutions of higher learning.

CHAPTER ONE

INTRODUCTION

1.1 Background of the problem

Literacy has been viewed as the individual's ability in all walks of life to make sense of something for purposes of applying the same to achieve specific milestones for social or professional interests. This is the ability to read and write on traditional forms of media, that is; books, chalkboard, Magazines, newspapers, flyers, newsletters and scholarly journals. Heick (2015) observes that 21st century has seen the emergence of new forms of literacies that are largely defined by a student or trainers' ability in the study to understand what is communicated through digital media. Therefore, according to Heick (2015), digital literacy is the ability to make sense of digital media by extracting both implicit and explicit ideas for consumption in personal areas of interest. The researcher chose digital literacy because it is the most sought-after technological ingredient for any educational institution that aspires to produce graduates ready for skilled labour that is heavily dependent on technology.

Van Joolingen (2004) looks at digital literacy in a learning setup as student's interests, attitudes to appropriately use digital tools, digital skills, digital elements and digital infrastructure to access, manage, integrate and evaluate information, construct new knowledge and communicate with others in order to participate effectively in society. Key to his observation is how the trainer and the student from private and public TVET institutions that have access to digital infrastructure obtains information from online sources by use of available digital tools and application of digital elements in learning and teaching of automotive engineering.

Globally, the International Society for Technology in Education (2007) looks at digital literacy using six standards of; creativity and innovation, communication and collaboration, research and information fluency, critical thinking, problem solving and decision making, digital citizenship,

technology operations and concepts. In the context of this study, if the automotive engineering trainers and students know how to use technology that they are presented with to effectively teach and learn automotive engineering then they are deemed to be digitally literate.

In an automotive engineering environment, digital literacy is widely viewed as trainers' and students' thoughtful employment of the available digital technology to enhance their reading, writing, speaking and listening.

Students with access to a computer and the internet are able to find the answers to not only simple questions, but also to incredibly complex automotive engineering problems and apply the same information in emerging 21st century modern automobile technologies. That is digital literacy.

McAndrew (2014) divides digital literacy into six elements; *Information literacy,* where an automotive engineering student is taught to find, interpret, evaluate, manage and share information. *Media Literacy,* where an engineering student is taught to critically read creatively and produce academic and professional communication in assorted range of media. *Communication and collaboration,* where engineering students are taught through research on digital networks. *Digital Scholarship,* where automotive engineering students participate in academic and professional practices that entirely depend on digital systems. *Career identity and management,* this is about copyright of own works, digital reputation and online identity. *Learning skills,* formal and informal learning in what McAndrew (2014) calls "technology-rich environments" and lastly *ICT Literacy,* where the automotive engineering student is taught to adapt (familiarize), adopt (accept and approve) and use digital devices applications and services. In this study, the learner in automotive engineering class was deemed to have been taught and embraced all of the above elements to be appreciated as being digitally literate.

In Africa, the main focus has been on the five components of digital literacy that are illustrated by Aviram, A., & Eshet-Alkalai, Y. (2006). These components are classified according to usage as follows; photo-visual literacy, information literacy, socio-emotional literacy, reproduction literacy

and branching literacy. Further, Elkalai (2006) et.al supports this study by focusing on digital literacy components of digital tools and digital literacy skills which both the learner and trainer were investigated upon in the study and ultimately the digital structures upon which modern technologies operate.

Kenya ICT Authority's decision to roll out Digital Literacy programme in 2013 was borne out of the realization that the Kenyan youth lacked requisite digital literacy skills yet technology defines the world (Kenya ICT authority, 2013). The researcher picked on automotive engineering discipline because of the value attached to the subject by TVET institutions as being the leading course laden with beneficial technical skills that are relied upon in the motor industry that has embraced computerized systems. In the same breath, both private and public TVET institutions in Bungoma County offer automotive engineering as a key component in technical education. This necessitates integration of digital literacy for better teaching of content by trainers.

Governments around the globe continuously reflect on the appropriate digital literacy skills their youth in middle level institutions like TVET will require to drive a globally connected digital economy. N.Law et al… (2018) from Centre for Information Technology in Education (CITE) in their paper on global framework of reference on digital literacy supports the notion that digital literacy is the ability for an automotive engineering student in both private and public TVET or any institution of higher learning to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship.

1.2 Statement of the problem

A study done in Nigeria by Olanrewaju Ojo (2015) on use of digital devises in polytechnics that sampled over 2000 students revealed that despite heavy investment in the sector, there was still a challenge in adopting new way of teaching using modern systems. Similarly, both private and public TVET institutions in Bungoma County, Kenya, despite acquisition of modern technological equipment and laying of high speed fiber optic cable, trainers have not embraced the teaching automotive engineering using digital tools. There is no evidence to show that graduates from these TVET institutions have demonstrated knowledge of digital skills in troubleshooting, design and management of modern computerized car systems. TVET trainers' incompetence in use of basic digital literacy devices and infrastructure in teaching like laptops and learning management systems have hampered their productivity due to lack of capacity building by parent institutions.

Equally, TVET curriculum has stagnated and not extensively included digital literacy tools, digital skills and digital elements to equip both the automotive engineering trainer and leaner with much needed technical skills.

This study therefore sought to investigate the state of integration of digital literacy in the learning and teaching of automotive engineering in both public and private TVET institutions in Bungoma County. The study achieved this by evaluating how trainers and students in both public and private TVET institutions are integrating digital tools, digital skills, digital infrastructure and digital elements in teaching and learning automotive engineering in Bungoma County.

1.3 Purpose of the study

The purpose of this study was to find out how integration is taking place in applying digital literacy in the teaching and learning of automotive engineering in private and public TVET institutions in Bungoma County Kenya. Further, the study sought to find out if there's a difference in integration of digital literacy in public and private institutions in Bungoma County, Kenya.

1.4 Research Objectives

The objectives of this study were;

1. To verify the types of digital literacy tools that are integrated in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya.
2. To establish whether digital literacy infrastructure is integrated in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya.
3. To determine whether digital literacy skills are integrated in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya.
4. To examine whether digital literacy elements are integrated in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya.

1.5 Research Questions

The research questions of this study were;

1. What type of digital literacy tools are integrated in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya?
2. How does digital literacy infrastructure integrate in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya?
3. What digital literacy skills are integrated in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya?
4. How are digital literacy elements integrated in teaching of automotive engineering in public and private TVET institutions in Bungoma County, Kenya?

1.6 Significance of the Study

The findings of this study will benefit the Technical Vocational Education and Training institutions in developing automotive engineering or automotive technology curriculum that will complement the ever-changing modern ICT teaching methodologies in the instructional processes. The outcome of the study will help both learner and the trainer in TVET on how to effectively use the new digital literacy skills in executing training in automotive engineering as a subject and a skill to obtain desirable outcomes.

At the national level, the findings will guide the policy makers in state department of Vocational and Technical Training, ministry of education by providing necessary information to deal with challenges that affect trainers and learners when integrating digital literacy strategies in the subject. Quality assurance officers in the ministry of education with specific attention to automotive engineering as a practical subject and a skill will immensely draw parallels to other disciplines on how to effectively use digital literacy-based teaching approaches to improve the quality of learning and produce market ready TVET graduates.

1.7 Limitations of the Study

The study is only applicable to TVET institutions with similar characteristics like those of the research area.

1.8 Delimitation of the Study

The study was carried out in Bungoma County, Kenya. The researcher picked on this County because from the Ministry of Education report (2016), it is home to both public and private TVET institutions with sufficient student population for sampling that are enrolled in certificate and diploma level of study in automotive engineering as a course. The county was also recently installed with the underground fiber cable that supplies all TVET institutions which is a key component in the study.

1.9 Basic Assumptions

To elicit adequate responses, the study was guided by these assumptions;

Students and trainers in private and public TVET institutions will be truthful in their responses.

That trainers in both private and public TVET institutions use digital tools in teaching of automotive engineering.

1.10 Definition of key Terms

Automotive engineering

Deals with designing cars, diagnosis, troubleshooting, repair and managing computerized systems in cars and industrial equipment.

Digital Literacy

Digital literacy is using information and communication technologies to find, evaluate, create and communicate information, requiring both cognitive and technical skills in both oral and practical sessions in workshops to solve complex problems in modern automotive technologies.

Digital infrastructure

This is a joint fiber-optic and wireless-based advanced information and communication technology platform with embedded multi-functional application services that facilitate 24/7 online real-time connectivity between nodes in the operational network in the engineering workshops. Laptops, desktops, smartphones, tablets and related digital devices and learning platforms are classified under digital infrastructure.

Digital Tools

These were software or platforms, devices that work with text, images, audio, and video to enhance understanding of complex motor vehicle designs for purposes of troubleshooting. All software and digital devices that were used in this study, whether inbuilt in the car or customized form part of digital tools

Digital elements

These are norms of appropriate, responsible and empowered technology use. It is the behavior and good practice on digital tools use. Career identity and management for copyright of student's own academic work is an example.

Digital literacy integration

Using digital tools, digital skills, digital elements and digital infrastructure by trainers in the teaching of automotive engineering as a course.

Online Collaboration tools

Technology tools that used in the study by trainers in helping students work together to achieve a common goal or objective in automotive engineering. That is, email, workflow software, online workspaces, Skype, dropbox and Google docs. Tools used in this study for communication, storage and retrieval of automotive engineering content.

TVET

Technical vocational Education and Training. This is education and training which provides knowledge and technical skills for employment. Automotive engineering which was the focus of this study is one such skill in TVET. Study sampled trainers in both private and public TVET institutions in Bungoma County.

1.11 Organization of the Study

This study is organized into five chapters; Chapter one has the introduction to the study, followed problem statement, purpose of the study, objectives of the study and research questions. This is followed by significance of the study, limitations of the study, delimitations of the study and basic assumptions. Key terms come just before the organization of the study in that order.

The second chapter has the review of related literature from both primary and secondary sources in study objectives of digital tools, digital elements, digital infrastructure and digital elemental are discussed in relation to integration in automotive engineering. Theoretical and conceptual framework are discussed in this chapter.

Chapter three is research methodology. In this chapter, the study addresses the research design, target population, the sampling procedure and size, instruments, validity and reliability of collected data, procedure for data collection, data analysis and ethical concerns.

Chapter four presents the results, discusses results and interprets results from the investigation of integration of digital literacy in the teaching of automotive engineering in TVET institutions in Bungoma County

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

In this chapter, the study reviewed both primary and secondary sources that were relevant to this study as outlined in the objectives. Primary sources included writings about original researches conducted locally and internationally, scholarly research articles, case studies, and creative works. On the other hand, secondary data sources as Kothari (1990) observes, refers to the already existing data. Secondary sources in this research comprised online articles, videos, journals and textbooks touching on integration of digital literacy in teaching of automotive engineering in TVET institutions. It is important to note that digital literacy as a phenomenon came to fore from the year 2003 during the "Information Literacy Meeting of Experts" held in Prague, that led to the "Prague Declaration" (UNESCO,2003). This stressed the global importance of information literacy in the context of the "Information Society". In this regard therefore, the researcher mostly referred to studies and articles from that period through the year 2017 onwards. This chapter was divided into three sections of in-depth analysis of the themes outlined in the four research objectives, theoretical framework and conceptual framework.

As Gicharu (2018) rightly observes, "Vocational training used to enjoy pride of place in our education system. Then, education and economic policymakers clearly understood that technical graduates were the pillars of development." The study focused on a comparison of private and Public TVET institutions whose automotive engineering trainers and students identify with the value of embracing digital literacy in their learning and teaching. This would not just enhance efficiency in technical prowess of trainers but largely prepare graduates from both certificate and diploma levels of study in both private and public TVET institutions to mitigate challenges posed by the ever changing technological innovations in automobile industry.

2.2 Automotive Engineering in TVET institutions

Technical Vocational Education and Training is rapidly becoming an important part of modern-day education systems because of its focus on preparing its graduates for skills-oriented market economies. A study by UNESCO (2011) indicated that India has one of the largest technical manpower in the world. Because of high population in this Asian nation, most educated people largely remained unemployed and therefore this prompted the government to put greater emphasis and resources in vocational education. The number of automotive engineers that graduated at degree level was more than the diploma and certificate holders. This created an imbalance as more workforce was required at the lower level especially in areas like automotive engineering. Hence more polytechnics and technical training institutes were opened to bridge the gap. On the other hand, according to Hoffman (2015), Swiss TVET system is arguably the strongest in Europe because Switzerland is one of the several European countries with a so-called "dual" vocational education and training (VET) system in which students combine learning in school with learning in workplace settings.

At the dawn of the 21st century, vocational or career and technical education in both private and public TVET goes far beyond the specific technical knowledge and skills required for a particular occupation. Today, vocational education encompasses not only technical preparation but also sound academic foundations in digital literacy for an automotive engineering graduate from TVET to succeed in the competitive labour market (Wonacott, 2003).

Latchem (2017) believes that third world economies like Kenya should prioritize skills development through TVET because these institutions address many challenges that face individuals and communities by preparing their students for employment, decent work and sustainable employment through technical skills acquired in training.

Vocational training is therefore career oriented and traditionally non-academic which is why to determine competence in automotive engineering in this study, emphasis will be laid on practical activities in automotive engineering in TVET institutions workshops.

2.3 Integration of digital tools in teaching of automotive engineering

In this study, automotive engineering students were assessed according to their ability to find, evaluate and use digital information effectively, efficiently and ethically while applying that knowledge to diagnose, troubleshoot and repair modern computerised automobile systems. This was achieved by use of available digital tools in two categories of online collaborative tools and digital control systems as will be discussed in this chapter.

To access digital information, automotive engineering students used specialised digital tools to find digital information. American Library Association (2006) observes that digital tools are used to access (find), interpret (evaluate) and create (application or use) digital information.

Whyte, S. (2017) argues that digital tools are softwares and platforms. Automotive engineering students downloaded relevant software used in this study together with computers or mobile devices when they were working with audio to listen to recorded instructions to fix a mechanical issue in a car, videos for demonstrations and images for automobile designs. Digital tools for detection of electronic system failure and engine diagnostic tools were used by participants in the study. A key tool here was a digital torque adapter. According to Home Service Publications (2019), this is bolt tightening tool. It is used with a ratchet or breaker bar after setting a specified torque (twisting or rotation) and press a button to reach the set limit. This is a digital device that displayed a rising torque on the screen with the LED read out and a sound digital signal for alerts.

CT8002 Cordless Computer Safe Circuit Tester is described by Home service publication (2019) as a digital tool that probes electric flow within the car system. The tester is set to ring when it finds voltage or use the LED alert.

Additional digital tools used in the study as listed by mamagraphics blog (2019) included**;** Prezi,HaikuDeck,Animoto,Pixton,BoomWriter,Educreations,Glogster,Flipsnack,Padlet,Voice Thread,Quizlet,Socrative,Edmodo,choology,Piktochart and Visme. AutoCAD and Microsoft office The functions of these digital tools in automotive engineering include; sketching and technical drawing, animations, presentations, audio, video, tracking class progress, infographics, visual materials, template designs, access to resources and collaboration

This study was to identify not just these types of digital tools as used in teaching of automotive engineering workshop or class environment but most importantly, how efficient trainers use them to teach students to facilitate in understanding technical concepts.

2.3.1 Online Collaborative digital tools

Digital information literacy in this study also involved student's ability to create and use online collaborative tools. This study focused on online collaborative tools (software) that allow automotive engineering trainers and students to get their group work tasks accomplished whether the teams are in the same physical location or not.

A strong teamwork foundation according to Kashyap (2019) can be built by using online collaborative tools to enhance productivity, efficiency in automotive engineering.

Working on car designs, troubleshooting or repair of a complex mechanical problem on a car required collective effort. This therefore demanded that teams collaborate through various aspects to find technical solutions to technical problems in automobiles. Key aspect here is collaboration through communication. Student teams could be working on a prototype within or outside their institution which required them to share real-time data by use of online services regardless of their physical location. Collaborative tools were used according to their functional aspects as follows;

Design Collaborative tools*;* these are what Kashyap (2019) calls "powerful product design collaboration tools for designers and engineers**"** MockplusiDoc is one such tool that automotive engineering students use to connect the car design workflow and automate design handoff. Designs

are imported from sketches of Photoshop with proper specifications into MockplusiDoc for automation and eventually create animated prototypes to ease design collaboration.

Communication collaborative tools; Communication software for video and audio calls. Students benefited from online presentations from peers in the discipline who were not available physically through screen sharing using collaboration tools and File sharing tools like Google docs and SkyDrive for storage sharing and retrieval.

2.3.2 Digital control systems

Digital information literacy involved automotive engineering trainers demonstrating to students how to access and interpret data related to digital control systems in modern cars. It is worth noting that modern cars are fitted with computerized systems complete with the customized software that required interpretation of data displayed through alerts.

Digital control systems therefore as pointed out by Wojdyla (2012), are various computers called Electronic Control Units (ECU) throughout the car as a unit and therefore a modern day car is basically a computer network. This was previously called an electronic system but now the mission has moved from merely moving dump electrons to using sensors whose signals are picked up by the computer system (ECU), which obtains signals from car sensors. To be precise, computers and sensors form a collective muscle that is digital control system.

That car digital system makes the car more "intelligent" is qualified by the fact that computers, sensors and switches are wired together to detect car system variables through signals Wojdyla (2012). Sensors report for instance when the door is open or closed so that when the user pushes the button, the signal from the switch is broadcast on the network through computer protocols and the same can be visible on the LED on the dashboard to alert the driver. Automotive engineering students in the study were expected to have a basic understanding of the LED displays that send alerts so the dashboards for ease of interpretation and analysis as a form of diagnosis. The study

sampled the navigation systems available with a view to identifying their robustness, accuracy and reliability by use of GPS.

2.4 Digital infrastructure in TVET

Digital literacy required the automotive engineering student in the study to find and utilize information obtained through available digital infrastructure.

"Digital infrastructure are foundational services that are necessary to the information technology capabilities of a nation, region, city or organization (Spacey, 2017).

A report on digital infrastructure released by KPMG (2014), an Indian audit company, predicted the exponential growth of all things internet as most organizations are destined to be digital by default. Therefore, third world countries like Kenya need to prepare through institutions of learning like TVET for this growth by ensuring that there is strong digital infrastructure as a foundation for digital world.

This study endeavored to find out if the requisite digital infrastructure does exist to facilitate integration of online resources in teaching of automotive engineering. The study relied on the following types of digital infrastructure as highlighted by Spacey (2017). Fixed Broadband, Network infrastructure, datacenters, cloud computing, customized platforms and systems and end user digital devices that included smartphones (personal digital assistants), desktops and laptops.

2.5 Digital literacy skills in TVET

An automotive engineering students in booth public and private TVET institutions in this study had to demonstrate a variety of digital literacy skills taught by their trainers at both certificate and diploma levels as espoused by Levy (2018) as follows**;** *Functional Skills,* where automotive engineering students had enough grounding in emerging digital technologies to be able to efficiently navigate them during the study. Can a student confidently use a laptop, desktop computer or a smart phone? *Search Skills,* where automotive engineering students, after being taught, could comfortably navigate search engines in order to return relevant, respectable and safe results that represented a

broad range of viewpoints on automotive engineering selected topics. *Evaluating online Sources**,*** student to have been taught on authenticity of authors, reputable and trustworthy websites for required automotive engineering skills. A site that has automotive engineering articles from a renowned engineer or from a world-famous institution for that discipline will be more trusted and considered resourceful. *Critical Thinking**,*** where an automotive engineering student needed to have been trained to critically think of digital tools to use for effective outcomes in their practical sessions. This comes down to digital tools that can be selected by the trainer. *Creativity,* was about automotive engineering student's deeper understanding of digital tools for creative automotive engineering projects. Would they use animations, drawings or virtual reality for demonstrations during workshop practicals? *Communication**,*** was critical for automotive engineering students taught to exchange subject information on appropriate digital technology platforms available that depended on the TVET institution's ability to install the same. This was achieved through emails, chats and network shares.

Online Safety where habits had to be tamed. Automotive engineering student in the study was to be taught to be cautious of malicious content and safety of digital tools at play.

Flexibility enabled automotive engineering students to adapt to ever changing technologies and accordingly adjusted with minimal losses to data. *Knowledge of Chat Platforms* for talking to automotive engineering experts in the same profession around the world. *Knowledge of PLNPlatforms **(**Personal Learning Network**)*** for students like how to navigate twitter platform and stay abreast with new technological innovations and various perspectives and huge amounts of information from around the globe touching on subject areas. C*ollaboration,* where automotive engineering students shared content, held webinars and online workshops through assortment of digital tools like Skype. Most importantly, *Understanding of Data* obtained online. Automotive engineering students needed to have knowledge on how to store and retrieve data for safety, sharing and future reference. Webwise (2017) lists other digital skills as *coding* for basic understanding of

webpage language of HTML, *cloud software* knowledge for document management of student research and term papers saved on mail and online drives like Google drive, Dropbox and SkyDrive. Automotive engineering students' use of *Microsoft Office* on Google docs for document editing and sharing is considered a digital literacy skill.

2.6 Application of digital literacy elements in TVET

Six elements that were put to use are supported by (MacAndrew, 2014).*Information literacy*, is one such element with which automotive engineering students used in the study to find, interpret, evaluate, manage and share information (According to American Library Association, 2006). This was possible where this information was searched from the internet. *Media Literacy* is an element where automotive engineering student in the study read creatively and produced academic and professional communication concerning their profession through a range of media. In communication and collaboration, engineering students learnt through research on digital networks while in *digital Scholarship*, they participated in academic and professional practices that entirely depended on digital systems. *Career identity and management* element was about copyright of own works, digital reputation and online identity particularly where learners generated own automotive engineering write-ups. Formal and informal *learning skills* was practiced in what MacAndrew (2014) calls "technology-rich environments" and lastly *ICT Literacy***,** where the automotive engineering students would adapt (familiarize), adopt (accept and approve) and use digital devices applications and services.

In this study, the trainer and student in automotive engineering was deemed to have embraced the above elements to be appreciated as being digitally literate.

2.9 Theoretical Framework

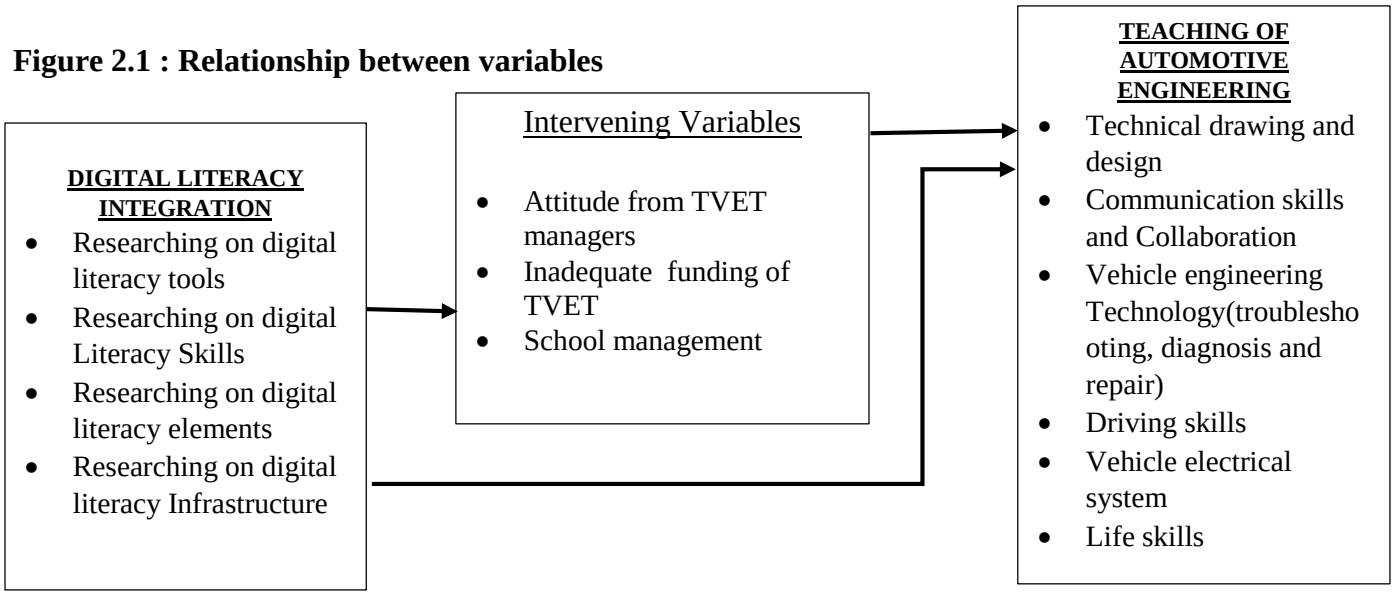
This study was guided by Technological Acceptance Model and Diffusion of Innovation Theory advanced by Fred Davis and Richard Bagozzi (1989) and E.M Rodgers (1995) respectively. Technological Acceptance Model elaborates how users receive new technology and its associated elements. How technology is accepted by end-users. Bagozzi et al (1989), contributed to this study with the view that when presented with new technology, which was digital literacy tools integration in automotive engineering, respondents were influenced by usefulness of the digital tools and ease of use in their practical sessions. The study also used diffusion of innovation theory which is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rodgers, 1995). That adoption of digital literacy concepts and eventual use by automotive engineering trainers and students in TVET would happen after going through several stages including understanding of digital literacy elements, persuasion by trainers on the value of information literacy, decisions reached on adopting digital literacy skills and finally put the skills into practice.

This study journeyed on both technology advancement model and diffusion of innovation theory as the researcher sought to explore how digital literacy had been adopted and explored by automotive engineering students in private and public TVET with a view to underscoring the value it would add to the graduates from these institutions. Van Joolingen (2004) looks at digital literacy in a learning setup as students' interests and their attitudes to appropriately use digital technology and communication tools to access, manage, integrate and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in society. It is with the above theories that the study findings found a contribution.

2.10 Conceptual Framework

The study presented a connection between the independent variable of digital literacy integration and dependent variable of teaching of automotive engineering in TVET institutions, this relationship is summarized in the diagram below.

Figure 2.1 : Relationship between variables



In *Figure 2.1,* the items in first part define the *independent variable* in the study which captures the key areas of interest in the study in which effective process of learning and mastery of skills in automotive engineering is dictated by trainers and students' possession of digital literacy skills, digital information literacy knowledge, availability of digital tools in the institution, effective use off online collaboration tools to store and retrieve data and TVETs ability to mount digital infrastructure to support the process of digitization of learning environment. In this aspect, digital literacy skills among trainers was a critical component in the study. Robinson (2010) notes that positive attitudes towards computers are positively correlated with trainers' extent of computer technology. Therefore the trainers' role in the research was paramount in delivering content in automotive engineering class using digital literacy tools and digital skills.

The middle section of *Figure 2.1* is intervening variables. These are factors that were not under study but they have an impact on the effect of digital literacy integration in teaching of automotive engineering in TVET institutions in Bungoma County. TVET managers in the ministry of

education do not capacity build trainers. Digital literacy not a priority. School administration is averse to technological innovations and resist change to traditional methods of teaching.

Third section of *Figure 2.1* is teaching in automotive engineering which was the researcher's dependent variable. Teaching in a class environment had observable outcomes determined by the researcher when all elements of digital literacy were incorporated in learning of automotive engineering. After data collection and analysis, the outcomes constituted findings from which the researcher drew conclusions and eventual recommendations.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

In this chapter, the study has addressed the research design, target population, the sampling procedure and size, research instruments their validity and their reliability of collected data, procedure for data collection, data analysis and ethical concerns.

3.2. Research Design

This study employed descriptive research design (descriptive survey) which is a type of quantitative design approach where the study sought to systematically measure or quantify the research problem at hand and expressing the output in form of statistical data or tables (Mugenda, 2003). Kerlinger (1969) notes that the key to descriptive research design is to describe the state of affairs as they exist.

The study was guided by descriptive research design in data collection. It focuses on observable situations. Findings from descriptive research design involve measurement, analysis, comparison and interpretation of the same data.

The study settled on descriptive research design because of the ease with which data was collected through a survey from respondents and compared through descriptive statistics in percentages and frequencies. Tendency to employ random sampling unlike purposeful sampling, here everyone has an independent chance of being selected. Study can generalize results.

3.3 Target population

The study targeted all TVET intuitions accredited by TVETA, all certificate and diploma students in private and public TVET institutions and all automotive engineering trainers for certificate and diploma levels of study in TVET institutions in Bungoma County, Kenya.

3.4 Sampling Procedure and Sample size.

Mugenda and Mugenda (2003), observes that is sampling necessary because the researcher cannot reach the entire population. That a sample size of 30-50% of the population is acceptable (Mugenda, 1999). Guided by this observation, the researcher settled on a sample of 50% for the total number of TVET institutions and their respective student population in Bungoma County. 50% of 7 institutions was 4 institutions in which three were public institutions and one private TVET.

The study started by using stratified random sampling to select 5 public and 2 private TVET institutions. Next step was sampling from public TVET institutions where 3 were randomly picked from 5 and 1 was randomly picked from 2 Private TVET to make a total sample of 4. This represented 50% as the representative sample for the entire population. Public institutions were labeled as A, B and C while private TVET as D respectively for the purposes of this study.

Institutions A.B, C and D had a combined engineering student population of 250. Additionally, all 60 automotive engineering trainers in both private and public institutions were targeted. 50% of the 60 were randomly sampled to remain with 30 respondents. 8 respondents from each of the three public TVET (adding to 24) and 6 from private TVET institution were purposefully picked to make (30) 50% of the population. All 30 questionnaires for trainers were duly filled and returned. It's important to note that for observation, the researcher went to classes where the data for both certificate and diploma was collected three times in class.

3.5. Research Instruments

The study used Instruments were questionnaire for trainers, questionnaire for students and, documentary analysis tool and observation schedule. These instruments were described in the following subsections; questionnaire for trainers and questionnaire for students respectively, documentary analysis tool administered on trainers and observation schedule administered on both students and trainers.

3.5.1. Questionnaire for students

This questionnaire had the following sections; section A is general questions/Biodata, section B is on Digital tools divided into online collaboration digital tools and digital control systems. Section C is digital infrastructure, section D is on Digital Literacy skills and section E on digital literacy elements. Students were required to respond to 122 items in the questionnaire.

The student questionnaire is in appendix II.

3.5.2. Questionnaire for trainers

The trainer questionnaire had five sections. A for general questions/Biodata, section B is on Digital tools divided into online collaboration digital tools and digital control systems. Section C is digital infrastructure, section D is on Digital Literacy skills and section E on digital literacy elements.

Trainers were required to respond to 88 items in the questionnaire.

The trainer questionnaire is available in appendix III

3.5.3 Documentary analysis tool

The documentary analysis tool was used in the study to analyze documents used by trainers in integration of digital literacy in teaching of automotive engineering. Analyzed documents were; syllabus, text books and students' progress reports, lesson plans, practical schedules, college master timetable, record of work, schemes of work, class attendance and lesson notes from trainers.

This gave the study a clear view of which areas in the syllabus needed to be integrated and strengthened by specific digital literacy skills to have better outcomes. This tool measured and provided feedback for automotive engineering student and trainer application of digital literacy elements and digital skills as objectives in the study.

Documentary analysis tool is in appendix IV.

3.5.4 Observation schedule for students and trainers

This instrument was used in the study to analyze the uptake of digital literacy tools among the trainers and students. The observation schedule was on a single page divided into two sections of observable activity and type of digital tool to be observed when students and trainers are in session.

The schedule was administered three times by the researcher on diploma and certificate students in class session when the trainer was teaching. A total of 26 digital tools were available to learners in class and the activities were varied depending on lessons. Activities included drawing and design, vehicle technology (troubleshooting), vehicle electrical system, communication/collaboration and life skills. The researcher used the tool to measure digital tools integration in learning of automotive engineering.

Observation schedule for students is in appendix V

3.5.5 Reliability.

The researcher undertook a pilot study in one of the public TVET institutions that was not part of the sample in Bungoma County by use of student questionnaire and trainer questionnaire, documentary analysis tool and observation schedule on trainers and students in automotive engineering to test the time it would take, size of the sample and data collection challenges that may affect instrument reliability. This helped the researcher identify inconsistencies in questions in the questionnaire and documentary analysis schedule elicited desired responses. Upon identifying anomalies in some questions, the researcher made corrections and further determined that the same instruments were appropriate for the study in terms of accuracy and reliability. Expert advice given by the supervisors in the study confirmed the reliability of the instruments.

3.5.6 Validity

The researcher undertook a pilot study in one of the public TVET institutions that was not part of the sample in Bungoma County by use of student questionnaire and trainer questionnaire, documentary analysis tool and observation schedule on trainers and students in automotive engineering to test the

time, sample size and any inconsistencies in objectives. The researcher made corrections and further determined that the same instruments were appropriate for the study in terms of accuracy and reliability. Expert advice given by the supervisors in the study confirmed the reliability of the instruments.

3.8 Procedure for data collection.

The researcher from the outset obtained necessary research permit from the National Commission for Science, Technology& Innovation (NACOSTI) whose requirements included the research proposal and reference from the University of Nairobi School of Education and External Studies. Authorization letters for this research were also obtained from County director of education, County Government and County Commissioner from Bungoma County respectively.

Upon getting clearance, the researcher in person distributed the questionnaires to the sampled automotive engineering students and their trainers in three public institutions and one private institution in the sample. This was facilitated by automotive engineering departmental heads who identified respondents in certificate and diploma levels of study.

The researcher timely distributed research instruments to students and trainers in one private and three public TVET institutions in Bungoma County, Kenya for both certificate and diploma level respondents institutions. The sample was 250 questionnaires, 66 for each of the three public and 52 to one private TVET institution respectively. Since they had similar set of questions, the questionnaires were distributed equally between 33 diploma and 33 certificate students in each of the three public institutions, 26 for diploma and 26 for certificate in private institutions. By way of introductory remarks, the researcher would give the introductory remarks and distribute the questionnaires to students in their respective classes with the help of engineering department trainers. A Similar procedure was followed for questionnaires for trainers in their departmental offices with 22 for public and 8 for private TVET institution. All the 30 representing 50% of the targeted sample of

60 questionnaires for trainers were filled and returned. Out of 250, 200 questionnaires for students were duly filled and returned representing 80% of the targeted student population in the sample.

Documentary analysis tool was administered to trainers by the researcher in their various departmental offices for one private and three public TVET institutions in Bungoma County. 30 copies of the documentary schedule were distributed and all duly filled and returned. The purpose of the research was well explained to trainers before filling. The trainers were the custodians of the documents listed in the documentary schedule.

Observation schedule was administered three times by the researcher on the two groups of certificate and diploma level trainers and students for both private and public TVET institutions for certificate and diploma levels on three separate occasions to ensure consistency in activities. This instrument would capture real-time activities in automotive engineering class when the trainer was in session.

3.9. Data Analysis

Data collected was collected through two questionnaires for students and questionnaires for trainers, documentary analysis tool and observation schedule. Questionnaires had serial numbers for accuracy and reference. Data derived from closed-ended questions was cleaned to generate categories and themes based on the four research questions. Data from open ended questions in the questionnaire was presented in narrative form consistent with the four objectives of the study. The data collected was analyzed based on the responses from the completed questionnaires from respondents.

The questionnaires were cleaned by removing those with incomplete blank spaces. Questionnaires were serialized for accuracy and consistency. Data was manually entered by the researcher into the data sheet view of SPSS version 21 after making necessary validations in variable view.

Questionnaires were grouped into six categories of students & trainers, Private & public TVET institutions and certificate & diploma levels of study respectively. The same was done to documentary analysis tool. Students responded to 122 items that had subsections named A1 –E14.9

respectively while trainers answered 88 questions A1- E17 as captured in SPSS variable view section. Documentary analysis tool data had 12 items serialized as A1-A12 as entered in the application. Questionnaire's YES/NO questions were represented by 1 or 2 while the Likert scale questions had 1-5 and open ended questions similarity of responses grouped and assigned 1-4 in data view respectively. In this format, data was manually captured for each item from all the 200 respondents which was important for descriptive statistics.

On the other hand, data from documentary analysis tool that constituted figures taken from report forms, automotive engineering syllabus, text books, students' progress reports, lesson plans, practical schedules, college master timetable, record of work, schemes of work, class attendance, and lesson notes was analyzed using descriptive statistics such as mean, mode, median, frequencies and percentages and presented using tables, pie charts and bar graphs.

Data from observation schedule that was collected on three occasions, depending on activities that the researcher observed, was categorized for trainers and students and divided in four to measure consistency of objectives of digital tools used in class, digital skills and digital infrastructure. This instrument measured how trainers integrated digital literacy tools in teaching and observation of how students used their digital tools in their lessons. Subsequently, the researcher would extract analyze data from 200 respondents consistent with the study objectives by use of the frequencies, percentages and total scores and present the same in tables, pie-charts and bar and column charts as analyzed results.

3.10. Ethical Concerns

Howe & Moses (1999) noted that informed consent is central in social research so that trainers and students in the study had to debate on the consequences and gains of participating in the study. In this study, the researcher informed the TVET institution's administration, trainers and students in the study about the objectives of the study and requested them to voluntarily participate in the same

without coercion. Anonymity was used to ensure confidentiality by asking respondents not to indicate their names on the questionnaires.

Information collected considered by the researcher that appeared sensitive was kept with confidentiality in respect of respondents' privacy. The researcher did not bribe or cheat participants to obtain data. Collection of own data by the researcher was a deliberate effort to avoid plagiarism.

CHAPTER FOUR

RESULTS, DISCUSSION AND INTERPRETATION

4.1 Introduction

This chapter presents the results, discusses and interprets these results. The results were to answer the following research questions of the study; digital tools types, digital infrastructure, digital skills and digital literacy integration in teaching and learning of automotive engineering in private and public TVET institutions in Bungoma County.

4.1.1 Distribution of respondents by type of TVET

The instruments were administered to respondents from the two types of TVET institutions, public and private. Returned instruments showed that public TVET had more enrollment in automotive engineering than private TVET. The summary of the findings is found in figure 4.1 and table 4.1 respectively.

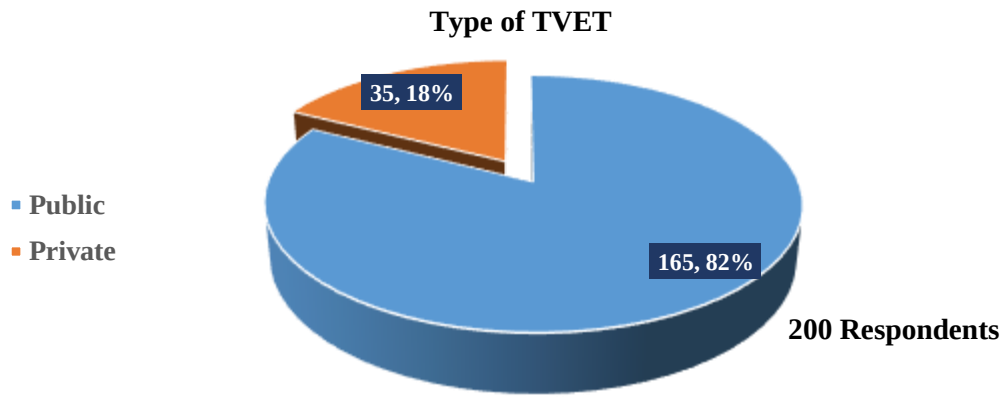


Figure 4.1 : Students distribution by type of TVET

Source: Research data

Figure 4.1 provides a view of students in the study by the two categories of public and private TVET institutions in which the researcher collected data. Public TVET posted the highest return on returned questionnaires at 165 representing 82% of respondents from public and 35 representing 18% of respondents from private TVET institution respectively. The high numbers of respondents

in public TVETs points to high enrollment rate because of government funding and subsidized fees particularly to engineering courses whose graduates have a high demand in Labour market.

Table 4.1 : Students distribution by type of TVET

TVET institution	Type of TVET	Frequency	Percent (%)
A	Public	70	35
B	Public	55	27.5
C	Public	40	20
D	Private	35	17.5
Total		**200**	**100**

Source: Research data

Table 4.1 public and private shows whether or not respondents' in both public and private TVET institutions type influences of digital literacy digital tools, elements, and infrastructure and digital skills in automotive engineering.

The table shows that institution A (public) attained the highest number of respondents as it had 70 (35%) study participants. Institution B (public) had 55(27.5%) respondents. Institution C (public) was represented by 40(20%) respondents, while institution D had (Private) 35 (17.5%) respectively. Institute A had the highest number of respondents because most learners had not left for attachment. This is also the oldest TVET institution in the region with the highest enrollment numbers in automotive engineering. Institute B and C posted low number of respondents because most students were on attachment coupled with their low enrollment numbers in the department. Institute C, a private institute located at the heart off town, posted the lowest because of the lowest enrollment in automotive engineering department totaling 35 represented 17.5 % of all automotive engineering students in the institution.

Out of 250 questionnaires distributed, 50 were either misplaced by students or never returned hence the final number of 200 representing 80% of distributed questionnaires.

4.1.2 Respondents by the categories of high schools attended before joining TVET

The respondents attended different types of schools before they joined TVET. The schools attended were categorized as private or public. The results of the respondents are summarized in table 4.2

Table 4.2 : Students distribution by High school attended

High School Type	Frequency	Percentage (%)
Public High School	173	86.5
Private High School	27	13.5
Total	**200**	**100**

Source: Research data

Table: 4.2 indicates that mores respondents who joined TVET from public high school 86.5% have a higher preference for automotive engineering as a technical course compared to their counterparts who joined from private high schools that represented 13.5% of respondents in the study. Most importantly, this variable was included by the researcher with the understanding that respondents who joined TVET institutions and enrolled for automotive engineering course from private high school could have a better entry level knowledge on digital literacy basic skills and have previously been taught how to use digital tools because of availability of developed digital infrastructure than their counterparts from public high schools. Further, students from private high school would find it much easier to integrate digital literacy in learning because of their entry behavior.

4.1.3 Respondents by the categories of age.

The respondents were categorized according to age that ranged between to 20 to 40 years. They were drawn from both public and private TVET in both certificate and diploma. The results of the respondents are summarized in table 4.3

Table 4.3 : Respondents by the categories of age

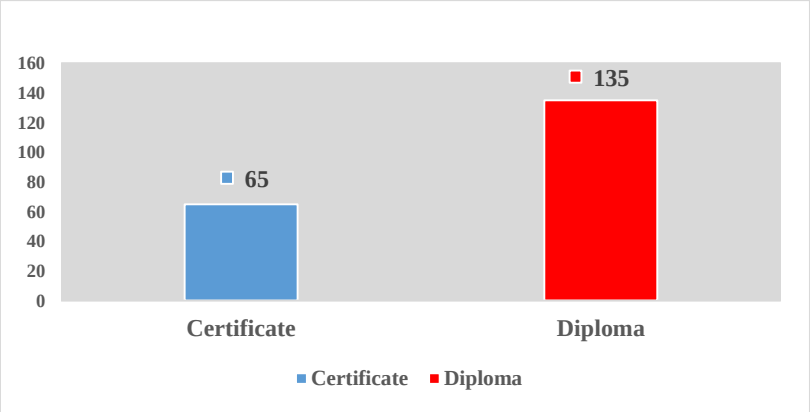
Age		Frequency		Percentage (%)
Range	Mid-x	F	fx	
20-25 Years	25	102	2550	51
26-30 Years	28	37	1036	18.5
31-35 Years	33	46	1518	23
36 - 40 Years	38	15	570	7.5
		200	**5674**	
		5674/200		
Average age		**28.37**		

Source: Research data

Table 4.3 indicates that most respondents in the study from public and private TVET institutions studying automotive engineering for both certificate and diploma were aged between 20-25 years at 102 representing 51%, between 26-30 Years representing 18.5 %, between 31-35 years representing 23% and 36-40 years and above representing 7.5% of respondents in the study respectively. The study included age variable in pursuit of its perceived influence on uptake of digital tools, digital skills digital elements and early exposure to digital infrastructure that would have an impact on digital literacy integration in automotive engineering course and eventual outcomes of the study. The dominant age of respondents was between 20-25 years (51%) this in the respondents responses, was attributed to the fact that most high school leavers at this age have been encouraged by their guardians to take up technical courses for future self-employment because of high demand in labour market and therefore perceived to embrace technological innovations more. This is indicated by the average age of 28 years from the findings median of 31 years.

4.1.4 Respondents by level of study in the TVET institution

The instruments were administered to respondents from the two levels of study, certificate and diploma. Returned instruments showed that TVET had more enrollment in diploma than certificate enrollment in automotive engineering. These results are shown in figure 4.2



200 Respondents

Figure 4.2 : Distribution of respondents by level of Study

Source: Research data

Figure 4.2 shows respondents in diploma level having the highest number of 135 representing 68% compared to 65 representing 32% from certificate. This variable was incorporated by the researcher to determine if level of respondents 'study in influences integration of digital literacy in automotive engineering course. The researcher included this variable to determine the level of study at which the uptake of digital literacy takes shape. At certificate, most respondents would be new to the environment and endeavor to learn new concepts while at diploma level the respondents were expected to have been taught by their trainers, acquired and using more digital literacy skills to better their performance in automotive engineering.

4.1.5 Respondents by Gender.

Respondents were categorized according to gender as either male or female. From retuned instruments, the number of male respondents was higher that their female counterparts. The summary of results is displayed in table 4.4.

Table 4.4 : Distribution by Gender

Respondent's Gender	Frequency	Percent (%)
Male	162	81
Female	38	19
Total	**200**	**100**

Source: research Data

Table 4.4 reflects respondents from both Public and private TVET institutions in certificate and diploma levels of study in automotive engineering who participated in the study by gender, Male respondents were most by 162 representing 81% and female by 38% representing 19% of the 200 respondents in the study. This was in pursuit of whether gender as a variable influences consumption of digital literacy by respondents. This findings show that male respondents take up automotive engineering course in TVET more that their female counterparts because of strenuous practical sessions and long hours in automotive workshops. Heavy machinery involved and clutter in workshops makes it less appealing for female students to enroll in the course.

4.2 Types of digital Literacy tools and their integration in automotive engineering in TVET

The respondents were categorized into trainers and students from public or private TVET institutions who were instructed to choose from for categories of digital tools; standard literacy tools, specialized simulation and testing tools, online collaboration tools and digital control system tools. Respondents use these digital tools in learning and teaching of automotive engineering in private and public TVET. The results are summarized in Figure 4.3, Figure 4.4 and Figure 4.5 respectively.

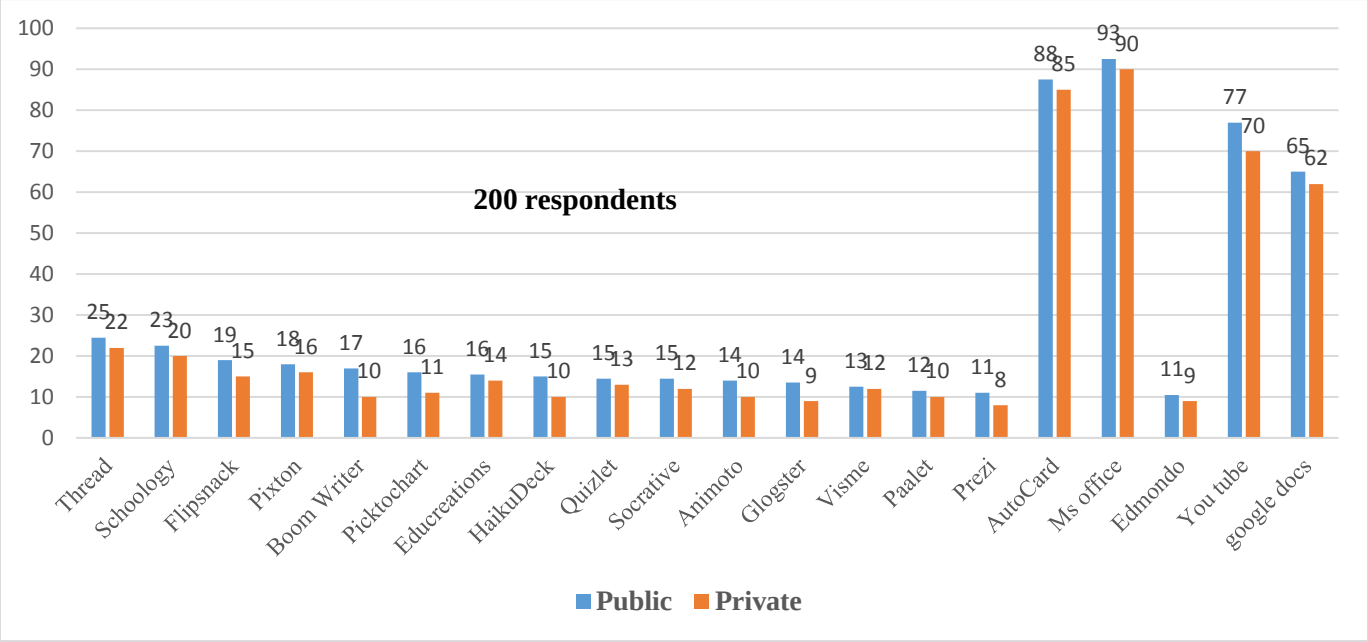


Figure 4.3 : Students uptake of standard digital tools

Source: Research data

Figure 4.3 displays responses from students from either public or private TVET .Respondents were instructed to choose the digital tools they were using in learning and teaching of automotive engineering. The study set out to find out the type of digital tools respondents have been taught to use. The Figure 4.3 displays standard digital tools used by respondents for animations, presentations, audio, video, infographics, visual materials, template designs, access to resource and collaboration in automotive engineering class. Respondents were instructed to pick the digital literacy tool they were taught to integrate in automotive engineering class.

The study findings in figure 4.3 found out that four tools out of 20 presented posted comparatively high return of positive responses in percentage of Ms Office 93%, AutoCard 88%, YouTube 77% and google Docs 65% for public TVET institutions respectively. For private TVET, Ms office 90%, AutoCard 85%, YouTube 70% and google Docs 62%. Therefore comparatively, students from Public TVET have a higher uptake on digital tools integration in automotive engineering than students from private TVET. Most integrated standard digital tools in learning of automotive engineering are AutoCAD, YouTube and Ms Office.

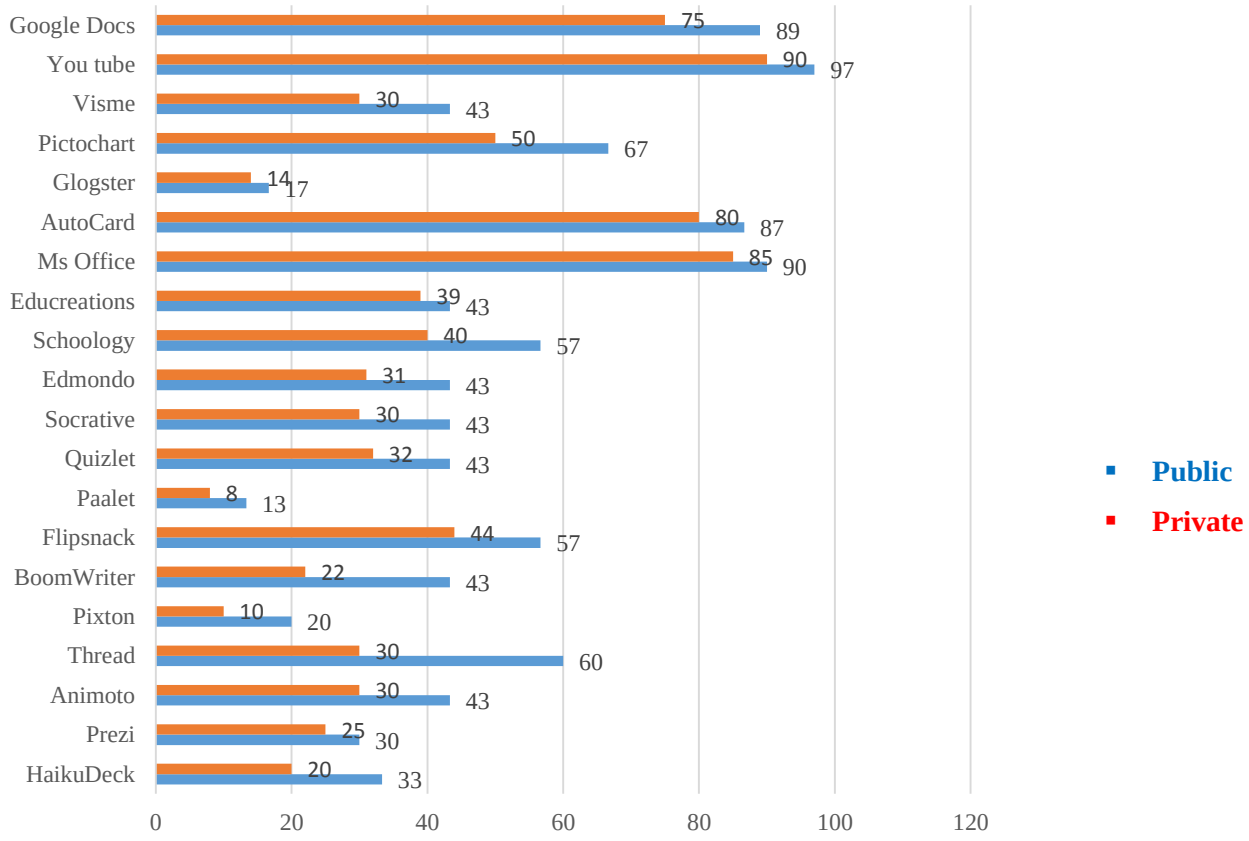


Figure 4.4 : Trainer uptake of standard digital literacy tools

Source: research data

Figure 4.4 is a display responses of public and Private TVET trainers' application of standard digital literacy tools with a direct comparison to students' responses in figure 4.3 on similar digital literacy tools. By so doing, the study endeavored to point out how digital literacy has been transferred from the trainer to the student by looking at tools understood and used by both sets of respondents. Ms Office 90%, AutoCard 86.7%, Picktochart 66.7% and thread at 60%, schoology 56.7% and Flipsnack 56.7% stand out as preferred by trainers. Ms Office 90% and AutoCard are most popular tools to both sets of respondents (trainers and students).

Therefore leading tools of AutoCard and Ms Office are integrated more by public TVET trainers that their counterparts in private TVET.

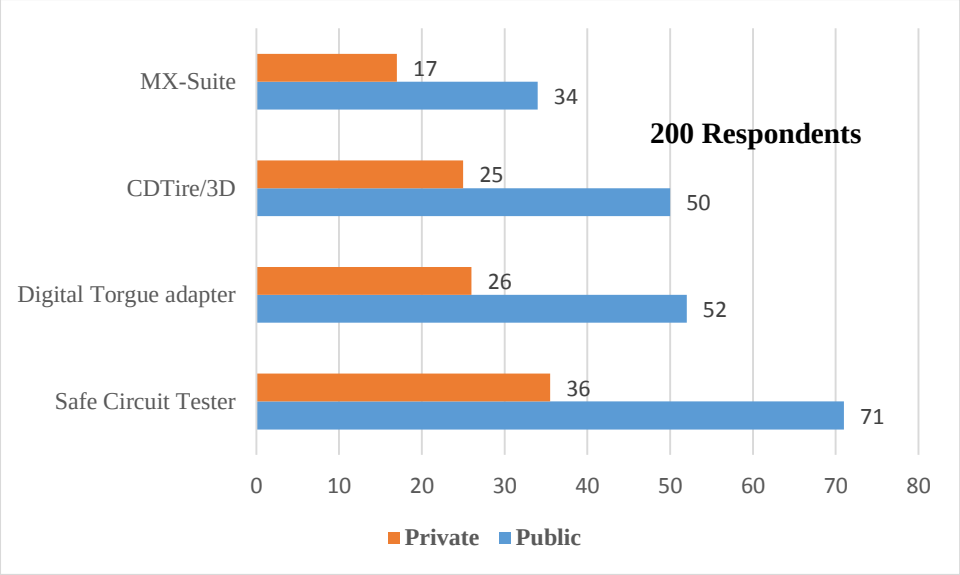


Figure 4.5 : Students use of specialized simulation/Testing digital tools

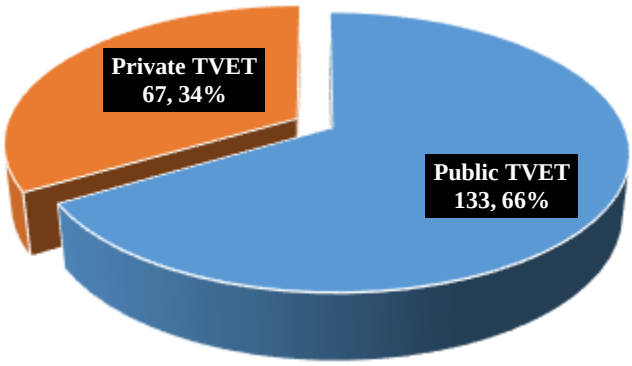
Source: Research data

Figure 4.5 according to the finding shows that Safe Circuit Tester digital tool with 71% positive responses is the most integrated digital simulation tool in automotive engineering by public TVET students against 36% from private TVET institutions

The findings indicate that unlike other digital tools in figure 4.4, testing and simulation tools in figure 4.5 are central to an automotive engineering student because they are expressly listed by class notes as supporting software to achieving lesson objectives in troubleshooting.

MX-Suite as integrated in automotive engineering by 34% students in public TVET and 17 % students in private TVET is the least used digital tool

Digital torgue adapter 52/26 %) and CDTire/3D 50/25% for public and private respectively. These troubleshooting tools are integrated more in automotive engineering by respondents from public TVETs than Private TVET students according to the findings.



200 Respondents

Figure 4.6 : Student response on online Collaboration for Public/Private

Source: Research data

Figure 4.6 shows that out of 200 respondents, 133 (66%) in Public TVET, students were found to have been taught by their trainers to share automotive engineering notes online through social media platforms like dropbox,GoogleDrive,OneDrive and email from their phones.

Respondents resolved to use the readily available gadgets not necessarily provided by the institution to compare notes and improve their productivity in practical sessions. These personal handsets do however have less capability to install resource intensive digital tools in figure 4.3 that this study set out to investigate. The above outcome compares to findings from a study by Doyle (2017). While carrying out a study Digital Literacy Tools Aid Young Readers Brooklyn USA, it was revealed that about 67% nationwide and 80% from low income kids were not proficient readers and therefore needed personalized learning and therefore incorporated digital tools and instantly found learning better. Doyle (2017). Further observed that digital tools were more effective compared to textbooks alone because kids enjoyed learning more and hard more target attention from the trainer. While this compares with this findings, this study differed in the type of responses returned because in Bungoma County, Public TVET institutions exceled by 66% in sharing online content and

collaboration than their private TVET counterparts at 34 % because of government laying fiber cable making internet readily available.

Table 4.5 : Trainers response on online collaboration tools

	Collaboration	S.disagree	Disagree	Neutral	Agree	S. Agree	Total
Public	Design	4	6	3	7	4	
	Communication	5	4	3	7	5	
	Documentation	3	6	5	2	8	
	File Sharing	4	5	5	2	8	
		16	**21**	**16**	**18**	**25**	**96**
Private	Design	1	0	2	3	0	
	Communication	2	0	1	2	1	
	Documentation	0	1	3	1	1	
	File Sharing	0	1	3	0	2	
		3	**2**	**9**	**6**	**4**	**24**

			Mean	Percentage %
Public	**303**	**303/96**	**3.16**	**63.13**
Private	**78**	**78/24**	**3.25**	**65.00**

Source: Research data

Table 4.5 presents trainers from public or private TVET who are trainers on how they responded on integrating collaboration digital tools in teaching of automotive engineering as TVET trainers for efficiency. Digital collaboration tools help the trainers to share, store and retrieve online automotive engineering content among between them and students. Collaboration tools were in categorized according to online use of design, communication, documentation and file sharing respectively.

Mean of more than 3 (3.16 & 3.25) indicate that trainers from private and private TVET teach with online collaboration digital tools but Private TVET trainers are heavy consumers with 65% than public TVET trainers with 63.13%.

File sharing and communication tools are popular for upload and download of automotive engineering class assignments. Email and google docs are the easily available tools for both public and private TVET students and trainers.

Table 4.6 : Students response on digital control system

		S.Disagree	Disagree	Neutral	Agree	S.Agree	Total
Public	System for onboard safety digital system control	2	9	19	15	11	56
	Ease of navigation configuration	1	7	8	3	6	25
	Speed management control system	6	4	6	7	5	28
	Fuel efficiency digital control system	3	5	5	11	4	28
	Engine optimization control system	3	9	10	5	4	31
Total		**15**	**34**	**48**	**41**	**30**	**168**
Private	System for onboard safety digital system control	2	1	0	2	1	6
	Ease of navigation configuration	2	4	0	2	1	9
	Speed management control system	1	2	1	1	1	6
	Fuel efficiency digital control system	2	1	0	3	2	8
	Engine optimization control system	1	4	0	1	1	7
		7	**9**	**1**	**9**	**6**	**32**

			Mean	Percentage %
Public	**541**	**524/164**	**3.22**	**64.4**
Private	**94**	**94/31**	**3.03**	**60.65**

Source: Research data

In table 4.6, the study sought to find out if respondents from private and public TVET were familiar with and could configure digital car control systems in automotive engineering sessions. The study

provided four dimensions of digital control systems of; onboard safety digital control system, configuration of car digital navigation system, fuel efficiency digital control system and engine optimization digital control system with which the respondents were instructed to agree/disagree with each of these statements based on a 5 point Likert-scale (that's 1= "Strongly Disagree", 2= "Disagree", 3= "Neutral", 4= "Agree" and 5= "Strongly Agree").

From the findings, a mean of more than 3 for both public and private TVET responses (3.22 & 3.03) indicate that trainers from private and private TVET integrate online collaboration digital tools in automotive engineering but unlike in online collaboration tools in table 4.5, more private TVET trainers integrate digital control systems in teaching of automotive engineering with 64.40% than private TVET trainers with 60.65%.

Because of lack of modern engineering equipment in the workshops that could vividly demonstrate how the aspects of control systems in a car work, students mostly rely on you tube videos to download simulation videos particularly on the engine optimization. Onboard safety digital control system, configuration of car digital navigation system and fuel efficiency digital efficiency tools are readily available in cars in TVET institutions for practical sessions by both trainers and students.

4.3 Digital infrastructure integration in automotive engineering in TVET institutions

Respondents were grouped according to public and private TVET institutions they came from and were required to confirm whether the listed digital infrastructure were available in their institutions and whether they had been taught by their trainers on how to use any or all of the available equipment in automotive engineering lessons. 5 items on digital infrastructure were presented to both trainers and students for response. A summary of the findings is found in figure 4.7, Table 4.8 and figure 4.9 respectively.

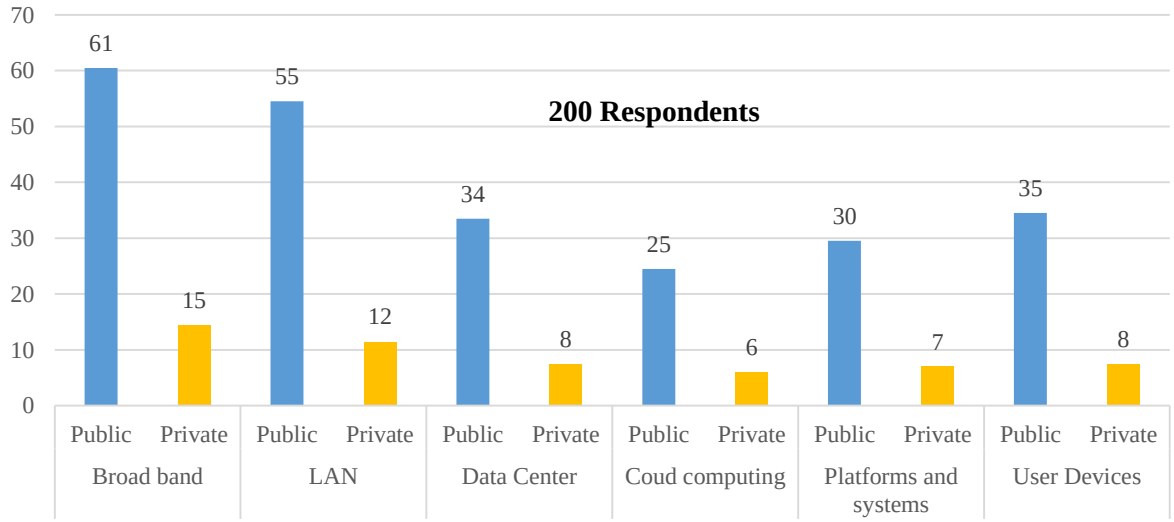


Figure 4.7 : Students' reponse to digital infrastructure in private or public TVET

Source: Research data

In figure 4.7, respondents were required to confirm whether the listed digital infrastructure were available in their institution and whether they had been taught by their trainers how use any or all of the available equipment in automotive engineering lessons. Infrastructure listed were fixed broadband/internet, network/Local area network, data centers, and cloud computing, platforms and systems and user devices.

Figure 4.7 displays respondents by type of institution either public or private TVET institutions.

From the findings, public TVET institutions posted the highest responses on availability of infrastructure. Broad band takes a lead with 61% of respondents confirming availability followed by LAN (Local area Network) at 55%. The study interpreted this result to mean that unlike private institutions, public TVETs sampled have installed Safaricom servers for broadband access. Broadband is typically supported by the LAN to supply internet to user devices in the institution. Respondents who confirmed availability of LAN 55% were unanimous that occasional availability of broad band 61% has enabled them view online automotive engineering vehicle control systems and vehicle engineering technologies is troubleshooting and automotive repair which has enormously impacted them positively in enhancing their efficiency. Complex vehicle electrical systems are similarly visible online and practiced by use of computer aided design tools on personal laptops which are in the category of user devices 34%. Documents can be uploaded and retrieved from the cloud (25%) by respondents who have personal user devices (35%) i.e. laptops and smartphones from their automotive engineering lessons.

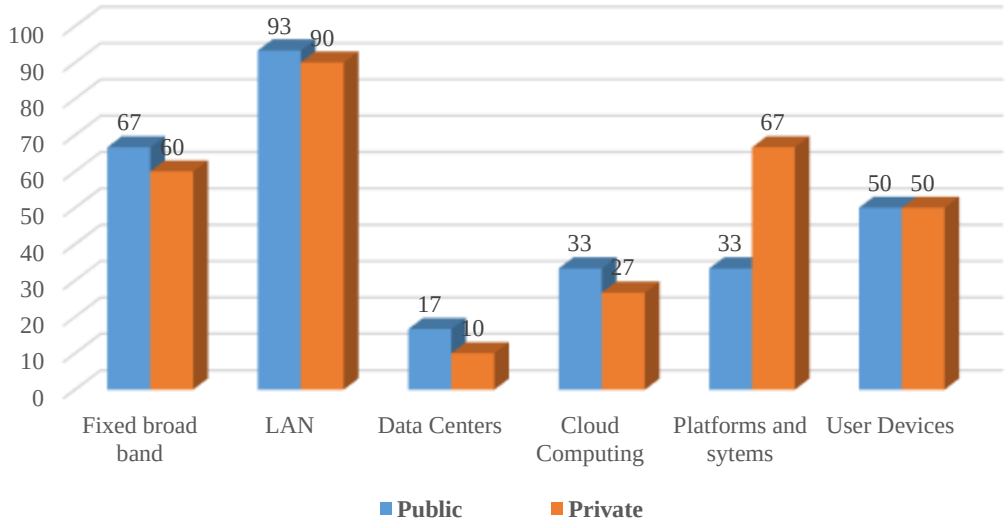


Figure 4.8 : Trainers' response on Digital infrastructure Use in Public and Private TVET

Source: Research data

Figure 4.8 displays the output of trainers' response to availability of digital infrastructure in their public and private institutions respectively. LAN (Local area network) posted 93% public and 90% in private. A clear indication that both sets of TVET have invested in laying network cables for LAN connectivity. Fixed broad with 67% from public and 60% from private institutions confirming availability shows presence of Wi-Fi for academic purposes is available but the institutions determine who uses it. Private TVET apparently have invested in platforms and systems (67%) used by automotive engineering departments compared to their public counterparts at 33%. Trainers in this study from private institutions teach using learning management systems for process and data management in automotive workshops. Both public and private institutions lack functional datacenters 17% public and 10% private. Trainers attribute this to the high cost of installing server equipment and trained support staff to run such facilities. User devises at 50% for both sets of trainers.

4.4 Digital Literacy Skills integration in teaching of automotive engineering in private and public TVET institutions

Respondents were categorized in according to their type of institution whether public or private TVET. Trainers and students were instructed to respond to the questions on the level of digital literacy skills they have and had applied integrated in the learning and teaching of automotive engineering respectively. A range of 13 digital literacy skills was presented. The summarized results are found in figure 4.9 and 4.10 respectively.

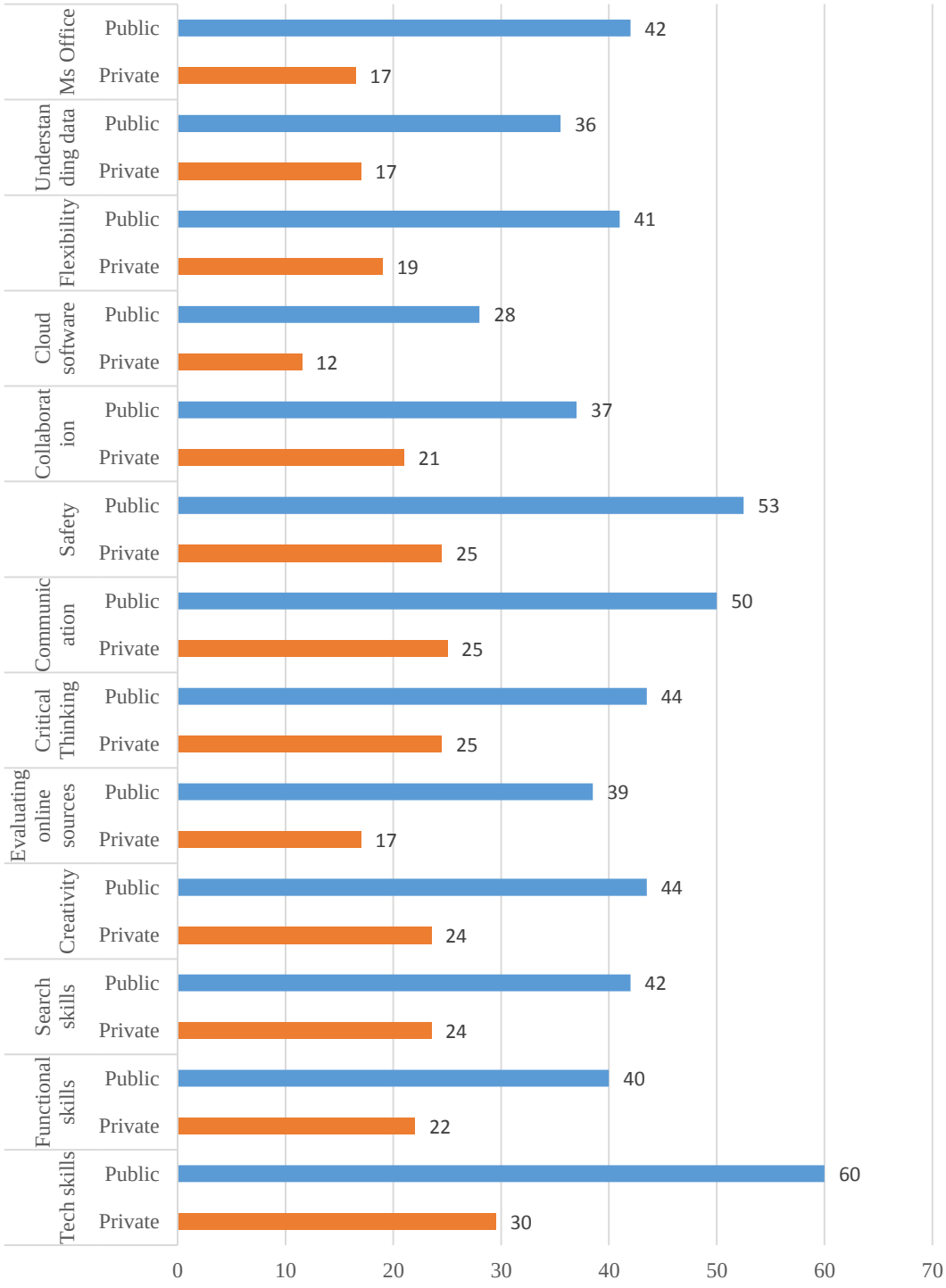


Figure 4.9 : Students' digital literacy skills level in Public and Private TVET institutions

Source: Research data

Figure 4.9 displays the output for digital literacy skills each respondent has been taught, possesses and uses the same to create, store and share information with other students and trainers in automotive engineering. Students were also requested to provide reasons for the skills they had no knowledge about.

Findings in figure 4.9 reveal that respondents in public TVET have the highest level of digital literacy skills with 60% technical skills,53% safety,50 % communication,44% creativity & critical thinking,42% Ms office & Search skills,41% flexibility,40% functional skills,39% online evaluation,37% collaboration and 36% understanding data. Therefore technical skills (60%), safety (53%) and communication (50%) digital literacy skills are skills that have been acquired by the highest number of public TVET students in the study.

Technical digital literacy skills are dictated by demands in the syllabus in module I where it is evident that respondents are introduced by their trainers to information communication and technology and basic engineering drawing/design where they use AutoCard and Ms Office as digital tools (see figure 4.4) to design vehicle electrical systems and workshop technology.

Therefore this finding shows that public TVET students integrate more digital literacy skills than their private TVET counterparts from the following results in figure 4.9 Safety; public 53% against 25% private, technical skills public 60% against private 30% and communication skills public 50% against 25% private

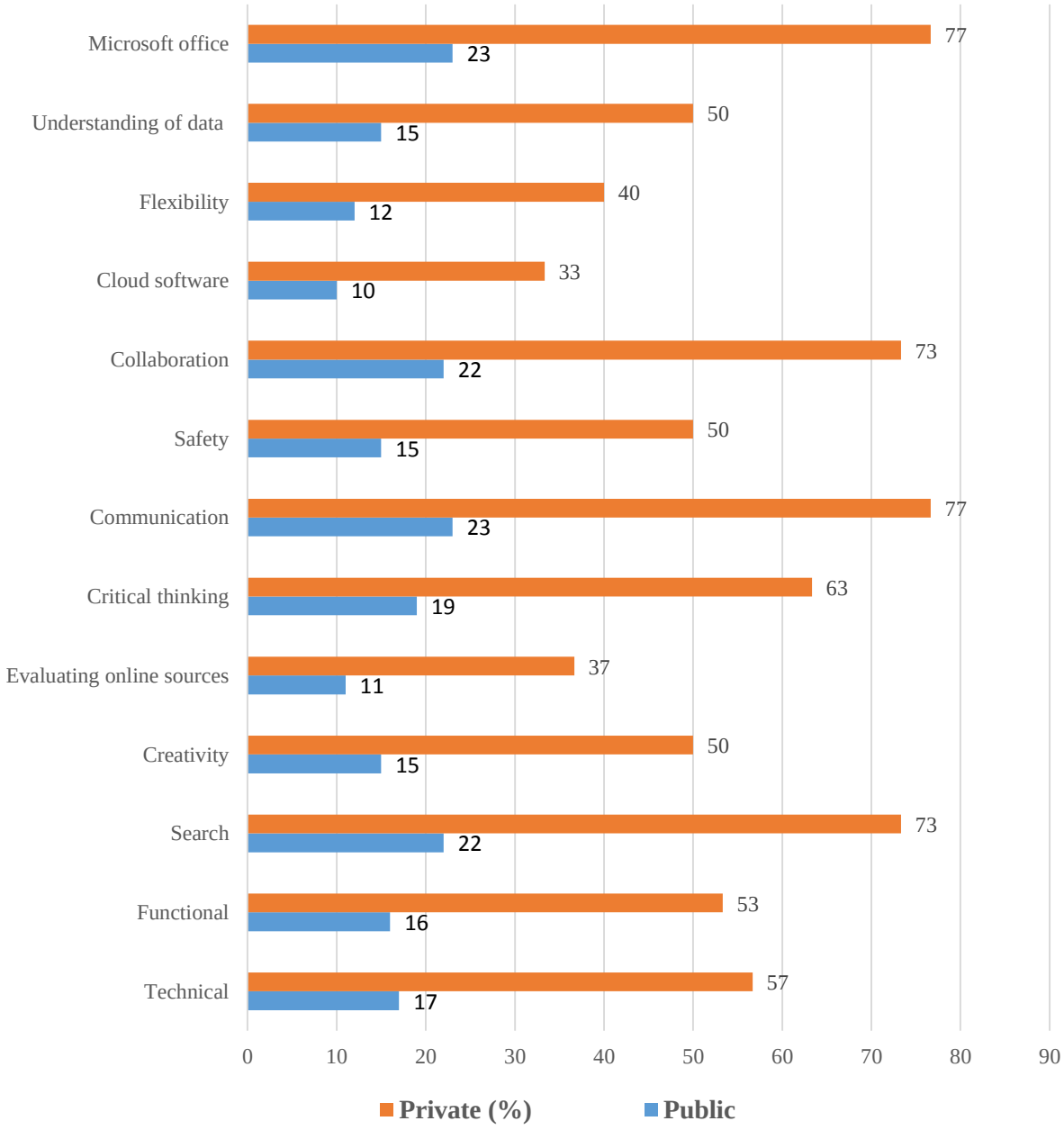


Figure 4.10 : Trainers' Digital Literacy skills in Public and Private TVET

Source: Research data

Figure 4.10 presents the level of digital skills for both public and private trainers in TVET. The study was of the view that trainers' skills would be passed over to students and help in automotive engineering lessons. Findings display impressive digital skills level that trainers possess and pass on to automotive engineering student through teaching.

From the findings, trainers in public TVET integrate more the following skills in teaching of automotive engineering than trainers from private TVET; these digital skis in figure 4.10 skills are Ms office & communication at 77%, search and collaboration at 73%, critical thinking 63%, technical skills 57%, understanding of data, safety & creativity at 50% respectively to close the top 10 out of 13 skills asked. This implies that public TVET trainers are efficient in 77% (10 out of 13 tools polled) of basic digital skills to safely navigate any technology environment in automotive. It's interesting to note that Ms Office and communication are skills owned by the highest number of trainers at 77% which essentially means they prepare documents for class notes, draw designs, store and analyze statistical data for students and teach using PowerPoint slide in automotive engineering. Communication digital skill has enabled them to share both audio and video content online using applications like Skype and social media applications that include; Facebook and WhatsApp to pass information (Basri et al, 2018). Trainers search for information frequently, communicate with students online and utilize Microsoft office digital literacy skills to pass automotive engineering content to their audiences for better outcomes.

4.5 Integration of digital literacy elements in teaching of automotive engineering in Public and Private TVET

Respondents were categorized as students and trainers from public and private TVET that were instructed to select statements that best describe whether they have taught or learnt to practice each of the digital literacy elements in their automotive engineering lessons. Trainer from both public and private TVET responded to questions that covered preparing students in examinable areas of integrating digital literacy elements in automotive engineering

The findings are summarized in figure 4.11 for students and 4.12 for trainers.

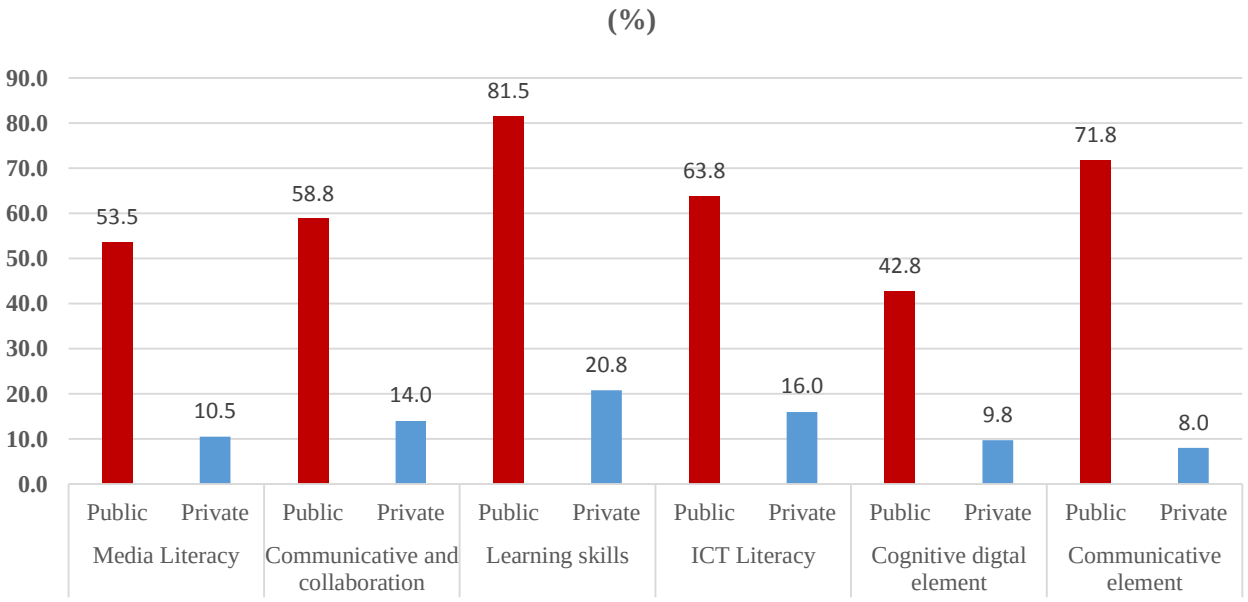


Figure 4.11 : Student Responses on digital elements integration

Source: Research data

Figure 4.11 indicates respondents who agreed to using digital literacy elements as shown on the X axis. The study presented 6 dimensions to which the respondents were instructed to agree/disagree with each of these statements based on a 5 point Likert-scale. Findings in figure 4.11 reveal that public TVET respondents posted more positive results than their Private TVET counterparts indicating that they have been taught by their trainers and subsequently applied digital literacy elements in their automotive engineering.

This is evident in the following output of selected three Digital literacy for Public TVET respondents as distributed in figure 4.11; 85.5% Learning Skills, 71.8% communicative element and 63.8% on ICT literacy respectively. Female respondents had 20.8%, 8.0% and 16.0% for similar elements comparatively.

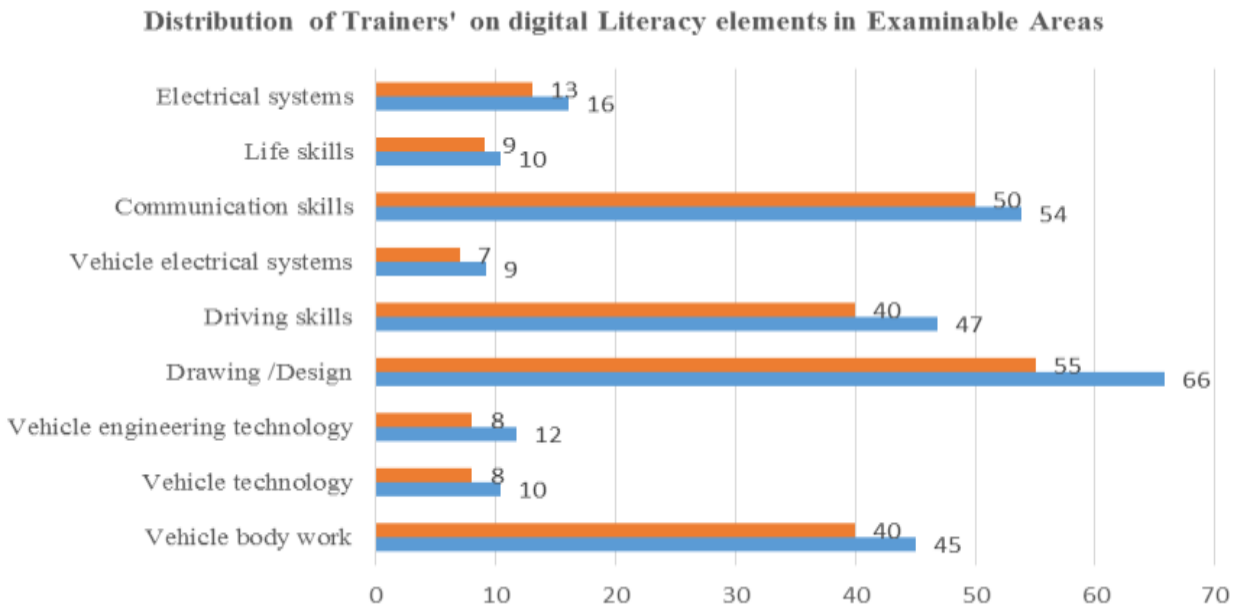


Figure 4.12 : Trainers' response on digital literacy elements in examinable areas in TVET

Source: Research data

Findings in figure 4.12 show that trainers in public TVET institutions lead in integrating digital elements in the following examinable areas; drawing and design 66%, communication skills 54%, vehicle body work 45% verses trainers in private TVET in the same areas at drawing and design 55%, communication skills 50% and vehicle body work 40% respectively. Digital literacy elements that were integrated in examinable areas by trainers are in figure 4.11.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the discussion of the research findings in chapter four of this research project as well as the general conclusions in relation to the objectives of this study and recommendations for further research. By presenting the findings of this study, the researcher has endeavored to answer the four research questions in chapter one that were derived from the four objectives that include; type of digital tools, digital infrastructure, digital literacy skills and digital elements integration in the teaching of automotive engineering in TVET institutions in Bungoma County Kenya.

5.2 Summary and conclusions

This section summarizes demographic profiles of respondents in the study. The discussion then delves into the summary of findings in chapter four. The researcher makes conclusions to each of the four research questions that were generated from research objectives in chapter one of this study. From analysis and interpretations in chapter four, the conclusions will be presented as types of digital tools that are integrated in teaching of automotive engineering, whether digital infrastructure is integrated in the teaching of automotive engineering, digital literacy skills that are integrated in automotive engineering and digital literacy elements that are integrated in teaching of automotive engineering in TVET institutions in Bungoma county Kenya.

5.2.1 General demographic characteristic of respondents

From the study sample, 165 represented 82% of respondents from public TVET institutions and 35 represented 18% of respondents from private TVET institution respectively. The study concluded that high numbers of respondents in public TVET corresponded to high enrollment rate because of government funding and subsidized fees particularly to automotive engineering course. The high demand in enrollment in automotive engineering course in Public TVET institutions is also

attributed to the need for graduates with technical skills in the labour market. Low enrollment numbers in TVET institutions are attributed to relying of funds from student fees and well-wishers. This source of revenue is not reliable for huge infrastructural investment for digital equipment to support integration of digital literacy in automotive engineering.

The study revealed that average age of respondents from both public and private TVET institutions in Bungoma County is 28 years (table 4.3). This had a huge influence on the integration of digital literacy in automotive engineering because these students are digital media enthusiast with access to personal handheld digital in fracture devices like smartphones and laptops for streaming online content that enhances collaboration and communication.

5.2.2 Types of digital tools integrated in automotive engineering in TVET institutions

The findings (see figure 4.3, 4.4, 4.5 and table 4.5) revealed that an average of 53.7% of 200 automotive students in the study from both private and public TVET have been taught to integrate digital tools in automotive engineering lessons. This is a relatively low uptake of technology.

Findings revealed that (Fig 4.6) public TVET at 66% are taught using digital tools than their Private TVET at 34% particularly on collaborative tools where they upload automotive engineering online using collaborative digital tools. Public TVET institutions have more elaborate digital infrastructure because of government support. This is concluded to mean that public TVET have more developed digital infrastructure laid by national government that enables access to internet making it easy to integrate digital tools in automotive engineering.

Top on the list of digital tools integration for students (see table 4.3) are AutoCard for drawing/design and Ms Office suite at 88% and 93% respectively starting in module II of diploma level of study. YouTube and google docs at 77% and 65% respectively. Trainers in public TVET integrate AutoCard 86.7% and Ms Office 90% respectively .In simulation and testing, safe circuit tester digital tool at 37 % and digital torgue adapter 26% respectively.

These simulation digital tools are used by respondents to improve their efficiency in vehicle engineering technology of troubleshooting, diagnosis and repair while simulation videos in CDTire/3D 25% have sharpened their driving skills.

Therefore popular digital tools integrated by both private and public TVET students are Ms Office and AutoCard which are traditional tools prescribed in the TVET syllabus so respondents are reluctant to venture into new technologies.

These findings are similar to a study carried out by G.W Kinyua (2017) on *Computer based instruction and gender effect on learners' performance in Art and Design in public secondary schools in Kenya.* The study found out that because of lack of modern digital tools and low level of computer literacy among Art and design trainers, learner instruction was largely executed through traditional methods. On the contrary, this study has concluded that TVET institutions are gradually embracing use of digital tools, skills and digital infrastructure in teaching because the automotive engineering curriculum demands so through use of AutoCard and Ms Office as a mandatory digital tools.

5.2.3 Digital infrastructure integration in teaching of automotive engineering in TVET

From the findings in fig 4.8, public TVET institutions have high integration level of digital infrastructure in teaching of automotive engineering than private TVET. LAN takes a lead with 93 % followed by both platforms/systems at 67%. Both Public and private institution trainers have the same level of integration for user devises. Students in public TVET agree to integration of LAN at 55%, broadband at 61% and user devises at 35%.

The study concluded that unlike private institutions public TVET sampled have installed Safaricom servers for broadband access. Broadband is typically supported by the LAN to supply internet to user devices in the institution. Therefore both private and public institutions have functional LANs, user devises that support digital integration. Only public TVET have embraced broadband and learning platforms. Data centers are nonexistent for both public and private TVET institutions.

5.2.4 Digital literacy skills integration in teaching of automotive engineering in TVET

The study came to a conclusion that digital literacy skills are gradually acquired for the duration a student takes at the TVET institution. At diploma level of study for instance, technical digital literacy skills at 57%, communication 77%, search at 73% and collaboration at 73% are dictated by demands in automotive engineering syllabus. It is was evident in the study that respondents are introduced by their trainers to information communication and technology and basic automotive engineering at certificate level module I of automotive engineering and gains momentum at diploma level where communication digital literacy skill is enhanced

Online Search digital literacy skills and Ms Office digital literacy skills coupled with critical thinking have largely enhanced respondents understanding of technical and more complex automotive engineering jargon making them efficient in theory and practical sessions. Digital literacy skills as trainers confirmed (see figure 4.10)with Ms office skills at 77% and search skills at 73%, enhances students communication skills and collaboration through digital media and sharing, storage and retrieval of automotive engineering content for class use.

The study concluded that the more time a respondent stays in the TVET institution the higher the need to use digital literacy and therefore more skills are acquired through personal effort hence the high number of diploma respondents with digital literacy skills that are useful in automotive engineering. Additionally, at artisan level which is entry to certificate programmes, students have little exposure to modern technologies that they interact with in the institution for the first time. Diploma students in public TVET in automotive engineering integrate digital literacy skills to excel in their technical assignments than those in privet TVET at 57% versus 17% for private respectively Both sets of trainers from private and public TVET had similar levels of skill set in use of Ms Office, communication and technical skills because of their similar experiences in using the standard syllabus of automotive engineering.

5.2.5 Digital literacy elements integration in teaching of automotive engineering in TVET

The study concluded that a huge gap for public and private TVET integration on communicative digital literacy element 71.8% Public and 8.0% Private is because Public TVET institution students have made a deliberate effort to learn through research from digital networks with available infrastructure in TVET. Disparities in the uptake of digital elements in this study compares to Kinyua (2017) findings on Computer based instruction and gender effect on learners' performance in Art and Design in public secondary schools in Kenya, where she holds the view that differences may be as a result of varied individual and personal abilities by individual students. Similarly, Private TVET institutions respondents may lack the individual drive, desire and passion to learn and adapt new technologies and use the same in automotive engineering.

Findings have shown that learning digital element skills 81.5% (see figure 4.11 and 4.12) are embraced by students from public TVET institutions than their Private TVET counterparts. Students from public TVET acquired learning skills digital element more steadily after being taught than students from Private TVET. This enables them to navigate through what MacAndrew (2014) calls "technology-rich environments". This is compounded by curiosity to learn, experience and practice on new skills with new technologies. Communicative digital literacy element 71.8% ICT literacy digital literacy element 63.8% and Communication and collaboration 58.8% have tremendously assisted respondents from both public TVET and private TVET in adapting and adopting usage of digital devices, applications and services in automotive engineering environment with specific mention of computer Aided designs in Module III at diploma level.

Learning and communicative digital literacy elements are the most sought and taught by trainers from both private and public TVET because both elements involve basic knowledge of operating personal laptops with Microsoft office that require less effort and basic level of digital literacy skills which respondents have exploited in advancing communication and technology unit in module I of automotive engineering.

5.3 Recommendations.

First, a researcher could go further and carry out a study on effect of digital literacy tools in civil, mechanical or electrical or any other areas of their choice at the university level while making a comparison between public and private institutions.

Secondly, a similar study on digital literacy skills effectiveness in other disciplines could be done. In both recommended studies above, the researcher could retain the objectives and research questions while altering the focus on variables.

Further to this, while doing a research on digital literacy, the researcher has to be careful not to interpret digital literacy to mean IT (Information Technology) because the former is about the end user of the technology while the latter is about the architecture behind the technology or a focus on the machines, the hardware, and the code that enables these machines to be controlled effectively.

Thirdly, the ministry of education, science and technology should invest in upgrading of digital infrastructure in TVET institution to meet the demands of rapidly changing technological innovations

Fourth, relevant government ministries should invest in capacity building for TVET institution trainers and bring them up to speed with new technologies on digital platforms to enhance their effectiveness in integrating digital literacy in the teaching of automotive engineering.

Fifth, the drafters of the automotive engineering curriculum should consider a review to enrich the document with modern digital tools, elements and skills that will be beneficial to both students and their trainers in class.

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APPENDICES

APPENDIX 1: RESEARCH QUESTIONNAIRE COVERING LETTER

Dear Respondent,

I am Maurice Wekesa Chonge, a final year student pursuing a Master of Educational Technology degree in the School of Education and External Studies, University of Nairobi. I am currently undertaking a research entitled;

'Investigating integration of digital literacy in teaching of automotive engineering TVET institutions in Bungoma County, Kenya.'

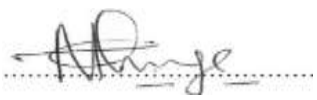
I have recruited you into this study because as a student in automotive engineering, you have important information that can help me accomplish this research.

In the context of this research, the term '**Digital Literacy'** is your ability as an automotive engineering student to use information and communication technologies to find, evaluate, create, store, retrieve and communicate digital content to enhance your technical skills in your practical sessions in workshops. This will be useful in solving complex problems in modern automotive engineering innovations and technologies.

Kindly assist me by completing this questionnaire. The questionnaire will take you 10-30 minutes to complete. Any information provided will be confidential and will be used purely for academic purposes. Your duly filled questionnaire should be handed to your class trainer.

If you have any questions regarding this questionnaire please contact the undersigned.

Name of researcher : Maurice Wekesa Chonge
Mobile phone : 0722941607
Email : wekesamc@gmail.com
Reg No. : E60/90011/2016

Sign : 

APPENDIX II. RESEARCH QUESTIONNAIRE FOR STUDENTS

Dear respondent, the questionnaire has five sections of A.B.C.D.E each section captures each of the four objectives of this study

SECTION A: GENERAL QUESTIONS

a) What is your age in years?

20-25 years ☐ 26-30 years ☐ 31-35 years ☐ 36- 40years ☐

b) What is your gender?

Male ☐ Female ☐

c) Which level of study are in?

Certificate ☐ Diploma ☐

d) Which type of high school did you attend before joining this Technical Training Institute?

Public high school ☐ Private High School ☐

e) Which type of Technical Training Institute are you in?

Public ☐ Private ☐

f) What's your general assessment about digital literacy as an automotive engineering student in this institution?

Please tick in the appropriate box (√) that represents your response or fill in the blanks with the appropriate ***(Indicate your response based on the following scale: 1= strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=strongly agree)***

	Statement	Response				
		1	2	3	4	5
i	Digital literacy tools have influenced my deeper understanding of automotive engineering concepts.					
ii	Digital Literacy skills facilitate my access to information and navigate Intricate digital environments in search of information					
iii	Availability of digital infrastructure in this institution has made it easy to engage online, retrieve and store information as an automotive engineering student					
iv	Digital literacy elements have broadened my knowledge of online privacy and security while enabling me to choose and apply the right content.					

SECTION B: DIGITAL TOOLS

I. Digital tools

1. Are you taught in using of these digital tools for the following functions; animations, presentations, audio, video, tracking class progress, infographics, visual materials, template designs, access to resources and collaboration?

Digital tool	Response			Digital tool	Response	
	Yes	No			Yes	No
HaikuDeck				Flipsnack		
Prezi				Paalet		
Animoto				Quizlet		
Thread				Socrative		
Pixton				Edmodo		
BoomWriter				Schoology		
Educreations				Piktochart		
Glogster				Visme		
You Tube				Google Docs		
Ms Office						

2. Do you use this digital testing and simulation tool in your automotive engineering workshop

-Digital Torgue adapter Yes ☐ No ☐ Safe Circuit Tester Yes ☐ No ☐

-CDTire/3D Yes ☐ No ☐ Mx-Suite Yes ☐ No ☐

II. Online Collaboration digital Tools

3. Does your trainer share with you automotive engineering content online ?

Yes ☐ No ☐

4. Collaboration involves sharing, storing and retrieving online content for academic use with your peers. Indicate if collaboration tool has been useful in your learning.

Indicate your response based on the following scale: 1= strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=strongly agree)

	Statement	Response				
		1	2	3	4	5
1	Design Collaborative tools					
2	Communication collaborative tools					
3	Documentation collaborative tools					
4	File sharing tools					

III. Digital control systems

5. Which area of digital car system control do you find easy to configure in your automotive engineering practical sessions?

Indicate your response based on the following scale: 1= Strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=Strongly agree.

	Statement	Response				
		1	2	3	4	5
1	System for onboard safety digital system control					
2	Ease of navigation configuration					
3	Speed management control system					
4	Fuel efficiency digital control system					
5	Engine optimization control system					

SECTION C: DIGITAL INFRASTRUCTURE

6. Indicate whether the following digital infrastructure is available in your institution for academic purposes

Digital infrastructure	Response	
	Available (Yes)	Not Available (No)
Fixed Broad band/Internet		
Network infrastructure		
Data Centers:		
Cloud Computing:		
Platforms and systems;		
User Devices		
Intranet		

7. For each of the statements numbered 1-6, tick the box that best represents you experience with the available digital infrastructure in your institution

Indicate your response based on the following scale:

1= Strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=Strongly agree.

No	Statement	Response				
		1	2	3	4	5
1	Broadband has necessitated fast internet speeds for information access from the internet					
2	Network infrastructure has made file sharing easier through LAN					
3	I use data center to secure critical digital data for practicals					
4	I use cloud computing for simulations in the workshop					
5	Learning management systems/platforms have transformed data handling and management in automotive engineering workshop					
6	Laptops, desktops and smartphones are regularly used to find and interpret data from various online sources related to automotive engineering					

SECTION D: DIGITAL LITERACY SKILLS

8. I've been taught and I'm now equipped with the following digital literacy skills that are useful in creating, storing and sharing information on automotive engineering

Statement		Response	
		Yes	**No**
1	Technical Skills		
3	Functional Skills		
4	Search Skills		
5	Creativity		
6	Evaluating online Sources		
7	Critical Thinking		
8	Communication		
9	Safety		
10	Collaboration		
11	Cloud Software		
12	Flexibility		
13	Understanding of Data		
14	Microsoft office		

9. From your experience of using digital tools, which of the digital literacy skills have you learnt and you find more helpful to your understanding of complex automotive engineering concepts? ***(Please tick all options that apply to you).***

Digital Literacy Skill		Response
1	Technical Skills	
3	Functional Skills	
4	Search Skills	
5	Creativity	
6	Evaluating online Sources	
7	Critical Thinking	
8	Communication	
9	Safety	
10	Collaboration	
11	Cloud Software	
12	Flexibility	
13	Understanding of Data	
14	Microsoft office	

10. Which of these digital literacy skills is easy to learn, practice and apply?

	Digital Literacy Skill	Response
1	Technical Skills	
3	Functional Skills	
4	Search Skills	
5	Creativity	
6	Evaluating online Sources	
7	Critical Thinking	
8	Communication	
9	Safety	
10	Collaboration	
11	Cloud Software	
12	Flexibility	
13	Understanding of Data	
14	Microsoft office	

11. Provide a general reason for the skills you have challenges mastering in No. 10 above

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SECTION E: DIGITAL LITERACY ELEMENTS

12. Select the digital elements you are conversant with.

No.	Digital Literacy Elements	Response
1	Media Literacy	
2	Communication and collaboration	
4	Digital Scholarship	
6	Career identity and management	
7	Learning skills	
8	ICT Literacy	
9	Cultural	
10	Cognitive	
11	Constructive	
12	Communicative	

13. Select the statement between 1-12 that best describes how you apply each of digital literacy elements in your automotive engineering practice.

Indicate your response based on the following scale: 1= Strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=Strongly agree.

No	**Statement**	**Response**				
		1	**2**	**3**	**4**	**5**
1	Media Literacy helps me to read creatively and produce automotive engineering academic and professional communication in a range of media					
2	Communication and collaboration enables me to learn through research from digital networks.					
3	Digital Scholarship enables me to participate in automotive engineering or professional practices that entirely depend on digital systems					
4	Career identity and management has enlightened me on copyright of own automotive engineering articles, digital reputation and online identity					
5	Learning skills both formal and informal enables me to navigate "technology rich environments" in the course of my studies					
6	ICT Literacy has helped me to adapt and adopt usage of digital devices, applications and services					
7	Cultural element have created awareness in me about cyber ethics, security and privacy. Cybercrime top on the list.					
8	Cognitive element has been about distinguishing which searched info is helpful to different aspects of automotive engineering.					
9	Constructive digital literacy element helps me use searched information to create prototypes out of existing automotive engineering content.					
10	Communicative digital literacy element assisted me in using existing digital technologies like web 2.0 to share new ideas with peers in the profession					

14. What reasons do you have for missing out on elements you found new to you?

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15. I have successfully learnt and applied digital elements in the following examinable automotive engineering areas

Indicate your response based on the following scale: 1= Strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=Strongly agree.

Examinable areas		**Response**				
		1	**2**	**3**	**4**	**5**
1	Vehicle technology					
3	Vehicle body work					
4	Vehicle engineering technology					
5	Electrical systems,					
6	Technical drawings/design					
7	Driving skills					
8	Vehicle electrical systems					
9	Communication skills					
10	Life skills					

Thank you for your cooperation!

APPENDIX III: QUESTIONNAIRE FOR TRAINERS

Dear respondent, the questionnaire has five sections of A.B.C.D.E each section captures each of the four objectives of this study.

Research questionnaire for trainers

Please tick in the appropriate box (√) that represents your response or fill in the blanks with the appropriate ***(Indicate your response based on the following scale: 1= strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=strongly agree)***

SECTION A: GENERAL QUESTIONS

1. For how long have you taught using digital tools automotive engineering lessons?

   Less than 1 year ☐ 1- 2 years ☐ over 2 years ☐

2. Which type of TVET institution do you teach in?

   Public ☐ Private ☐

3. What level of study did you start integrating digital literacy in your automotive engineering lessons?

   Certificate Level ☐ Diploma Level ☐ Both Levels ☐

4. Has digital literacy helped to increase enrollment in automotive engineering as course in the institution?

   Yes ☐ No ☐

5. Kindly provide a reason to your response above.

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SECTION B: DIGITAL TOOLS

IV. Digital tools

6. Do you use any these digital tools for teaching the following functions; animations, presentations, audio, video, tracking class progress, infographics, visual materials, template designs, access to resources and collaboration?

Digital tool	Response			Digital tool	Response	
	Yes	No			Yes	No
HaikuDeck				Flipsnack		
Prezi				Paalet		
Animoto				Quizlet		
Thread				Socrative		
Pixton				Edmodo		
Boom Writer				Schoology		
Educreations				Piktochart		
Glogster				Visme		
You Tube				Google Docs		
Ms Office						

7. What other digital tools do you use to train students in automotive engineering that is not listed above? In which areas?

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V. Online Collaboration digital Tools

8. Collaboration involves sharing, storing and retrieving online content for academic use with your peers. Indicate if collaboration tool has been useful in your teaching and learning.

Indicate your response based on the following scale: 1= strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=strongly agree)

	Statement	**Response**				
		1	2	3	4	5
1	Design Collaborative tools					
2	Communication collaborative tools					
3	Documentation collaborative tools					
4	File sharing tools					

9. Do you share automotive engineering content online for ease of access by automotive engineering students?

Yes ☐ No ☐

VI. Digital control systems

10. I have trained students on digital car control system configuration in automotive engineering practical sessions

Indicate your response based on the following scale: 1= Strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=Strongly agree.

	Statement	**Response**				
		1	2	3	4	5
1	System for onboard safety digital system control					
2	Ease of navigation configuration					
3	Speed management control system					
4	Fuel efficiency digital control system					
5	Engine optimization control system					

SECTION C: DIGITAL INFRASTRUCTURE

11. Indicate whether the following digital infrastructure is available in your institution for academic purposes

Digital infrastructure	**Response**	
	Available (Yes)	Not Available (No)
Fixed Broad band/Internet		
Network infrastructure		
Data Centers:		
Cloud Computing:		
Platforms and systems;		
User Devices		
Intranet		

SECTION D: DIGITAL LITERACY SKILLS

12. Tick the digital literacy skills that you possess as a trainer

Statement		Response	
		Yes	**No**
1	Technical Skills		
3	Functional Skills		
4	Search Skills		
5	Creativity		
6	Evaluating online Sources		
7	Critical Thinking		
8	Communication		
9	Safety		
10	Collaboration		
11	Cloud Software		
12	Flexibility		
13	Understanding of Data		
14	Microsoft office		

13. Kindly give a general reason for the "No" answers above if any.

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14. As a trainer, which of these digital literacy skills is easy for students to learn, practice and apply?

Digital Literacy Skill		Response
1	Technical Skills	
3	Functional Skills	
4	Search Skills	
5	Creativity	
6	Evaluating online Sources	
7	Critical Thinking	
8	Communication	
9	Safety	
10	Collaboration	
11	Cloud Software	
12	Flexibility	
13	Understanding of Data	
14	Microsoft office	

15. Kindly Provide reasons for the skills students have challenges mastering in No. **13** above

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SECTION E: DIGITAL LITERACY ELEMENTS

16. Select the digital elements you are conversant with and integrate in automotive engineering lessons.

No.	Digital Literacy Elements	Response
1	Media Literacy	
2	Communication and collaboration	
4	Digital Scholarship	
6	Career identity and management	
7	Learning skills	
8	ICT Literacy	
9	Cultural element	
10	Cognitive element	
11	Constructive element	
12	Communicative element	

17. As a trainer, I have successfully applied digital literacy elements for preparing my students in the following examinable automotive engineering areas

Indicate your response based on the following scale: 1= Strongly disagree, 2= Disagree, 3=Neutral/No response, 4=Agree and 5=Strongly agree.

Examinable areas		**Response**				
		1	2	3	4	5
1	Vehicle technology					
3	Vehicle body work					
4	Vehicle engineering technology					
5	Electrical systems,					
6	Technical drawings/design					
7	Driving skills					
8	Vehicle electrical systems					
9	Communication skills					
10	Life skills					

18. In your opinion as a trainer, what needs to be done for automotive engineering students to acquire digital literacy skills?

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Thank you for your cooperation!

APPENDIX IV. DOCUMENTARY ANALYSIS SCHEDULE FOR TRAINERS.

A document that has content of either a title, topic, subtopic, questions/answers, remarks, discussion or reference to any of media literacy, communication & collaboration, Learning skills, ICT literacy, cognitive element, and communicative element is deemed to be digital literacy integrated document.

Kindly indicate with (√) or (X) for documents where applicable in the table below.

DOCUMENTARY ANALYSIS SCHEDULE FOR TRAINERS							
		Digital literacy Elements in examinable areas					
Examinable Areas	**TVET**	Media Literacy	Communicative and collaboration	Learning skills	ICT Literacy	Cognitive digtal element	Communicative element
Student text Books	public						
	private						
Report forms	public						
	private						
Lesson Plans	public						
	private						
Students' progress records	public						
	private						
College Master timetable	public						
	private						
Class attendance	public						
	private						
Record of work for trainers	public						
	private						
Schemes of Work	public						
	private						
Lesson Notes	public						
	private						
Fliers for marketing	public						
	private						

Thank you for your cooperation!

APPENDIX V: OBSERVATION SCHEDULE FOR STUDENTS

Observation Schedule for Trainers/Students											
Date											
Time											
Respondents under observation		**Trainers/Students**									
Lesson		Automotive engineering									
Duration		Day 1									
Level of Study		Diploma/Certificate									
TVET		Public/Private									
Level of Study		Certificate/Diploma									
Observer		Reseacher									
	Item	**Class Activity**									
		Drawing & Design		Vehicle Technology /Troubleshooting		vehicle electrical system		Comm skills and Collaborationon		Life Skills	
Sno.	**Digital tool**	F	%	F	%	F	%	F	%	F	%
A1	Thread										
A2	Schoology										
A3	Flipsnack										
A4	Pixton										
A5	Boom Writer										
A6	Picktochart										
A7	Educreations										
A8	HaikuDeck										
A9	Quizlet										
A10	Socrative										
A11	Animoto										
A12	Glogster										
A13	Visme										
A14	Paalet										
A15	Prezi										
A16	AutoCard										
A17	Ms office										
A18	Edmondo										
A19	You tube										
A20	google docs										
B1	Digital Torgue adapter										
B2	CDTire/3D										
B3	Safe Circuit Tester										
B4	Mx-Suite										
C1	File sharing tools										
C2	Communication tools										

APPENDIX VI: NACOSTI RESEARCH AUTHORIZATION LETTER

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **445998**

Date of Issue: **19/September/2019**

RESEARCH LICENSE

This is to Certify that Mr.. MAURICE CHONGE of University of Nairobi, has been licensed to conduct research in Bungoma on the topic: EFFECT OF DIGITAL LITERACY ON TVET STUDENTS PERFORMANCE IN AUTOMOTIVE ENGINEERING IN BUNGOMA COUNTY,KENYA for the period ending : 19/September/2020.

License No: **NACOSTI/P/19/1523**

445998

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX VII: COUNTY COMMISSIONER AUTHORIZATION LETTER.

REPUBLIC OF KENYA

THE PRESIDENCY
MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telephone: 055- 30326
FAX: 055-30326
E-mail: ccbungoma@yahoo.com
When replying please Quote

Office of the County Commissioner
P.O. Box 550 - 50200
BUNGOMA

23rd September, 2019

REF:ADM.15/13/VOL.11/177

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION –MAURICE CHONGE

Reference is here made on the letter Ref; NACOSTI/P/19/1523 dated 19th September, 2019 from the National Commission for Science, Technology and Innovation on the above subject.

The bearer of this letter is a student at the University of Nairobi has sought authority to carry out research on, ***"effect of digital literacy on TVET students' performance in automotive engineering in Bungoma county, Kenya"*** for a period ending 19th September, 2020.

Authority is hereby granted for the specific period and any assistance accorded to him in this pursuit would be highly appreciated by this office.

L.N WALUKHU
For: County Commissioner
BUNGOMA COUNTY

COUNTY COMMISSIONER
BUNGOMA

APPENDIX VIII: COUNTY DIRECTOR OF EDUCATION AUTHORIZATION LETTER.

REPUBLIC OF KENYA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
State Department of Education – Bungoma County

When Replying please quote
e-mail: bungomacde@gmail.com

Ref No: BCE/DE/19/VOL.III/68

County Director of Education
P.O. Box 1620-50200
BUNGOMA

Date: 23rd September, 2019

TO WHOM IT MAY CONCERN

RE: AUTHORITY TO CARRY OUT RESEARCH – MAURICE CHONGE – NACOSTI/P/19/1523

The bearer of this letter Maurice Chonge of University of Nairobi has been authorized to carry out research on ***"Effect of digital literacy on TVET students performance in automotive Engineering in Bungoma County, Kenya."*** a period ending ***19th September, 2020.***

Kindly accord him the necessary assistance

CALLEB OMONDI
For: COUNTY DIRECTOR OF EDUCATION
BUNGOMA COUNTY

APPENDIX IX: COUNTY GOVERNMENT RESEARCH AUTHORIZATION LETTER

COUNTY GOVERNMENT OF BUNGOMA

OFFICE OF THE COUNTY SECRETARY AND HEAD OF PUBLIC SERVICE

DIRECTORATE OF HUMAN RESOURCE MANAGEMENT

Telephone: 055-2030144
E-mail: bungomacountygovt@gmail.com

Municipal Building
P.O Box 437- 50200
BUNGOMA

Our Ref: CG/BGM/HRM/GC/VOL.II/(103)

4th October, 2019

The Chief Officer
Department of Education and Vocational Training

RE: MAURICE WEKESA CHONGE
The above subject matter refers,

This is to kindly request you to allow the bearer of this letter conduct his research in your department which was granted by the National Commission for Science, Technology and Innovation (NACOSTI) ending 19th September, 2020.

Note that during research the information given should be purely for academic purposes and information provided should not be used for any other purposes.

Any assistance accorded to him will be highly appreciated.

JOSEPH KISINDAI
FOR: COUNTY SECRETARY/HPS

APPENDIX X: UNIVERSITY OF NAIROBI RECOMMENDATION LETTER

UNIVERSITY OF NAIROBI
COLLEGE OF EDUCATION AND EXTERNAL STUDIES
DEPARTMENT OF EDUCATIONAL COMMUNICATION AND TECHNOLOGY

Telephone: 020-2500759, 020-2500760
020-2500762,020-2460056

P.O. Box 30197,00100 NAIROBI
P.O. BOX 92.00902 KIKUYU

13th March 2019

TO WHOM IT MAY CONCERN

SUBJECT: WEKESA MAURICE CHONGE – REG NO. E60/90011/2016

This is to certify that **Wekesa Maurice Chonge Reg. No: E60/90011/2016** is a student at the University of Nairobi, College of Education and External Studies in the School of Education, Department of Educational Communication and Technology. He is pursuing a course in Master of Education in Education and Technology. He is currently working on his project work

Any assistance accorded to him will be highly appreciated.

Chairman
13 MAR 2019

PROF. PAUL A. ODUNDO
CHAIRMAN, DEPT. OF EDUCATIONAL COMMUNICATION & TECHNOLOGY