IMPLEMENTATION OF UNESCO FRAMEWORK FOR THE ACQUISITION OF ICT-COMPETENCY OF TECHNICAL AND VOCATIONAL EDUCATION IN FEDERAL COLLEGE OF EDUCATION AKOKA, LAGOS

By

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ABSTRACT

Technical and Vocational Education and Training (TVET) was established to make pre-service teachers acquire practical skills, knowledge of job creation and self-reliance for national economic growth and development. However, studies have shown that the outcomes of TVET (skills acquisition and creativity) could not be achieved as a result of inadequate ICT resources. Previous studies focused largely on improvisation and improvement of instructional strategies without much attention on the use of ICT to teach TVET practical skills. A survey of TVET teachers in Lagos State showed that they had low technology literacy and knowledge creation. Therefore, this study was carried out to implement UNESCO ICT-Competency Framework (Technology Literacy - TL; Knowledge Deepening - KD and Knowledge Creation -KC) for the acquisition of ICT-based teaching competencies among Federal College of Education TVET pre-service teachers in Lagos State.

Competency and Engagement theories provided the framework. Design-based approach of mixed methods adopted was in four phases – analysis, development, iterative and reflection, which were carried out in 16 weeks. Multi-stage sampling procedure was used. Federal College of Education (Technical), Akoka was purposively selected being a college of education with adequate technical and vocational resources in Lagos State. Fourteen 200 level pre-service teachers were enumerated and purposively selected in their ultimate year, where the bulk of the courses were taken. The instruments used were Skill Acquisition (r=0.72); Technology Literacy Assessment (α=0.98); Knowledge Deepening Assessment (α=0.87) and Knowledge Creation Assessment (α=0.94) scales, and UNESCO training module. A session of focus group discussion was held with TVET class representatives. Quantitative data were subjected to descriptive statistics and paired t-test at 0.05 level of significance, while qualitative data were content analysed.

The majority of the participants (92.9%) were male. Pre-service teachers' TL (85.0%); KD (78.5%) and KC (73.1%) were high. Pre-service teachers demonstrated high creativity in use of ICT (ease of use - 76.3%; engagement - 71.0%). There was a significant difference (t =5.302; df=13) between the level of ICT use. The mean of level of ICT use before training was ($\bar{x}$ = 80.07), while that of after training was ($\bar{x}$ = 142.50). Pre-service teachers' knowledge of skills (71.4%); standard of work (57.2%); autonomy of work (71.4%); coping with complexity (57.1%) and perception of context (78.5%) were high. Despite preparation, pre-service teachers lack ICT skills. In addition, they prepared ICT-based lesson notes which were used to teach Technical Drawing. They perceived the use of ICT tools as relevant and related to achieving the objectives of TVET. They demonstrated acquisition of practical skills and creativity after the training.

The implementation of UNESCO framework for the acquisition of ICT competency for Technical and vocational education in Federal College of Education Akoka, Lagos was effective. The framework should be adopted by technical and vocational education teachers.

Keywords: Technical and vocational education and training, ICT- competency of pre-service teachers, Creativity and Skill acquisition, Design-based research approach

Word count: 454

CERTIFICATION

I certify that this work was carried out by Henry Feyisayo OGUNDOLIRE in the Department of Science and Technology Education, University of Ibadan, Ibadan.

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DEDICATION

This work has come from Him and now dedicated to Him, God of all, the Father of Jesus Christ and My very own Father, who raised Christ from death, and has promised resurrection to all who believe in Christ Jesus: the owner of Life Himself. He is the Lord indeed and forever.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The 21st-Century has been characterized by the use of computers, and applications of Information and Communication Technology (ICT) used in carrying out daily activities and duties of professionals. It plays very vital roles in the social, political and economic life of every nation because it makes information collection, processing, dissemination, and storage very fast, easy and efficient. ICT has become a household term globally and has brought radical changes in the way people live, learn and work. The last two decades have witnessed tremendous changes in the ways businesses and organizations operate due to the emergence of ICT. Computer and ICT usage is always dynamic because of its evolving nature, which comes with demands required of every user, for a regular update. To meet up with the demands and the evolving nature of the 21st-century, professionals in all sectors of life have to update their technological practices and competencies, knowledge and skills.

Ezenwafor (2012); Aurelio, Boado, Casem, Guba-Lobão, and Pereira (2016) emphasized the need for requisite ICT competencies and skills for office workers, technologists, and businessmen. It is equally paramount for professionals in all fields of studies, especially in this era of technological evolution where no government, nor private sectors globally can boast of job security to all her citizenry. This is because of the changing nature of the 21st-century society demands in terms of competencies required by the government, private sector for job effectiveness.

Updating ICT competencies and skills, as required by professionals in this century necessitates that efforts should be made for adequate systems, policies and deliberate re-positioning of priority by the agencies concerned. One of the major ways to achieve this is through developing and raising participating citizens for the knowledge economy, and the teaching profession is central in achieving this agenda. Education should be geared towards achieving educational goals and national development, and teachers become a driving force. Ekpiken and

Edet (2014); Musa, Jimba, and Ogundele (2015) submitted that qualified, competent and dedicated teachers are the major instrument for achieving educational goals and national development. Also, teachers are the real agents that help in the development of various skills and competencies. It should be noted that the more qualify teachers the nation has, the better equipped the citizens and hence more development of the country. It has been found out that teachers are the major driving force in ensuring the facilitation of 21st-century skills. This is generally agreed among scholars that teachers in higher institutions should be trained to acquire ICT knowledge and skills that will assist them to process information and adopt problem-solving strategy, which in turn create learning in learners they teach. The necessity for teachers to be equipped with ICT skills and knowledge requires competence, a good teacher is expected to know what to teach and how to teach it convincingly. In developed societies, teacher's ICT competence is a very trendy theme, for example, to equip their learners with 21st-century skills that make them relevant in today's workforce and therefore in our continent, ICT core competences should be mandatory for all teachers (secondary schools teachers inclusive) (Bukaluga and Mubika, 2011). Though, teacher's ICT competence is required, the extent to which an individual acquires it determines to a great extent how the curriculum would be implemented. The challenges posed by ICT, especially to teachers in this 21st century should not affect the concerted efforts that should be set rolling towards ensuring teachers' acquisition of ICT competencies.

ICT has many benefits in the field of education. Radloff (2001) highlights the opportunities that ICT presents for enhancing the quality of teaching and learning which include: providing encouragement for teachers to reflect on how they teach and learn; applying theory, and research on learning, and principles of good instruction to designing online learning environments; making teaching and learning more feasible and public; encouraging collaboration and teamwork among teachers (and students); offering greater access to learning for more people. As a result of these, Amuche (2010) posited that teaching has been the most challenging profession because of the rapidly expanding knowledge and advent of modern technologies, which thus pose challenges for teachers to adjust their pedagogical roles.

Furthermore, using ICT for any activities including pedagogical roles of teachers requires competence. The general view is that teachers are the main concerns when it comes to the use of ICT in teaching and learning. Therefore, they require detailed training in the proper use of ICT.

Eck, Volman, Kraan, Dijk (2002), had mentioned the following ICT competencies that teachers should have in the use of ICT tools for teaching and learning. These are the use of ICT in the learning process and the coaching of the students; an ICT competent teacher should plan professionally related activities with the help of ICT skills that must have been acquired for job performance. However, using ICT in teaching for some years has been undergoing constant changes in its approach from being an introduction to the system to organisational infusion as presented in Table 1.1. The approach explains the pedagogical ability of teachers in relation to ICT use. (Hogenbirk, 2006). The ICT competence matrix for teachers in Table 1.1 emphasizes that teachers' duties do not only interact with himself alone but much more with all other elements in the teaching-learning process. These elements are teachers' duties interacting with himself; students; colleagues and environment. The implications of the interaction are that teachers' ICT competence in relation to his duties should be effective towards all other elements within the teaching-learning process.

Table 1.1: ICT competence Matrix for Teachers (Hogenbirk, 2006)

Themes Interaction with	Pedagogics	Curriculum	Professional development	Organization	Policy	Ethical aspects	Innovation	Technical aspects
Himself								
Students								
Colleagues								
Environment								

Furthermore, United Nations Educational, Scientific, and Cultural Organization (UNESCO ,2015) emphasized the importance of ICT competencies to teachers and identified a set of ICT skills that 21st-century teachers should possess. Teachers are expected to have these skills to cope with the rigor of 21st-century classroom activities and meet the needs of 21st-century learners. These skills by UNESCO (2015) are clearly itemized and they are:

- Operate computers and use basic software for word processing, spreadsheets, email, etc. (All the productivity tools should be learned)
- Evaluate and use computers and related ICT tools for instruction (Evaluation of educational media)
- Apply current instructional principles, research, and appropriate assessment practices to the use of ICTs (Pedagogy with Technology PTK)
- Evaluate educational software.
- Create effective computer-based presentations (Authoring e-learning packages)
- Search the Internet for resources (Internet searching techniques)
- Integrate ICT tools into student activities across the curriculum (TPACK)
- Create multimedia content to support instruction.
- Create hypertext documents to support instruction.
- Demonstrate knowledge of ethics and equity issues related to technology keep up-to-date as far as educational technology is concerned.

The implication of this is that to really have the utmost attention of these learners, ICT usage must be woven into their learning activities. The various descriptions of ICT related issues and its corresponding teachers' competence, as they can be used in the teaching-learning process have shown to a greater degree than, teachers/instructors across all levels need ICT skills and competencies--Technical and Vocational Education and Training (TVET/TE) teachers inclusive.

Using ICT in TVET/TE seems a little different from all other disciplines, and this is because of the practical nature of the TVET/TE program. Using ICT in TVET programs requires two categories of ICTs: standard technology and specific technology. Standard technology is involved in the use of analog and digital equipment while specific technology involves the use of

specific and job-related tools and equipment to perform certain job scope, (Lux, 2010; Mishra and Koehler, 2006).

Moreover, the use of Specific Technology in TVET is premised on the knowledge of operating certain machines such as offset printing machines and slicing machines for a fiber optic installation. The study covers only Standard Technology, the reason being that TVET programmes require the instructors to acquit themselves with specific abilities or competencies related to a particular job prescription. This specialised knowledge will assist TVET instructors to stay relevant and competitive across national boundaries. So, TVET teachers should be able to operate multiples machines, engage in the higher-order of thinking, and involve in the teaching-learning process capable of inducing learning across the three domains of learners. (Mishra, Koehler, and Henriksen, 2011). The study of Mishra, Koehler, and Henriksen, 2011 reveals that when Standard Technology (ICT) is engaged to enhance TVET instruction, it is called ICT-based instruction.

The teaching-learning process and assessment can be greatly effective when an ICT-based instruction is applied to deliver, support and enhance the process. ICT-based instruction is generally referred to as the use of electronic and media technology. This environment enables students to interact with themselves without physical interactions, and this is so because ICT-based instruction has proven to be effective and advantageous in recent studies on TVET students, as well as to solve the problem of material and staff shortage. (Karahocaa, Duldaa, Karahocaa, Yücela, Gulluoglua, and Arifoglua, 2010)

The ICT skills and competencies needed by all teachers are further strengthened by past studies from the employers' assessment, these studies show that teachers are expected to possess ICT skills and competencies needed to prepare students who are turned-out to solve societal problems, but the results of these studies have shown the contrary, in that, graduates being turned out from our educational institutions are not competent to cope with the rigor of the world of works. And because of these gaps, graduates are unemployable. These graduates are the products of an educational system, where teachers supposedly would have taught for at least three (3) years. Evidence from past studies, such as Pitan and Adedeji (2012), Alade (2002), Dabalen, Oni, and Adekola (2000), and the National Universities Commission (NUC) (2004), show that the nature of the unemployment existing in Nigeria is structural, as many graduates are unemployable because they lack high-level skills, such as creativity, critical thinking, and ICT. Employers'

assessment of Nigerian university graduates in a World Bank study (Dabalen et al., 2000) revealed that employers believe that university graduates are poorly trained and unproductive on the job, and shortcomings are particularly severe in oral and written communication and in applied technical skills.

The un-employability of the products of the Nigerian educational system in specific terms is related to a lack of relevant skills needed by the employers in the world of work. It is based on this that, Pitan (2015) identified the skills needed by every product of the Nigerian educational system. These skills are generally referred to as generic skills, they are: analytical, critical-thinking, communication, entrepreneurial, decision-making, information and communication technology (ICT), interpersonal, self-directed learning, technical and numeracy skills. One of the generic skills required of Nigerian graduates in Information and Communication Technology (ICT) skills. Pitan (2015) asserted that in all the five sectors understudied, education ranked the highest sector on high demand for generic skills -ICT skill inclusive. Various studies like Omoniyi and Quadri (2013), Kayode, Ngozi and Irene (2014), Adebakin, Ajadi and Subair (2015), Pitan and Adedeji (2012), Okoro (2013) and Sodipo (2014) show that Nigerian graduates including teachers in both secondary schools and primary schools are inadequate in ICT skill and are therefore not employable. These ICT skills have been termed as the most sought for by employers in the world (Adebakin, Ajadi and Subair 2015). Furthermore, these studies also show that teachers in this category show low competence in ICT skills. Teachers generally, TVET teachers/instructors inclusive, have low competence in ICT skills, however, one cannot say teachers have low competence in ICT skills when no one is aware of the ICT domains required of teachers in this 21st century. Hogenbirk (2006) and Eck, Volman, Kraan, Dijk, (2002), made attempts to explain the required ICT competencies of teachers, still, their descriptions never show the ICT domain of knowledge and how ICT skills can be applied to various duties of teachers in the teaching-learning process. Filling this gap, UNESCO 2011 published a document called Information and Communication Technology and Competency for Teachers (ICT-CFT).

UNESCO's Framework emphasizes that it is not enough for teachers to have ICT competencies and be able to teach them to their students. Teachers need to be able to help the students become collaborative, problem-solving, creative learners through using ICT so they will be effective citizens and members of the workforce. The Framework, therefore, addresses all

aspects of a teacher's work. It is argued that modern societies are increasingly based on information and knowledge. Consequently, they need to: build workforces which have ICT skills to handle information and are reflective, creative and adept at problem-solving in order to generate knowledge and enable citizens to be knowledgeable and resourceful so that they are able to manage their own lives effectively, and able to lead full and satisfying lives. This will encourage all citizens to participate fully in society and influence decisions. (UNESCO, 2011). Ensuring the achievement of these goals in teachers, an international benchmark was created by UNESCO in collaboration with industry experts and subject matter experts, to acquit teachers with the necessary ICT competencies needed to effectively teach their various subjects with ICT.

According to UNESCO (2011), ICT-CFT articulates three different successive approaches which are Technology Literacy—students at this stage is enabled to use ICT tools to effectively learn, the second stage is Knowledge Deepening — students at this acquire school subject knowledge through ICT and apply the knowledge to solve complex real-world problems. Knowledge Creation, the third stage enables students to use knowledge of the first two stages to create new knowledge required to live harmonious, fulfilling and prosperous life in the society.

The framework, therefore, addresses all aspects of a teacher's work, by relating the three approaches to teaching and learning which is based on human capital development ideology. The three approaches are cross-linked to six typical duties of teachers (UNESCO, 2011) The UNESCO framework itself will not translate into ICT competencies in teachers, it must, however, be used to guide the acquisition of ICT standards in by teachers. However, before these could happen, conducting a needs assessment is paramount. Therefore, in this research, the framework was used as the basis for need assessments

A survey study was carried out amongst TVET teachers in southwestern institutions running technical education, to create a baseline for the study. The survey assessed the ICT competencies of TVET/Technical Education Instructors (Pre and In-services) (TE) teachers using the framework (ICT-CFT) as a guide. It also ascertained the ICT competency level of teachers. The reports of the survey study are summarised as follows.

Data analyzed from a field survey (2016) by this researcher has revealed that:

1. The level of awareness of the Technical Education (TE) lecturers towards policy formation, a component of TVET, is high. However, the classroom application of this policy is challenging, this is due to the fact that the policy has not translated into having more resources and tools in their respective institutions, thereby making it difficult to apply the policy (Field survey, 2016).

2. The finding of the survey also shows that TE lecturers' competency level on the use of ICT tools for planning curriculum and assessment of TVET courses is on the average. They sparsely use ICT tools such as Presentation tools for example PowerPoint showing graphics and texts to support student's understanding. Furthermore, their use of the tools for formative and summative assessment, for feedback on students' performance is on average. (Field survey, 2016).

3. Going by the technology literacy index of UNESCO ICT-CFT benchmark, the findings of field survey also reveal that Technical Education lecturers have a high ICT competence in relation to using ICT tools to implement pedagogy at technology literacy level of UNESCO (2011) ICT-CFT benchmark. However, the interview conducted reveals that TE lecturers do not use specific applications which they have high competence in terms of awareness to support collaboration in both theory and practical classes. (Field survey, 2016)

4. Further analysis of the interview revealed that technical education lecturers do not use alternative ICT tools and resources for the teaching and learning process. More importantly, the use of these ICT resources should be supported by departments and institutions in which TVET programs are operated. This implies that, while Technical education instructors do show a level of ICT competence at Technology literacy level, yet further interview indicates that the Technical education instructors have not satisfied the requirements for ICT competence by the UNESCO ICT-CFT framework for teachers published in 2011. Therefore, technical education instructors do not have ICT competencies for knowledge deepening and knowledge creation according to the UNESCO ICT framework for teachers is below expectation, this is because the UNESCO benchmark states that a teacher is said to have ICT-competence when such teacher could use ICT tools to have occasion knowledge deepening and creation in their area of specialty In response to this assertion. The level of the ICT incompetence among Technical education instructors according to UNESCO ICT standard is deplorable, and this may hinder, the achievement of the main objectives of the programme in Nigeria, if not given adequate attention. Nigeria is far behind compared to other African nations like Botswana and South Africa which are developing countries

that have started to shift attention to the acquisition of adequate ICT skills, especially the TVET instructor across all levels of their educational systems. Contrariwise, Nigeria as a nation might have not been looking in this direction, hence the reason for slow technology development. (World Economic Forum, 2017)

Past studies like Zhang (2004); Garcia, Marcos, GuanLin, and Escribano (2013); Ng, Miao, Lee (2009) and Digital Bridge Institute of the National communication commission (DBINCC) have shown that attempts have been made to provide solutions to the low ICT competence of teachers across all levels of Technical and Vocational Education and Training (TVET) and the whole educational system, solutions like workshops, seminars, ICT related researches, and short-term training have been variously organized to cater for this gap. However, none of these attempts have been able to provide long-lasting solutions to this problem, they have been found to have short-lived impacts, and this is due to the fact that ICT training is haphazardly done because of lack policy standard (Chao 2015). These attempts have been carried out and handled mainly by educational technologists.

However, Educational Technologists' roles in refining practices in education in teaching and learning environments is panned as over-stimulated with little effects on the target audience (Reeves, 2006). It implies that the quality of educational system output is below the expected result, in spite of the ubiquity of ICT tools. There is no consistent improvement in the effects of the tools used. Considerably, the resultant effect might be from a minor role educational technology research plays in transforming the use of technological tools in the classroom. Various research approaches have been used to address the problem of using technologies in teaching and learning. However, the results from some of these studies have been reported not to have a lasting impact (Amiel and Reeves, 2008). It is argued that a robust research approach that considers the effects of the end-users could contribute to the initial take-off of an experiment, be adopted to address the gaps created by other research approaches, hence, Design-Based Research (DBR) is suggested.

McKenney and Reeves (2012) proposed Design-based research (DBR), and it is also called design experiments (Brown, 1992), design research (Collins, Joseph, and Bielaczyc, 2004), and educational design research (McKenney and Reeves, 2012), has generated increasing interest among educational researchers in the last decade (Anderson and Shattuck, 2012). Wang and

Hannafin (2005) defined DBR as a systematic but flexible methodology aimed at improving educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings and leading to contextually-sensitive design principles and theories. Also, researchers can increase their contribution to improving educational practices through a research practice that allows contributions from various stakeholder and equally identify technology as an integrative system. Based on the general argument, the impact of traditional-based research approaches in educational technology research had been minimal in informing actual and consistent use of ICT tools. In other words, the aim of educational technology research is to examine the effects of tools to assist the educational process to make systematic decisions that impact its practitioner, but the effects of this exercise have been reported to be insignificant.

Also, the process of conducting research can be affected more significantly when technology is viewed as a system and not as merely a tool-set, especially in the educational technology field. Consequently, it is therefore suggested that an innovative approach such as design-based research is adopted to conduct research in education, (Amiel and Reeves, 2008). With the adoption of this innovative approach, the researcher has no option than to first question the existing research methods, as a result of a complex nature research environment. Furthermore, research guiding values should also be questioned by the practitioners and equally participate in dynamic engagement with field professionals to assist in direct technological development. More systematic and collaborative research methods will promote the conduct of significant researches. Additionally, two deciding factors should inform Educational Technology research: first, technology as processes should be properly comprehended as against being regarded as artifacts and secondly prioritizing value addition being properly guided by research principles will significantly affect Educational Technology research., (Amiel and Reeves 2008). Therefore, the study is conceived to use DBR to solving the problem of TE instructors' low ICT competence.

This study adopts the design-based research approach to find a more effective solution to the problem of low ICT competence among TVET/TE lecturers in South Western, Nigeria. As stipulated by the design-based research (DBR) approach, a need analysis should be carried out to investigate factors responsible for low ICT competence of TVET/TE teachers/instructors. Various interview was carried out to ascertain the responsible factors. Some of the responses came largely

from the Technical education Instructors: the factors include; lack of skills, and knowledge of ICT, attitude of TE instructors towards the use of ICT in TVET program, past experiences of TE instructors with ICT use, finance, lack of support from government and institutional supports and finally the industry-based supports. The summary of the factors responsible for the low ICT competence of TE instructors is captured as follows.

The problem with the use of technology in teaching and learning in Africa generally is not in the technology parse but the 'INTEGRATION' and ADOPTION. ICT is now available and adapting it to our own culture is now the problem. And adapting it is based on the skills teachers have, some teachers lack skills and the readiness is not there and the main reason for unreadiness is the lack of skills and incompetence. If the skill development area is not covered, we will remain like this forever. (Field survey, 2016)

This response summarises what other teachers who were interviewed had said clearly indicates that using ICT is not first and foremost the access or availability of ICT but solely the skills and knowledge of teachers especially TVET/TE instructors. The fact remains that, the problem of not applying ICT by teachers will keep being unresolved until the factors responsible for ICT incompetence of teachers are gradually and progressively handled. The other responses further strengthen the fact that TVET/TE teachers will not use ICT, if the problem of low competence on their part, is left unattended to, and they will resist the use of it. When some teachers were asked, why they resist the use of ICT in teaching TVET courses, these are the responses gathered:

> *You cannot blame somebody for not using things when he does not know the full details of what such things can do, such an individual will continue to kick against it because he/she does not know the full potentials of ICT especially to the teaching of a technical course,*
>
> *TVET teachers must have the complete idea of what ICT can be used for, not knowing it will lead to under-utilization. You cannot use it because there is old idea of what technology can do and since you cannot do beyond what you do not know, until when they see a proof which will happen when they are trained, they will keep kicking against the use of it (ICT).*
>
> *However, when they are trained to know the complete potentials of what ICT can do, they will be ready and embrace the use of it.*
>
> *So, the skill gap is still missing. The skill gap must be filled and bridged with complete knowledge of the affordances of ICT especially to the teaching and learning of TE courses, until them, TVET/TE teachers will remain adamant to how ICT could be used for technical courses like ours, until the skill gap*

is taken care of, we will not be relevant in the global world. (Field survey 2016)

The study of Tola and Okoye (2015) further proves that TE instructors' level of ICT use in the teaching of TVET courses is very low. The findings among other things show that teachers are to demonstrate competence in using PowerPoint presentations for lesson delivery; incorporate the use of media and technology for teaching where appropriate, however, the extent at which teachers use ICT tools is very low.

If TVET/TE teachers would be able to use ICT for their teaching, it then requires that TVET/TE instructors be empowered through training. To empower TVET/TE teachers generally on the use of ICT requires not just to have competencies in the knowledge of ICT tools but also to be able to use them to create technology literacy, occasion knowledge deepening, and finally induce knowledge creation among students. In achieving these multiple responsibilities of TVET/TE teachers, models or frameworks are necessary to help TVET/TE teachers progressively acquire standardized ICT competence. Such models/frameworks which are in existence are TPACK, TPCK, ICT-eTD, ICT-eTSA, and ICT-CFT. All of these frameworks give opportunities for the acquisition of ICT competencies. However, none of them except ICF-CFT shows how teachers can progressively acquire ICT competence that will lead to knowledge creation. ICT-CFT framework is therefore considered appropriate to stage ICT training for TVET/TE instructors.

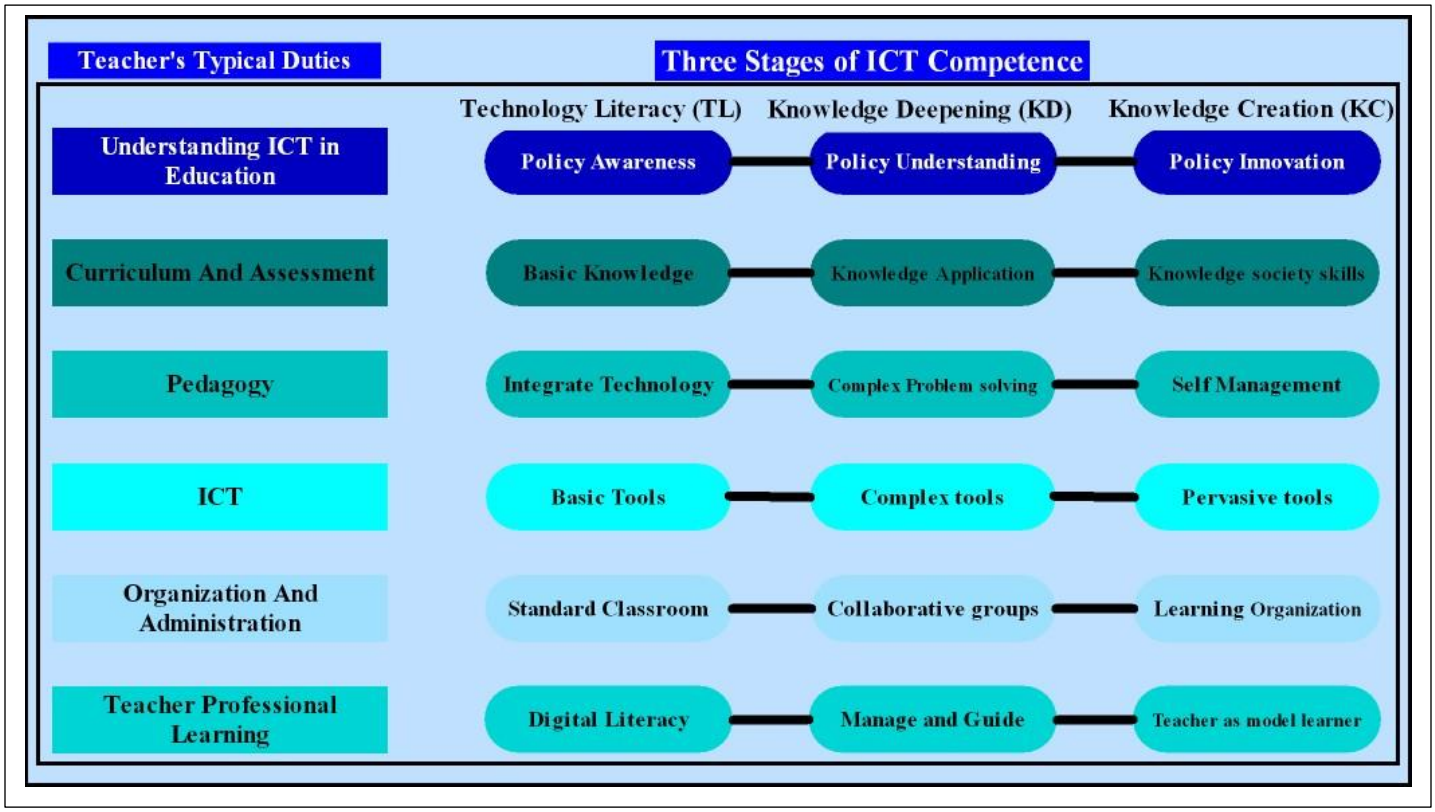


Figure 1.1 UNESCO 2011 ICT-CFT Framework for Teachers

It is based on the framework in fig 1.1 that for TVET teachers to accomplish their 6(six) duties as shown in the UNESCO ICT-CFT (2011), he must progressively be taken through the three stages of ICT competency. At each stage of learning, a teacher is expected to do the following:

1. At the technology literacy level, it involves the development of teachers' competences with technology literacy which are fundamental digital literacies and. It also involves the selection and appropriate use of off–the shelf application software specifically designed educational purpose like, games, and all other computer-mediated resources which have been already installed in computer laboratories. When these computer-mediated resources are utilized, they serve as complementary resources for curriculum objectives and lesson plans. TVET teachers must also be able to manage classroom data and support professional and technical learning with ICTs. (UNESCO, 2011). Taking Basic Technology teacher as a sample teacher, teachers are expected to make the effective use of an IWB alongside with PowerPoint to teach concepts like Gearing System or any other TVET topics, The teacher, prior to this development, using projector for classroom presentation has been the usual ICT related activities.

2. Also, at Knowledge Deepening (KD) level, the aim of the knowledge deepening approach is to increase the ability of students, citizens, and the workforce to add value to society and to the economy by applying the knowledge gained in school subjects to solve complex, high priority problems encountered in real-world situations of work, society and in life generally. Educators, with this methodology, must comprehend strategy objectives and social needs and have the option to distinguish, plan and utilize explicit classroom exercises. With this in place, methodology regularly will require changes in the educational program that underline the profundity of comprehension over the inclusion of substance and evaluations that underscore the use of comprehension to certifiable issues. The evaluation centers around complex critical thinking and fusing appraisals into learning exercises. (UNESCO, 2011). A Technical drawing instructor is baffled that a considerable lot of his understudies are not inspired by Technical illustration and don't comprehend its significance. He considers the utilization of ICT to change their mind-frames on how to use ICT to improve Technical drawing exercises.

3. On the final note, at Knowledge Creation (KC) level, the objective of the phase is to build profitability by making learners, residents, and a workforce that is persistently occupied with, and

profits by, the creation, development, and deep-rooted learning. TVET Instructors, in this phase, ought not exclusively to have the option to structure learning exercises that advance these objectives. (UNESCO, 2011). A Building drawing teacher plays a main job in sorting out an ICT-based venture for learners in a joint effort with the Electrical drawing teacher and other TVET teacher. In perspective on this, the report from field study demonstrates that this sort of circumstance does not happen among TVET Instructors. At TL, KD and KC levels, educators particularly TVET instructors are relied upon to do their obligations as presented in the UNESCO ICT-CFT document. Every one of these obligations is relied upon to be completed utilizing ICT aptitudes and abilities of instructors. The obligations of the TVET teachers cover essential learning, information application, and learning economy aptitudes (UNESCO, 2011). This is bolstered by Acuna (2008) that the instructor's competency set indicates that teachers must have useful information on the educational program gauges for their subject, just as learning of standard evaluation methodologies. Moreover, teachers must almost certainly incorporate the utilization of innovation into the educational curriculum. For the most part, educators may realize how to actualize the educational program in the different subjects and techniques for evaluation, in any case, the reality remains that utilizing ICT abilities which will empower them to utilize ICT tools to execute educational program and appraisal in the subject may need to rely upon the ICT competencies of such teachers, However, the study of Badau and Sakiyo (2013) reveals that teachers do not possess requisite ICT competence to implement subject or content based on curriculum and evaluation. Supporting this finding, the report of field survey 2016 shows that TE instructors have low ICT competence to implement curriculum and assessment. Therefore, this study intends to train TVET pre-service teachers to acquire ICT competencies with curriculum and assessment.

The most important aspect of teachers' work during the teaching-learning process is for teachers to display adequate and effective methods of teaching. What makes a teacher different from just anybody is the ability to adequately select appropriate and suitable methods to teach a particular concept in the subject area. There are various methods of teaching available for teachers from which teachers make a selection, and use the method to induce learning. These methods used by teachers to deliver content are generally referred to as pedagogy which is the art or science of teaching. Traditionally, teaching methods available for teachers are categorized into two major

headings: Teacher-centered method and Student/learner-centered method. In this age of technology, there is a need for teachers to possess technological skills to ensure 21st-century knowledge, skills, and abilities, which are often expressed among students of the same generation who are practically employed to carry out teaching and learning activities. Due to this age of technology teachers, principals and school administrators have had new demands placed on them requiring them to redevelop school-wide ICT integration strategies to deliver on the 21st-century skills and knowledge agenda (Hew and Brush, 2007). Skills Australia Institute (SAI) states that there has been an unprecedented shift in modes of delivery and practices to engage learners, transforming the way Australians live and work.

> *The digital age is upon us …it provides untold opportunities to reach learners across the country and to engage younger learners who, as participants in the digital revolution at schools, will expect easy to access learning by using the web at a time and place of their choice (2011, p. 109).*

This assertion mandates that teachers in Australia will need to have a paradigm shift in the way they present content to their students. This can also be said to be true of Nigerian students. Due to the influx of technological tools, students of this century are dependent on ICT to carry out their daily activities most of which are not necessarily related to learning. In this 21st century, teachers must have to change the way they deliver content to their learners. Several tools can help to implement pedagogies in the teaching-learning process. These are Social media, flip learning, WebQuest, video-based instruction, interactive video, learning management system, micro-learning, mobile learning, and user-generated learning. These approaches have changed the way teachers teach in 21st-century classrooms. Pedagogical duties of TE instructors cover integrating technology into methods and strategies of teaching; induces complex solving skills and self-management. The investigation of Badau and Sakiyo (2013) shows that ICT teacher instructional method capability to use the educational program in secondary schools is low. Changes in instructional practice include the incorporation of different ICT tools, devices, and digital content as a major aspect of the entire class, group, and individual learner's exercises to help teaching and learning activities. Teachers must be aware of where, with whom, when (just as when not) and how to utilize ICT for learning activities and presentations. (UNESCO, 2011). The report of baseline study (2016) indicates that TE teachers and instructors do make use of ICT tools like open-source tools to implement their strategies in the teaching-learning process. However, the

interview conducted further reveals that TVET instructors and teachers do not use specific ICT tools to implement strategies in their area of specializations. Therefore, this study intends to train TVET pre-service teachers to acquire ICT competencies in relation to pedagogy with specific ICT tools that could assist in implementing pedagogies.

According to UNESCO 2011, it is expected that any teacher in the 21st century who will prepare students for the knowledge economy would have to acquire ICT competencies and skills for organization and management of activities that take place in a classroom setting. Teachers must be able to use technology with the whole, small groups, and individual activities and ensure equitable access is provided to all students. (UNESCO 2011). The implication of this assertion is that teachers of TE will have to acquire ICT competencies and skills that will assist them in organizing and managing lesson delivery via technological tools. The overall goal of the UNESCO ICT-CFT 2011 document is to ensure digital competence among teachers who are the major drivers of technology integration in society. Digital literacy implies that teachers center around the advancement of digital competence and the utilization of ICT for professional improvement. This implies teachers must have the innovative aptitudes and information of web assets important to utilize innovation to secure additional topics and pedagogical information that will help in their own professional learning (UNESCO, 2011). Hooker, Mwiyeria, and Verma (2011a) study reported that policy, educational program, instructional method, innovation, organization, and professional development are significant to ICT instructor's competencies for the usage of ICT educational programs in Colleges of Education in Nigeria.

The general consensus of past studies is that most secondary school teachers do not possess adequate ICT competencies. These competencies include MS office applications such as MS Word, Access, Excel, which are applied to capture, process, transform and communicate data, especially Social Studies teachers. This finding is also supported by Iwuamadi and Ajeka, (2010). These duties of a typical teachers (TE) are required to be carried out with ICT skills at different levels, therefore teachers in this study will be trained to acquire ICT competencies according to UNESCO standards which will enable TE pre-service teachers and instructors to create an ICT-based software that will be used to teach the identified topics in technical drawing

In Technical Education (TE), different areas of specializations ranging from woodwork, metalwork, building construction, electrical/electronics, ceramic, auto mechanics to plastic

technology exist. However, in all of these areas of specialization, a fundamentals course is important to all of them. Students are exposed first to this course, as they are admitted into these areas of specialization in TE. This course is known as Technical Drawing (TD) with technical education nomenclature or Engineering Drawing with engineering nomenclature. Either of the two nomenclatures, Technical Drawing is a compulsory course. In this study, it will be referred to as Technical Drawing (TD).

This is a course that all technical education pre-service must offer TD because it is a universal language in the Engineering field. All engineering/technology students are required to take engineering drawing/technical drawing courses in their first two years in school and after which, students are to go into different areas of specializations of their choice, and it continues there as electrical/electronic drawing, building drawing, mechanical drawing. TD provides necessary information about the shape, size, surface quality, material, tolerance, and manufacturing process. It is, therefore, the graphic language from which a trained person can visualize objects (Reddy, 2008). In spite of the great importance of TD to students of Engineering education, the delivery of the course, TD, has been faced with so many problems, ranging from teacher-related problems to students-related problems. Relevant related literature shows that the quality of the teaching personnel, the learning atmosphere (situation), mastery of the subjects' matter by the teachers, the teaching process, drawing studios, instructional and educational items are all important factors in students' performances, especially to TD (Diraso, Manabete, Amalo, Mbudai, Arabi, and Jaoji, 2013). Igbinomwanhia and Aliu (2013) also describes the continuing declining performance in his study. Information gathered from the baseline study (2016) shows that the situation is the same in some other universities in southwest Nigeria as explained.

An interview conducted with the stakeholders also revealed that, though the TD is interesting and very crucial to the development of students' Technical and creativity skills, yet there are issues with the teaching. They include as captured by the responses of TD teachers:

1. *Teachers should present the subject and topics logically as simple as possible and should also identify the strength and weakness of each student.*
2. *The subject should be made interesting and appropriate teaching aids and materials should be provided to boost the learning.*
3. *It should be presented to the interest of the students; the areas of weaknesses and strengths of each students should be identified.*

4. *Quality and simplified textbooks should be used by students.*
5. *There should be proper orientation on the significance of the subject to various courses in higher institutions.*
6. *Provision of adequate teaching and learning aids to improve student's intellectual abilities.*
7. *Attracting student's interest by making the teaching of the subject simple.*
8. *This course is subject to teachers 'abilities (Field survey, 2016)*

The assertions given by the stakeholders of TD shows that the subject is faced with a number of problems, which must be solved if the objective of the subject would be achieved. Some of these problems are related to different topics taught in TD, as illustrated in Figure 1.2. Figure 1.2 is constructed based on the difficult topics in TD as identified by the students interviewed. The difficulties have been attributed to various strategies teachers use to teach, inadequate instructional materials and among others.

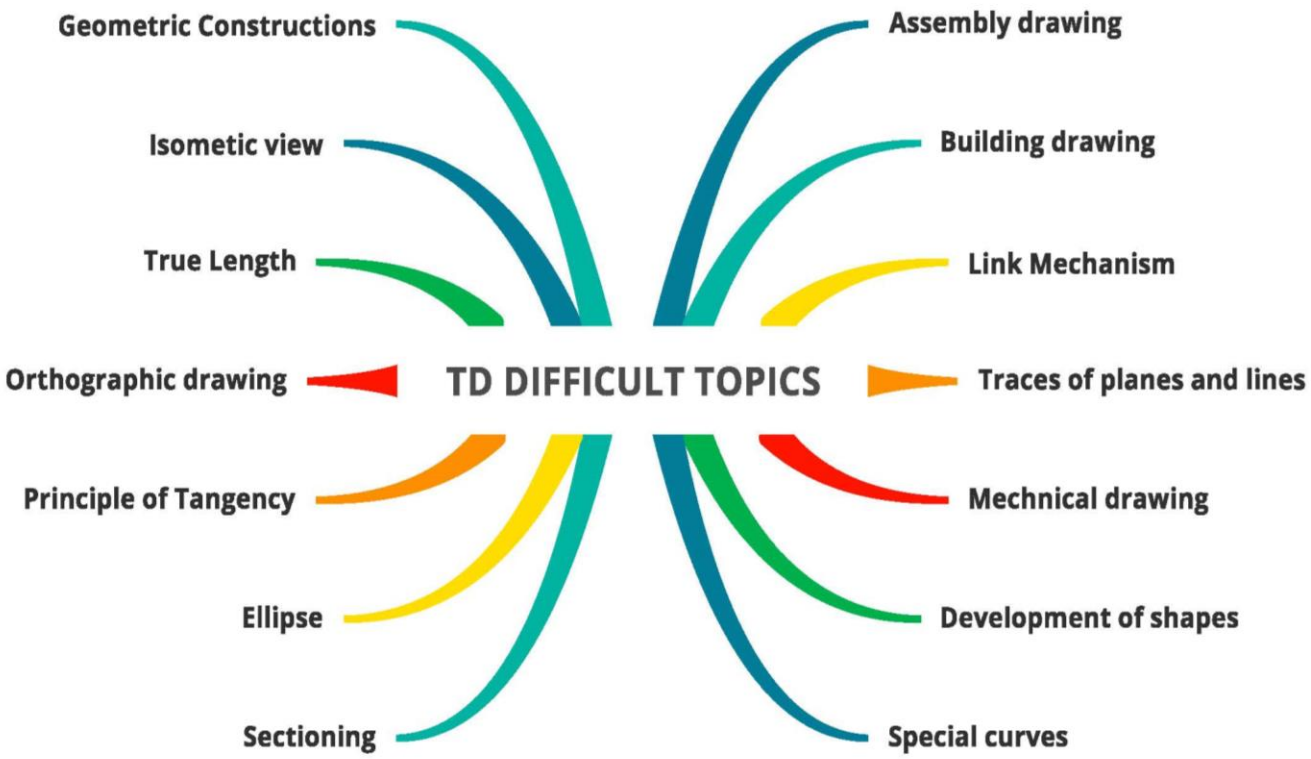


Figure 1.2 Most difficult topics in Technical Drawing: Students' view (Field survey 2016)

The quality of teaching and learning TD can be significantly and convincingly enhanced when Information communication Technology (ICT) tools which are regarded as intellectual multi-tool are put to use. The advent of ICT has provided many options and alternatives to teaching strategies and techniques in TD (Otunla, 2015). Studies like Abd-El-Aziz (2014), Gambari, Yusuf and Balogun (2015), Lilia, Ruhizan and Azaman (2012), Oppong, Vivian, and Eunice (2013), Oyebode, Adebayo, and Olowe, (2015), and have shown positive effects of using ICT for the teaching and learning of TD. These studies reported high performance of students in achievement when they were exposed to one kind of technology used to teach some selected TD topics. Therefore, using technology for courses/subjects like TD is of great benefit. However, where skills and competencies needed to appropriately use technology are not present, then, it may be difficult to use.

Therefore, this study is using Design-based Research (DBR) approach to train TE Pre-service instructor to acquire ICT incompetencies using the framework of the United Nations Educational, Scientific and Culture Organization (UNESCO, 2011). The framework ICT-CFT UNESCO document (2011) version would be used as a basis of training for TE pre-service instructors for the acquisition of ICT competencies. The outcome of the training would produce ICT- competencies and an ICT-Based instructional software for Technical drawing which would be produced by the trainees after the training.

1.2 Statement of the Problem

The utilization of digital technology in education implies new teachers' jobs, new instructional methods and new ways to deal with teacher education. The present circumstance of TVET/TE instruction in connection to ICT skills is below the standard as stipulated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in ICT competency standard for teachers, and the productive blend of ICT usage in the classroom will rely upon the capacity and competency of teachers, to structure the learning condition in innovative ways. Mandatorily, these innovative ways require that TVET pre-service teachers blend innovation with new instructional methods; grow socially dynamic classrooms; empowering co-operative connection; community learning, and group work. Accomplishing these requires an alternate arrangement of classroom teaching and management skills. Past studies and baseline studies indicate Technical Education teachers/educators or TVET lecturers in South Western Nigeria do

not have these ICT skills when measured against the UNESCO ICF-CFT 2011 models. These competencies are Technology Literacy (TL), Knowledge developing (KD) and Knowledge creation (KC) cutting over the six normal obligations of a teacher. These obligations are understanding ICT in education; curriculum and assessment; pedagogy; ICT; Organization and Administration, and finally teacher professional learning. Past studies and efforts completed, for example, workshops and courses/seminars to ICT competency of educators/teachers have been named as momentary works and efforts.

This is because, these studies and efforts do not make use of a research approach that could involve the stakeholders who are in connection with practice in the field, and also ICT competency of teachers is often carried out in total isolation from their duties. This by implication, teachers view such, as not directly related to their professional practice. It is also observed that past ICT training of teachers is haphazardly done due to a lack of policies and standards. The baseline study conducted reveals that TE pre-service teachers need to develop ICT competencies. Achieving these competencies will ensure that TE Pre-service instructors meet the goals of TE in Nigeria. Hence, this study is conceived to apply a design-based research approach to develop and implement ICT competency-based training for Technical Education pre-service teachers in Ogun state, and the skills and competencies acquired will be used to create ICT-based resources for Technical Drawing topics.

1.3 Research Questions

The research questions raised here are in phases according to design-based approach (DBR)

Research Questions:

1. What is the level of Pre-service teachers' awareness of the national policy that support ICT use for teaching and learning after the training at the following levels?

    a. Technological Literacy,
    b. Knowledge deepening and
    c. Knowledge creation

2. What is the level of Pre-service teachers' ICT skills for Curriculum and Assessment after the training at the following levels?

   a. Technological Literacy,
   b. Knowledge deepening and
   c. Knowledge creation?

3. What is the level of Pre-service teachers' ICT skills for Pedagogy after the training at the following levels?
   a. Technological Literacy
   b. Knowledge deepening
   c. Knowledge creation?

1. To what extent would the students' output that have been developed meet the competency standards after the training?
2. What is the level of creativity of the students' output work after the training?
3. What is the level of students' ICT-Skills after the training?

1.4a Hypothesis

HO_1: There is no significant difference in pre-service teachers' ICT Competence before and after the training at the following levels:

   a. Technological Literacy,
   b. Knowledge deepening
   c. Knowledge creation

1.5 Significance of the study

The findings of this study have established that ICT competency level of Technical education teachers can be linked directly to their duties, and ICT competency level of Technical education teachers can be progressive. Also, various findings of previous studies have established that Technical education instructors can use ICT skills to enhance the process of teaching and learning Technical drawing. The study has been considered significant because, if completed would serve as empirical background to support a change from the inability of not using ICTs to being able to use ICTs in relation to Technical education programme and TVET programme at large. The study would help to develop the ICT competencies of Pre-service Technical education

teachers so that they would be able to provide technology that supports learning opportunities for their students and also to be able to cope in this ever-changing world of ICTs. The findings of the study would also be available for policy and decision-makers on how best ICT practices and approaches can be integrated into the mainstream of Technical education programme, in that, the framework for implementing the ICT-CFT standards for teachers would be available in the study alongside with the principles that are contextually relevant. The following set of people would benefit from the study: Policy- and decision-makers; Managers and administrators of education and training institutions; instructional designers and developers; programme planners; teachers, trainers, workplace educators, tutors, mentors, and coaches; teacher educators and trainers of trainers; researchers; programme and product evaluators; ICT specialists and e-learning experts.

1.6 Scope of the study

The study covered the acquisition of ICT competency skills as contained in the UNESCO ICT-CFT standards (2011). The three levels of approaching ICT competencies as considered were: Technology literacy (TL), Knowledge Deepening(KD) and Knowledge Creation(KC) covering the six domain duties of a typical teacher ((Technology Literacy, Knowledge Deepening, and Knowledge Creation) with the six components of the educational duties (Policy and Vision, Curriculum and Assessment, Pedagogy, ICT, Organization and Administration, and Teacher Professional Development). It also covered students who are undergoing training for Nigeria Certificate in Education in Southwestern with Technical Education programmes.

Technical/Engineering drawing was used as a fundamental and common course for all the areas of specialization available in Technical Education programmes. The effect of ICT competence of Technical Education students was measured against the creativity of the students' artifacts

1.7 Operational Definition of Terms

New technologies: These are computer-based resources like productivity tools and other electronic gadgets like Mobile devices, computers, and Interactive white board etc.

Technology Literacy: It is referred to enabling Technical Education pre-service teachers to use ICT productivity tools in order to learn more efficiently

Knowledge Deepening: It is referred to enabling Technical Education pre-service teachers to acquire in-depth knowledge of their school subjects and be able to apply it to complex, real life problems with subject-related ICT tools

Knowledge Creation: It is referred to enabling Technical Education pre-service teachers to create the software using ICT competencies acquired from the previous two stages

Technical and Vocational Education and Training (TVET): This refers to education and training that prepare people for employment and makes them more productive in various economic fields.

Productivity tools: They are Word processing tools, presentation tools and spreadsheet tools

ICT Competency: It is referred to teachers having ICT skills, knowledge, and attitude in relation to Technology literacy, knowledge deepening and knowledge creation across their six duties (UNESCO ICT-CFT, 2011)

UNESCO ICT-CFT: UNESCO's ICT Competency Framework for teachers, also referred to as the framework.

Technical Educators: These are Technical education Instructors in Colleges of education, Polytechnics and Universities institutions running Technical education programmes

Technical Education Students: This is referred to students in tertiary institutions studying Technical education programme

Artefacts: Students' practical digital output

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews related and relevant literatures under the following headings and sub-headings:

2.1 **Conceptual Review**

- 2.1.1 Concept of Competence
- 2.1.2 ICT competence
- 2.1.3 ICT-CFT
- 2.1.4 Instructional Design Model
- 2.1.5 Technical and Vocational Education and Training (TVET)
- 2.1.6 Technical drawing
- 2.1.7 Role of ICT in TVET Program
- 2.1.8 Design-based Research (DBR)

2.2 Theoretical Framework

- 2.2.1 Competency Theory
- 2.2.2 Engagement Theory

2.3 **Empirical Review**

- 2.3.1 Information and Communication Technology (ICT) Competence and Educational ICT Policy
- 2.3.2 Information and Communication Technology (ICT) Competence and Curriculum and Assessment
- 2.3.3 Information and Communication Technology (ICT) Competence and Pedagogy
- 2.3.4 Information and Communication Technology (ICT) Competence and ICT Tools
- 2.3.5 Information and Communication Technology (ICT) Competence and Organization and Administration
- 2.3.6 Information and Communication Technology (ICT) Competence and Teacher Professional Learning

2.4 **Appraisal of literature**

2.1.1 Concept of Competence

The idea of competence has been on the talk for a considerable length of time and has drawn the consideration of such large numbers of researchers, educationists, creators, policymakers, teachers, and decision-makers. It is a subject that is required by all experts since it makes them relevant in the world of works, it offers definitions to a specific profession.

Generally, competence is known for displaying the learning, abilities, experience, and attributed to the required skills to function adequately. It is the acquisition of information, aptitudes, and capacities to perform appropriately in a given assignment. The UK Cultural Heritage National Training Organization (CHNTO, 2004) implies competence to mean a test to the capacity of an individual to execute a duty or work to broadly agreed models. As demonstrated by CHNTO, 2014, a key idea of competence is associated with the capacity to: perform occupational practices; work dependably on the agreed models - a person's presentation must meet Specific criteria before the individual being referred to be competent; transfer aptitudes to a reasonable extent. Competence is viewed as having a dimensional nature of quality. The perfect idea of execution should be exemplified in the exhibition criteria; however, the degree of the ability can be found in the range articulations which depict the different conditions wherein an individual is required to work.

In the context of the above definition, Competence could then mean specific knowledge, skills, and attitude which are central for convincing performance in a position. Additionally, it infers the ability to complete assigned assignments effectively. As demonstrated by Wojtezak (2000), such knowledge, skills, and attitude are required to perform assignments that mirror the degree of master, in any case. Wojtezak (2000) alerts that those Competencies are only not equal to formal expert capability. Correspondingly, Larsen (2006) agrees that it is a mix of theoretical knowledge, abilities and reasonable experience that prepare a person to make the right activity in the step by step working condition. For every profession, affiliations, and systems, there are ordinarily a couple of capabilities that must be required to play out some basic assignments and to remain significant in the framework. Dreyfus and Dreyfus (1980) accumulated these skills into four general regions:

- Meaning Competency

- Relation Competency
- Learning Competency
- Change Competency

Meaning Competency: The individual surveyed must probably relate to the reason for the organisation or network and act from the preferred future following the values of the organisation or network.

Relation Competency: The individual's capacity to make and sustain associations with the partners of the essential undertakings must appear.

Learning Competency: The individual evaluated must most likely make and search for circumstances that make it conceivable to try different things.

2.1.2 Information and Communication Technology and ICT Competence

In the 21st century, where the main driver of the century is ICT, therefore, no individuals can be on top of the assigned duties without the knowledge of the tools used to assign the task, and which of necessity must be delivered by the same tools. These tools are called ICT tools, and to be able to use these ICT tools, competencies are required. There is a need for continuous acquisition of ICT skills by teachers. Also, obstacles such as access to equipment, time pressure, lack of mentor and opportunities of apprenticeship for observation have an impact on teachers' ability to use ICT (Slaouti and Barton, 2008). Furthermore, teachers' workload and time management were found to be inhibiting the implementation of computer instructions in the classroom. While, many studies about how ICT is being used in developed countries, there is not much information on how ICT is being integrated into schools in developing countries (Beukes-Amiss and Chiware, 2010). However, teachers are required to choose how to utilize ICT in the classroom, where there are never again lecture-based showing techniques in the classroom anymore.

Consequently, teachers need to redesign their skills and knowledge in the field of ICT just as in different subjects. Teachers and the government must see the need for skills acquisition to effectively use the technology created by multimedia in the teaching process. This training would be better, achieved through professionalization. According to Giwa, (2011) professionalization

ensures that only professionally qualified teachers are allowed to teach in Nigeria. In any case, teachers should be trained in the accompanying zones: (a) individual ICT skills, (b) proficient ICT skills and competence, for example, understanding the pertinence of ICT in education, understanding the significance of ICT in teaching-learning, understanding how to design ICT for teaching-learning across the educational program, and managing ICT in the classroom are fundamental. He opined further that, training teachers in the successful utilization of ICT in the classroom needs to begin from the pre-service training. In such a manner, Maeers (2009) communicated that pre-service teachers need to think about ICT and its affordances: It ensures that teachers undergo periodic re-training through in-service courses. The pedagogy of teachers needs to be improved to enhance the use of many new teaching-learning styles. Accordingly, the duty of the teacher now is imperative. It is realized that teachers do not have sufficient energy to altogether assess the instructive qualities and shortcomings of a significant bit of the current educational program materials, software, and textual materials before they are utilized (Giwa, 2011). Ya'acob (2010) has suggested, training should be offered to teachers on a continuous, rather than a one-off, basis so that their IT knowledge is upgraded over time. This is in agreement with previous studies which found teachers' attitude toward computers as a key factor in predicting the frequency of technology use (Becker, 2005; Zhao and Frank, 2007). The finding is consistent with the findings of the previous study which concluded that teachers who are more competent in using computers have also more favorable attitudes towards computers (Jegede, 2007).

A lot of teachers in the Technical Education programme hardly see the relevance of ICT-facilities in Technical Education training because it is a skill-oriented course. There is a need to train them in this regard. In this regard, it is obvious that if teachers do not acquire and demonstrate this ability to reclassify their skills for the assignment of teaching, and on the off chance that they do not demonstrate in their very own conduct, and they differ in qualities – adaptability, organizing, innovativeness – that are currently key results for learners, at that point the test of tutoring in the following thousand years may not be achieved. Jurema (2007) emphatically contended that almost no consideration has been given to an instructional method of Informatics, which mulls over learning and showing forms, an association of educational plan and reflection on individuals/machine connections in learning and the more extensive network. As per Passey (2008) teachers who become exceptionally gifted in supporting students with ICT are talented in three unmistakable territories:

- Intentions of the learning movement, it means regardless of whether it is worried about research, or with composing, or with altering, or with visual imagination, it occurs.
- Cognitive results of the learning movement it means, regardless of whether it is worried about gaining information or with an examination of specific material, or with a combination of material from an assortment of sources, it occurs.
- Management of classroom cooperation means, when it is not suitable to mediate, or what to intercede about, or why intercession should be utilized at a specific time to refocus students' consideration on the task.

The motivation to prepare TVET teachers is consequently significant. ICT (Information and Communication Technology) is an approach to improve the teaching-learning procedure utilized by educators. The trouble experienced by teachers can be decreased and their instructional method improved by the utilization of and openness to ICT in the teaching-learning process. The works of Choy, Wong, and Gao (2009) indicate preservice teachers assume a significant role in establishing teachers' usage of classroom application of ICT. Studies up-to-date has announced that pre-service teachers who have gained a more elevated amount of specialized skills are more eager and willing to utilize innovation in the Generally, various studies such as Hammond et al. (2009); Paraskeva, Bouta, and Papagianna, (2008); Brown and Warschauer, (2006); Lee, Chai, Teo and Chen, (2008) have shown that pre-service teachers who had earlier ICT abilities express a more grounded supposition of self-abundancy as for ICT use

However, the existing findings that show the significance of teachers' role in integrating ICT in classroom practice, a great depth of studies (Haydn & Barton, 2007; Lawless &Pellegrino, 2007; Mishra, Koehler and Kereluik, 2009) equally show some gaps still existing in the teachers' training curriculum towards ICT integration. Researchers such as (Kay, 2006 and Swain, 2006) have shown their concerns about how pre-service teachers' training programs have not satisfactorily prepared them to utilize ICT applications in the teaching and learning process. The changing nature of ICT usage in teaching and learning should require a constant dynamic change in the preparation of training pre-service to use ICT for their preparation.

2.1.3 Information Communication and Technology-enhanced for Teacher Development (ICT-eTD)

This study has two conceptual frameworks which are: ICT-eTD (Information and Communication Technology-enhanced for Teacher Development) and Information and

Communication Technology-Competency for Teachers (ICT-CFT)**, Temechegn (2011)** Using technology for teaching and learning process as explained by Temechegn (2011) is not a once and for all affair, there are stages involved from which teachers or instructors are equipped to move effectively and efficiently in the use of technology progressively. According to Temechegn (2011), this framework helps teachers to develop technology integration skills that are broken down into four progressive stages. This framework is called ICT- enhanced for Teachers Development (ICT-eTD).

The ICT-enhanced Teacher Development (ICT-eTD) model is conceptualized as the procedure where ICT upgrades the social, individual and expert advancement of teachers, and as one in which the improvement of development in one viewpoint cannot occur except if different perspectives are created also. ICT-eTD is seen as setting-subordinate since social, individual and master advancement of instructors similarly as their usage of Information and Communication Technologies (ICTs) are affected by the setting in which the educators are working (Temechegn ,2011). The ICT-eTD model is delineated as a tetrahedral arrangement of Technological Pedagogical Content Knowledge (TPCK) as showed up in figure 2.3. It passes on the changed thought of TPCK from its constituent content information, instructive learning, and innovative learning. The tetrahedral framework sees and shows the dynamic nature of TPCK. Educators in this tetrahedral model of ICT-eTD advance from the hidden period of observing TPCK through to being imaginative and inventive TPCK specialists (that is, from the base of the pyramid through to its most astounding point. (Temechegn, 2011). The ICT-eTD has a four-continuum arrangement that educators or teachers who need to coordinate innovation can pursue, the stages are subsequently discussed.

Emerging TPCK indicates the underlying phase of TPCK development by teachers. Teachers at this stage are starting to recognise the nature and significance of TPCK in their social, personal and professional development. In TVET programs, teachers are relied upon to familiarize themselves with standard innovation data of ICTs where they begin to comprehend the possibilities of utilizing innovation. This stage illuminates TVET teachers to convey ICTs. Such organizations start to acquire equipment, computer, and software system. At the initial/underlying stage, TVET administrators and teachers are simply beginning to investigate the conceivable outcomes and results of including ICT for school and integrating it into the educational plan. Temechegn (2012). TVET teachers at this stage will start to create files/documents using word processing, spreadsheet,

and database software. TVET teachers at this stage, are equally introduced to programming and the utilization of web and email.

- Applying TPCK is described by teachers who began to utilize TPCK-based projects/exercises/modules/resources created by others. Educators at this stage additionally begin to immerse themselves in discourse about being an instructor of TPCK-based curriculum; emotional related issues and students' sentiments while experiencing the TPCK-based educational plan, and so on. Temechegn (2012). This can be adopted for TVET programs.
- Infusing TPCK addresses a phase of TPCK development where educators will start to change and adjust their very own TPCK-based materials/exercises/modules for various groups of students. Educators at this stage possess the ability to guide/exhort different instructors about what and how TPCK-based educational projects. They can likewise easily adjust to new circumstances in those projects. They can plan and execute TPCK-based exercises to tackle individual and institutional issues. Temechegn (2012). This stage can be adopted for TVET programs.
- Transforming TPCK is the most noteworthy phase of the social, personal and professional development of 21st-century teachers. Educators at this stage are imaginative and creative in that they not just grow new and fitting TPCK programs for their organizations, but yet additionally think of speculations about the nature and systems of TPCK. Temechegn (2012)

Utilizing technology for teaching and learning process as clarified by Temechegn (2011) is not a for the last time undertaking, but includes stages from which teachers or educators are prepared to move adequately and productively in the utilization of technology for teaching and learning. Accordingly, Temechegn, (2011) created a system to enable educators to create innovation integrating skills divided into four dynamic stages and TPCK being coordinated over every one of the stages, this structure is named ICT-enhanced for Teachers Development. (ICT-eTD). The ICT-enhanced Teacher Development (ICT-eTD) model is conceptualized "as the procedure wherein ICT develops the social, personal and professional areas of educators, and as one in which the enhancement of development in one angle cannot occur except if different viewpoints are created also.

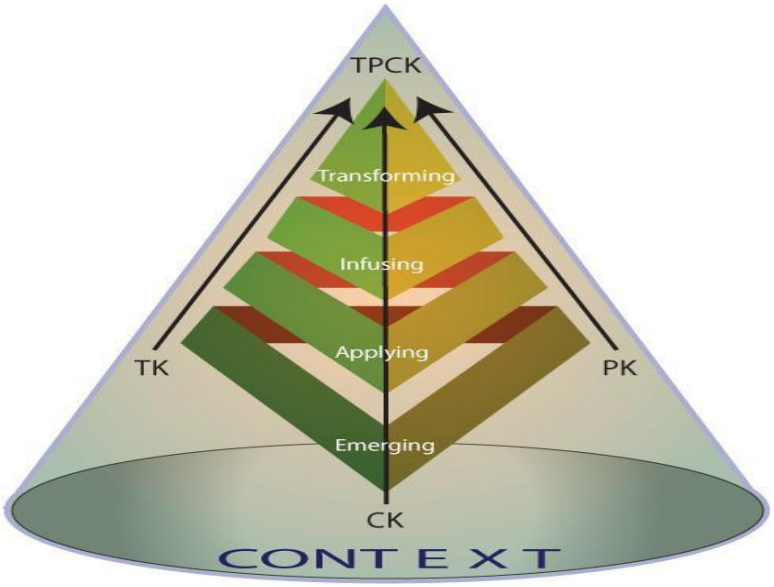


Fig: 2.3 ICT-enhanced Teacher Development (ICT-eTD) (**Temechegn, 2011)**

2.1.4 Information Communication and Technology –Competency for Teachers (ICT-CFT)

The second conceptual framework in this study is ICT-**CFT UNESCO (2011) version.** The ICT competency framework for Teachers (ICT-CFT) was designed by UNESCO (2008) and the first version was released in 2008 which is meant to enable Policymakers and education planners to harness the competencies educators need to utilize ICT in the organization of educational services. The competency benchmarks were made in a joint effort with International organizations like Cisco, Intel, and Microsoft, and ISTE. The structure was made by a convergence of three ways to deal with ICT integration, they are Technology Literacy, Knowledge Deepening, and Knowledge Creation. These three phases have six typical duties of teachers, which are understanding ICT in education, Curriculum and Assessment, Pedagogy, ICT, Organization and Administration, and Teacher Professional Development. (UNESCO, 2011). The Framework is critical to Teachers, academic networks, and the private sector that are interested in creating and developing a well-balanced model to integrate ICT into the professional development of any field of practice. UNESCO ICT-CFT framework is a global plan to augment any country that is interested to contextualize the standards of teachers' ICT skills for the utilization of ICT in the educational plan. The structure was contextualized in the study for the Vocational and Technical Education Program in Nigeria. Figure 2.4 shows the schematic figure of UNESCO ICT-CFT

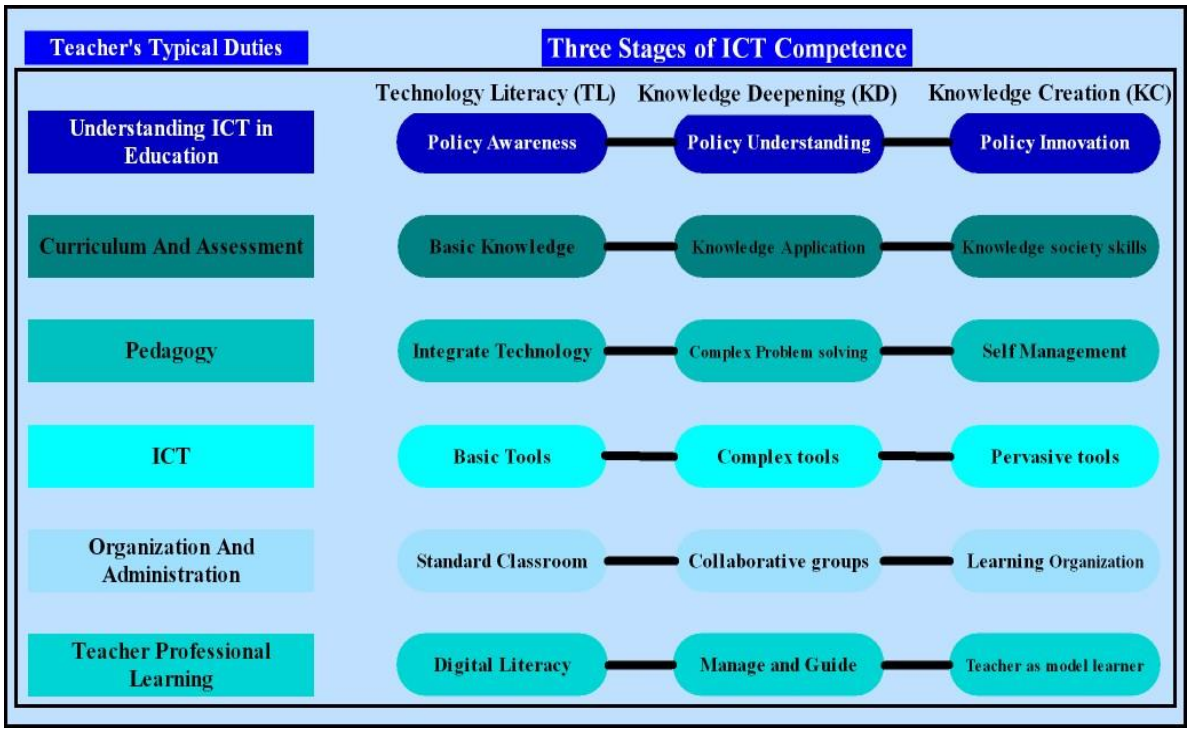


Fig 2.4 ICT-CFT UNESCO 2011 Re-illustrated (modified version)

The final product of this study would require students to produce instructional software that can be applied to teaching and learning some specific topics adjudged difficult to teach and learn by teachers and students of Technical Drawing. Therefore, there is a need for a careful and more relevant instructional design model that will accommodate the nature of Technical Drawing. Kemps model has been found useful and relevant. Kemps model is a model not linear in nature, that is, one construct does not lead to another which makes it flexible for designing instruction, it is cyclic in nature which means you can start from anywhere in the design. It allows the designer to isolate the constructs without one affecting the other.

There are nine components in the focal point of the procedure which Morrison, Ross, and Kemp accept as fundamental for compelling planning (Gustafson, Branch, and Eric Clearinghouse, 2002). In no specific request, an instructional designer following the Kemp model would use the Kemp model because of its suitability for large course design. It allows instructional designers to initiate the process of instructional design at any point in the model. The software of the final product on Engineering/Technical drawing course will cover all the adjudged difficult which are normally taught in the first year of universities, polytechnics and colleges of education/Technical for engineering or technical education students, it is a large instructional content creation that will not only require a careful planning but much more require opportunities to begin the content creation process at any point in time which other models do not allow because they are linear sort of in the approach; it also gives support services by giving a cursory attention to learners' environment.

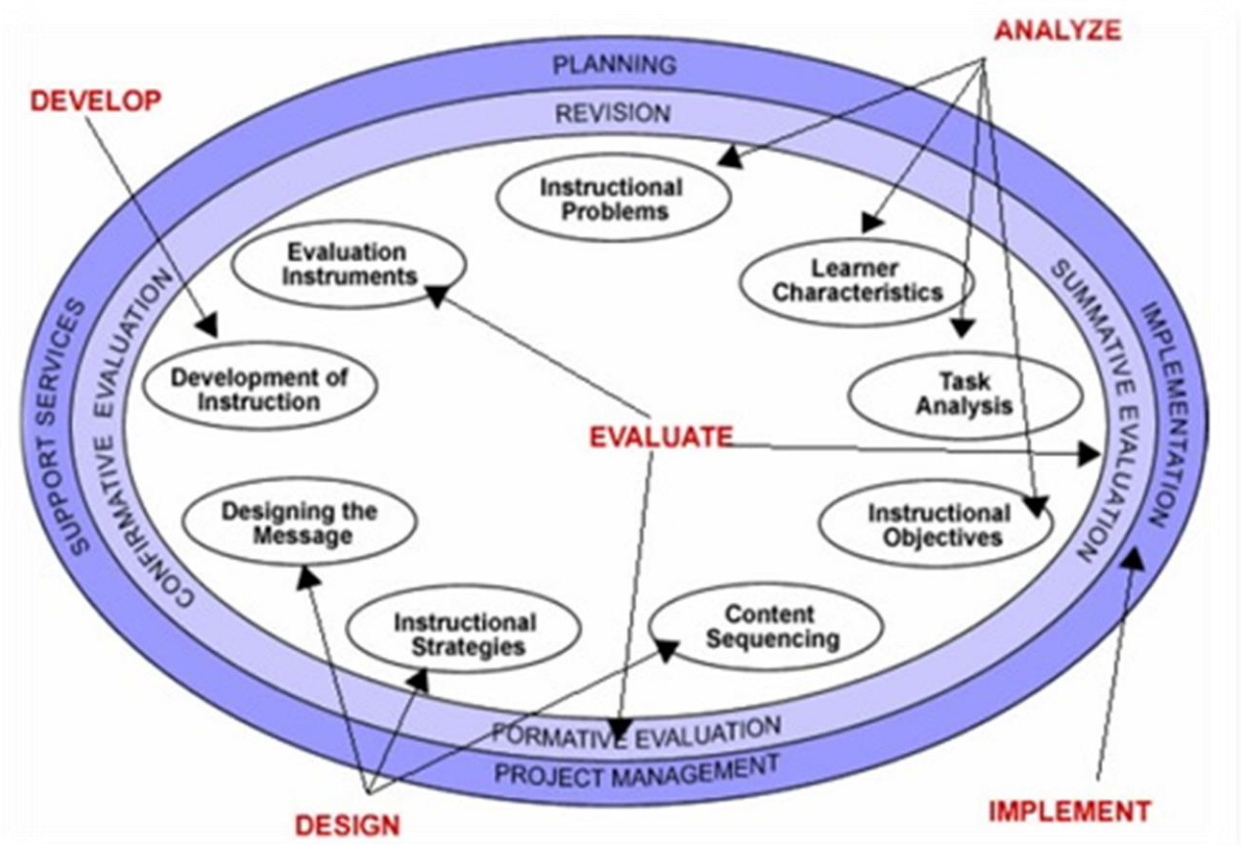


Fig 2.5 Kemp Instructional Model (Morrison, Ross, & Kemp, 2007)

1. Identify the instructional problem: What is it that you have to educate? The instructional designer may carry out an exercise of requirements appraisal, objective assessment, or performance evaluation to decide the instructional objective
2. Examine the intended audience: Describe the statistic attributes of the student and their experience information
3. Examine subject content: Consider the present reality applications of the content from the student's point of view. Decide the learning setting and performance setting. What learning and skills, methodology, and correspondence are essential?
4. Compose instructional objectives: Define the cognitive and affective aptitudes the student will execute because of the guidance. Incorporate criteria and conditions explicit to the guidance
5. Request instructional content: Determine a logical succession for the guidance while considering factors, for example, requirements and level of difficulty
6. Choose how to exhibit the material: Develop instructional techniques for review, reconciliation, organisational, and elaboration. Models incorporate retention, producing questions, sorting, and making charts
7. Build up the instruction: Prior to guidance, conduct a pre-test, state the destinations to the students and present an outline to the student. Choose how to present your "message" to the group of audience
8. Create assessment instruments: Conduct developmental and summative assessments dependent on models of achievement. Incorporate opportunities for self-assessment, just as testing for abilities, practices, and mentalities
9. Select significant assets: Identify beneficial assets, for example, media and models, gear, and even staff to help your guidance.

2.1.5 Technical and Vocational Education and Training (TVET) in Nigeria

Technical and Vocational Education & Training (TVET) is to make individuals in the society to acquire skills, knowledge, and creativity that depend on the quality and capability of the TVET, (Obadara and Oyebolu, 2013). Technical and Vocational education (TVE) enhances

skills that are valued in global and local economic growth. TVET is potentially one of the most important tools for national and regional development. It is also one of the most important vehicles for developing essential skills in young people in and outside schools. These skills are essential for employment and the nation's economic growth. Technical and Vocational Education as a commonly known term has been seen by different authors in different ways, authors like Okolocha (2012); Bushra and Xueping (2013) and Jallah (2004). Some authors explained the concepts separately while others explained the two concepts jointly. Generally, the TVET program has been viewed as a program of education which is also known as a skill-based program designed for sub-professional level education and based on a specific vocation.

The real distinction between the two terms is that professional training gives general specialized learning. While each professional training project is specialized in nature, not all specialized instruction is professional. This inconspicuous relationship represents the compatible utilization of the two terms in scholastic writing. The Federal Republic of Nigeria ((2004) through the National Policy on Education (NPE) (2004) expressed Vocational and Technical Education/Technical and Vocational Education (VTE/TVE) as those parts of instructive procedures including notwithstanding broad training, the investigation of advances and related sciences and the acquisitions explicit abilities required for the economy and national activity.

The NPE which appeared because of the national educational plan gathering of 1969 further expressed that VTE/TVE is a fundamental piece of general instruction and a method for preparing individuals for word related commitment and successful investment in the realm of work. It is a part of life learning and readiness for dependable citizenship; an instrument for advancing earth sound reasonable advancement and a technique for lightening destitution. Okolocha (2012).

Meanwhile, TVE/VTE has been unable to perform this function of improving the skills of the recipients of the program. However, to arrest the situation, the educational policy at both post-secondary and posy secondary levels in Nigeria is being revised to reposition TVE/VTE program, (Otunla, 2015).

The National Policy on Education under section 3 sub-section 49 refers to TVET as a far-reaching discipline alluding to parts of instructive procedures including liberal education, technologies and related sciences investigations or researches and the securing of aptitudes, frames

of mind, understandings and information identifying with occupations in different segments of economic and social life, FRN, 2013. In an attempt to ensure the reliability and sustainability of the mission of National Policy, NPE has highlighted the goals of TVET as follow:

- Provide trained manpower in applied sciences, technology and business particularly at a craft, advanced craft and technical levels;
- Provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development;
- Give training and impact necessary skills to individuals for self-reliance economically.

TVET is an educational training that encompasses knowledge, skills, competencies, structural activities, abilities, capacities and all other structural experiences for securing jobs in various sectors of the economy or even enabling one to be self-dependent by being a job creator. It is clear in the assertion of Okolocha (2012) that the issue of competencies is key to making individuals relevant in society by contributing his/her quota to the development of the society he/she belongs to.

The above definition as stated in the National Policy on education has only catered for the broad aspect of TVET but on the other hand, Technical Education as a component has its focus on practical skills that should be acquired through both formal and informal education

2.1.6 Teaching of Technical Drawing

Engineering/Technical Education is a professional discipline that is fully committed to solving societal problems with the available resources and in the most economical ways. For any economy to stand the present challenges of development, the government must pay adequate attention to technological advancement in all aspects of its national life. Many stakeholders said that this can only be done according to engineering its rightful place in the scheme of things. Nearly all human daily endeavors are driven by engineering. The beds we sleep on, the water from the tap, the toilet, the car, elevator, photocopying machine, wristwatch are all products of engineering. Without engineering, little or no development could be attained. It is significant for everyone to comprehend the significant job of building for the right situation of the calling through joint endeavors (Adeola, 2010). Present-day countries show incredible worry for education and training, particularly in science, building, and technology. This is because it enables rapid development of the social and economic infrastructure necessary for the growth of enterprise, Gemade, 2009 and reduces poverty; bridge the gap between nations in the knowledge emerging society. Ajimotokan

et al (2010) reported that the Nigerian government has made frantic efforts to encourage engineering education. From the mid-1980s, specialized universities with a mandate to increase scientific, technological and agricultural contributions to the transformation of the country were established Ajimotokan et al., (2009); Ekeh, (2009). There is a growing concern over the astronomical decline in students' academic achievements in engineering drawing courses in tertiary institutions in Nigeria. While some experts have blamed the spate of failure on the lack of commitment on the part of the government at all levels, others feel it is a problem of implementation of government policies on education. Onyeachu 2008 asserted that no matter how well a curriculum of any subject is planned, designed and documented, implementation of the curriculum is important.

All learners at the various levels of the nation's educational system are expected to be provided with appropriate learning experiences. Systematic integration of a variety of resources in the teaching-learning process and environment produce appropriate learning experiences, which in turn result in effective (active) or meaningful learning. The problem bedeviling the effective teaching and learning of this important course (Engineering drawing) is what this paper intends to investigate and proffer possible solutions. Researchers generally agreed that a basic understanding of fundamental concepts of projection theory, orthographic projection, isometric drawing, hidden views, and sectional views was problematic to most learners due to poor spatial ability. Also, the ability to grasp these topics is critical as it represents the fundamentals of engineering drawing that deal with the construction of 2D and 3D geometry, and the creation of multi-view and pictorial representations (Bertoline and Wiebe, 2002; Olkun, 2003).

2.1.7 Roles of ICT in TVET Program in Nigeria

Country working for practical advancement and economic development is subject to an increasingly educated workforce that can enhance monetary yield which effectively prompts country building and economic frameworks. This workforce needs capacities to enable them to enhance a country. Its absence can make the general public and its residents absorptive, Edu, 2016. Nonetheless, countries like Nigeria where the enormous number of laborers have lost their jobs, and a noteworthy number of youngsters are jobless or underemployed, how would you anticipate that such a country should grow financially when skills polarization between supposed personality or information specialists and untalented low-learning specialists has been created.

Youth, women, and older workers are the most affected groups. To have a workforce that is productive in terms of economic output requires that such be skilled in whatever occupations they engage in. Occupations like crafting, technology-oriented occupations, skill-oriented works amongst others are supposed to make individuals in a society employed having acquired the necessary skills during training. When individuals acquire this skill-based training which normally should take place in institutions running Technical and Vocational Education and Training (TVET), such individuals should possess the necessary skills to function effectively in society. Workforce not being able to perform effectively as expected has brought about considerable challenges to Technical and Vocational Education & Training (TVET), a course of study supposedly to cater to skilled-oriented individuals in the society.

In recent years, this process of teaching and learning has witnessed a major shift in the way it is presented especially in the 21st century where technology is the major driver of both economic and social life. This has emphasized technology use in education parlance and also brought a shift in teaching and learning. Due to this paradigm shift in teaching and learning towards the use of Information and Communication Technology (ICT) to enhance the teaching and learning, TVET as a course of study is not left out from the effects of this shift., the shift towards the use of ICT has some vital benefits that can help lift the face of TVET program in Nigeria and also provide ways of solving problems associated with the running of TVET in Nigeria.

Imel (1998) recognized four unique utilization of ICTs in grown-up education, to be specific: Technology as curriculum, Technology as a conveyance component, Technology as a supplement to guidance, and Technology as an instructional device. Following is a short portrayal of each methodology. When utilizing technology as a curriculum the attention is on creating ICT proficiency competencies. There are two kinds of ICT in education. The first is nonexclusive ICT education competencies, for example, keyboarding, word-handling, utilizing databases, utilizing spreadsheets, work area distributing and utilizing the Internet for research and correspondence Kasworm and Londoner (2000). In this system economy, each alumnus from TVET projects needs to possess these fundamental and conventional ICT education abilities. The second ICT range of abilities are occupationally explicit ICT literacy skills. Instances of these skills incorporate the capacity to utilize CNC hardware, work with CAD/CAM, and work gear with computerized framework controls.

At the point when technology is utilized as a conveyance system, the attention is on bundling course content for digital delivery. Normal methodologies in current use include Computer Assisted Instruction (CAI), Computer-Based Instruction (CBI), and electronic or online guidance. Open and Distance Learning programs utilize technology as their conveyance component. At the point when technology is utilized to supplement instruction, the accentuation is on giving opportunities to rehearse practical abilities taught and broadening learning by working with explicit programming applications Kasworm and Londoner (2000). Simulation systems are frequently utilized in TVET to address safety worries during the underlying period of preparation and to counterbalance the expense in leasing hardware for preparing crane operators and truck drivers. In its least complex structure, technology can be utilized for drill and practice to supplement instruction. TVET program in Nigeria has been plagued with so many problems for its non-being effective in delivering its goals.

Some of the identified problems associated with the TVET programmes as shown in various studies like Otunla 2015 and Uwaifo, 2010 have been seen to pose a great threat to the survival of TVET programmes in Nigeria. This has lingered for decades without any flick of improvement on the existing deplorable conditions. These problems are discussed with how technology could be used to proffer solutions to them.

One noteworthy issue related to TVET programmes in Nigeria particularly is the issue of insufficient supply of specialized workshops/Laboratories. The majority of TVET offices in Colleges of education do not have a research center or adequate workshop facilities not to mention gears, and departments where they exist, the accessible laboratories and materials have been provided by the department when it was simply established. Uwaifo, 2010 attested that of the considerable number of institutions in Nigeria running Technical Education starting in 2005, only 40% are with laboratories or workshop spaces for Technical Education programmes. The other 60% do not have laboratories or workshop spaces, Oryem-Origa (2005). There are two fundamental solutions that technology can bring: It is either, a virtual workshop/laboratory usually called workshop less kit is used or a video shot of a standard workshop/laboratory in a particular area or field of study is recorded and make available for use in another area for replications. If technology is used to have access to virtual workshop and laboratory through the internet which is not limited by time or space, the problem of inadequate supply of Technical workshops/laboratories for TVE programmes will be considered and relatively solved for the

process of teaching and learning of the Technical Education recipients. Therefore, translating virtual skills to technical skills will be very practical unlike when such is not available at all. This virtual workshop/laboratory is designed to accommodate different operation as if one it is in a real practical workshop with the use of animation and simulation. This problem can be solved if a virtual workshop is brought into play to foster the process of acquiring virtual skills which can be translated into technical skills in a real situation.

Problems that would be available in the reality can be mirrored and replicated through computer simulation and dedicated virtual laboratories to be presented to learners and tutors to make use during practical periods of technical course. Examples of this virtual kit is the movement in Europe popularly known as Engineering Mobility in Europe.

The problem of lack or inadequate supply of workshops is often accompanied by the problem of inadequate instructional materials and consumables in TVET and where they are available, they are very expensive to procure and the federal and state governments have not been providing funds to address this critical area. All we are getting in Nigeria has been just lip service to TVET. These instructional materials and consumables differ from one area of specialization to another which makes it more difficult to procure all the needed materials to explain different concepts and make them available for practice. Instructional materials and consumables are two different things. Instructional materials are used to support or aid teaching and learning of courses in TVET but Consumables are material needed to do practical works in the workshop/laboratory. Of course, in a virtual workshop/laboratory, there are adequate requisite resources that could be used as many times as possible without depreciating or loss of value in any way.

In terms of instructional materials, there are enough supporting materials over the internet to be used for any concepts being provided by some institutions that have gone ahead in development and made available for nations to make use of with no charge of fees. These resources are available in form of online or offline (downloaded) which are in different formats such as PDFs; audio description of concepts; video files of how complex mechanism takes place; different animation and simulation of different operations. The use of technology in TVET programmes cannot be overlooked at all because of the globalization effect around the world that gives everybody equal access to what is being done in another place which can be beneficial.

The truth is, TVET instructors and students are not motivated at all due to inadequate supply of workshops and laboratories and where they are available there are no adequate instructional

materials and consumables. The motivation in this context is alluding to when the conduction unit is prepared to direct for it, not to conduct is irritating but rather if the conduction unit is prepared to conduct for it to direct is fulfilling. Often students and instructors are ready to conduct or motivate either by what they want to learn or teach for them to conduct or be motivated to do what they are motivated to do is satisfying. The kind of environment provided by technology could motivate TVET instructors and students to greater levels to work when they have access to create virtual samples of works that can be replicated in the real world.

The products of this system, of course, would meet the requirements of the society solving real-life problems that already have been demonstrated virtually in the virtual classroom. This virtual classroom or workshop gives opportunity for both instructors and students to think critically and creatively and this would, in turn, improve the professional, personal and public image of TVET programmes which has been seen as another problem plaguing TVET programmes in Nigeria Even though the general attitude of the public towards TVET programmes is negative, however, general public must be made to recognize that TVET programmes are the backbone of any nation for technological development. But this cannot be redeemed if there are no positive proofs to change the attitude of people.

Another problem that has been found to plague the TVET programmes in the Nigerian educational system is the problem of a well-equipped library for research work or projects. This does not leave TVET programmes unaffected because it is a part of the system. However, this problem in TVET programmes can also be solved with technology use if properly annexed. Having access to this kind of technology-based learning environment like LMS and CMS will provide opportunities for their users to access the backpack or library where research works and projects can be carried out. Each of these platforms has a well-equipped library full of resources for their users. Moreover, opportunities are abounding over the internet for virtual libraries in different areas. There are specialized libraries for TVET in Singapore. Therefore, TVET instructors or students that are ready to carry out some research works/projects can do this successfully because the online or virtual libraries are stocked with up-to-date textbooks and periodicals in their area of specialization, some of which are available offline.

It is not possible to have this kind of learning environment where creative and critical thinking are encouraged and real-world learning would not have taken place. Having authentic learning in

TVET programmes is a serious bottleneck to achieve in TVET and this is due to lack of enviable and conducive learning environment. But with technology, this is possible by giving access to students and teachers to collaborate and interact among themselves. They can even have access to collaborative works of students in advanced countries who are undergoing the same projects and ideas could be shared. This is possible with a lot of web 2.0 or 3.0, the likes of social media, blogs, wikis that allow people to share their views and pass comments and even at times ask questions. There are YouTube videos that are interactive, webinar, web-conferences and others that TVET can make use of. Again, lack of this kind of environment will be frustrating and will unavoidably make some intelligent individuals migrate to where they can be allowed to explore their talents, this is called Brain Drain.

Concerning this investigation, the cerebrum channel alludes to the development of instructors of TVET which are required for the financial and mechanical headway of Nigeria from one university to another university or to different professions (counting legislative issues) calling for better states of administration. Akintunde (1989) distinguished five unique segments of mind channel: specialists in scholastics who moved to the business where they show signs of improvement pay for their administrations; speakers and students who leave the nation to gain more information and expertise however later would not return; teachers who move from one nation to another looking for better states of administration; competent experts who abandon the act of Technical Education for other progressively worthwhile monetary profession and political appointment which are not identified with their preparation; talented experts, although in their field of preparing who do not give their complete consideration to their activity due to their push to enhance their income through other inconsequential financial exercises.

The report of Bassi (2004) demonstrates that: about 45% of every single Nigerian expert including Technical Educators has left the Nigerian shores throughout the decades since colonization. Somewhere in the range of 1997 and 2007 alone, Nigeria lost more than 10,000 middle- level and abnormal state directors toward the western economies. Around 500 speakers from Nigerian universities keep on emigrating every year, especially to Europe, America and other African nations where the state of administration is generally better. These Nigerians in Diaspora contribute multiple times more riches to Europe, America and other African economies. The central issue would now be how could technology be utilized to offer help for TVET courses and help the teaching and learning of TVET courses?

The consensus among educational practitioners is that the use of ICT/Technology is the use of processes and technologies to create, distribute, manage, and enable learning via an electronic network. One may wonder how ICT (e-learning environment) that is similar to distant learning in design and presentation can support the nature of courses offered in TVET because the majority of the courses require hands-on activities (practical activities). ICT-based environment and its flexibility can be used for the development of course content by lecturers/instructors. This will offer both teachers and students an opportunity to upload and download course materials (interaction), such as materials that deal with practical (hands-on) activities. (Gupta, 2002).

2.1.8 Design-Based Approach (DBR)

Design-Based Research (DBR): The introduction of cooperation among masters and specialists at the beginning period of research is an effective way to deal with and its capability to facilitate technological innovation in schools. Associating clearly with specialists and school situations can wipe out much unrewarding examination. While specialists or teachers could present an insignificant request, having a certified exchange and dialog over the exploration motivation uncommonly grows the probability that the right request will be suggested — conversation starters that will incite examine that produces important and material picking up keeping an eye on the prerequisites of instructors. The emphasis of professionals, at whatever point given full idea, inconsistently address unnecessary issues. The movement of investigators and experts is to organize what can look at.

The undertaking that initiates the investigation is based on another instrument at the basic level, which is viewed through the goals of a genuine circumstance and researcher’s input or contribution that could assist in adopting such designs and tools. The cycle of interactions supported by authentic situations can help generate effective interventions. Considering the explorations that should help to select the sample of structures for educational technology in schools, such as specialists' job that incorporates a working job inside the framework, organizing the improvement and affirmation of new tools and strategies. DBR provides a cycle that advances the intelligent and whole deal foundation whereupon conducting research can be established. Educational technology specialists should be stressed over breaking down the innovative method as it spreads out in all our educational institutions which will impact on the larger society.

These results in a cycle of research that is strikingly not exactly equivalent to what is correct currently looked for after by various analysts in the field. In standard observational traditional

research, another new procedure is put under an amplifying glass in a controlled domain. The time of commitment with the upgrade is commonly confined under time prerequisites. Cycles are asked to refine theories, yet the duty to the iterative structure is commonly obliged (one-shot examinations).

Finally, Instructional designers and developers should on different occasion work closely with field experts and, when accomplished effectively, interest is confined and is implemented outside of the zone of training. Specialists are only here and there part of the examination configuration process; they are planned to get the advantages of research when it is finished. DBR begins with the course of action of research goals among specialists and scientists.

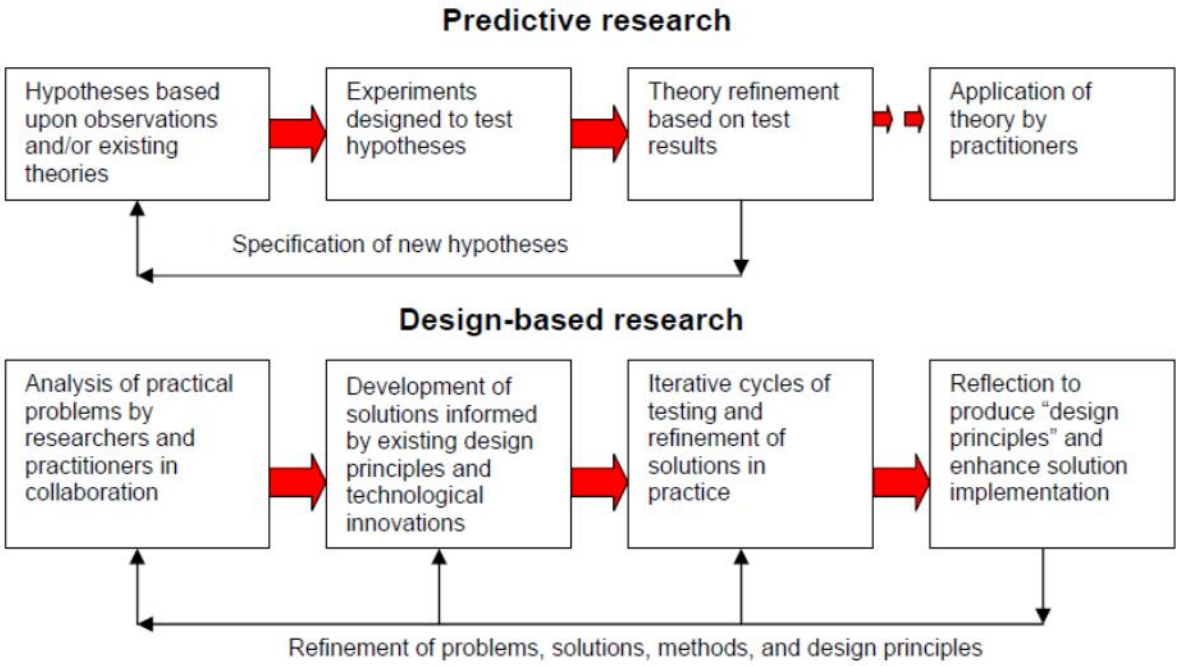


Figure 2.6 Design-based research (DBR) (Amiel and Reeves (2008)

Figure 2.6 shows that the specialists are seen as a significant accomplice in generating questions that could be used to kick-start the inquiry and perceiving issues that are relevant to the investigation. Additionally, effective plans to address the teaching-learning environment should be proposed. The DBR specialist is unassuming in pushing toward research by seeing the multifaceted design of associations that happen in genuine conditions and the significant confinements of proposed structures. The improvement of structure guidelines will encounter a movement of iteration cycles. Data is accumulated productively re-portray issues of potential courses of action, and the guidelines that could be used to solve them. As information is reevaluated and reconsidered, new initiative ideas are made for implementation, making a predictable cycle of structure reflection-structure.

DBR's by-products are a lot of plan models or rules chose decisively and richly outlined, which can be executed by others eager about taking a gander at proportional settings and concerns. While a total goal is the improvement of speculations, this may essentially happen after the entire arrangement obligation and distinctive arrangement assessments. Five attributes of DBR perceived by Akker, Gravemeijer, McKenney, and Nieveen, (2006) will be investigated to address this solicitation. They are: interventionist, iterative, process organized, utility masterminded, and theory orchestrated. The comprehension of advancement as a procedure remarkably manufactures the multifaceted thought of the blend of instruments into learning circumstances. Instructional Technology becomes more than essentially a self-overseeing variable in an examination of students' learning. Consolidating signs of progress into the learning condition prompts amazing changes in a social connection, learner-instructor connections, and a horde of different parts that cannot be broken down suitably by customary research.

Examiners must make an assurance to driving interventionist look into in true settings, for example, schools, bearing the multifaceted nature of the setting. The work of Kafai (2005) is of a contrary opinion educational institution can make available settings in which researchers could experiment with the ideas that mirror the reality. One of the DBR stages which is to iterate solutions at different times or the order would make researchers control key factors that are perceived to be responsible for the problem initially discovered. Point of fact, it is idealistic to foresee enormous and transferable results from a onetime examination of innovative intercession. Using iterative cycles of plan and re-structure, while thinking about the assessment of these fundamental elements and hindrances, creating logically transferable and supportive results.

Nelson, Ketelhut, Clarke, Bowman, and Dede (2005) portray this system in the arrangement of a multi-customer virtual condition in Rivers state, used to indicate youths water tainting. They tried numerous emphases of a plan with a wide range of gatherings of youngsters while rolling out deliberate improvements to specific parts of the structure and reporting its belongings. Various emphases took into consideration design changes and testing with an assortment of gatherings, loaning more prominent transferability to the structure itself.

2.2 **Theoretical Framework**

2.2.1 Competency Theory

The study is dependent on two theoretical reviews: Competency and Engagement theories. Competency theory is generally called transposition of competency and learning. The theory was first introduced in 2005 (Azemikhah,2005). The statement of the theory shows that competency is a bye-product of mind, hand, and a balancing element. Therefore, competence is first created conceptually and transferred to hand for implementation which is usually moderated by a balancing element that adjusts the effect of formally conceptualized ideas.

The theory clearly states that competency development has three integrating elements which are the conceptual, physical and equilibrium. The conceptual element is targeting the mind, the physical targeting the hands and while the equilibrium element balances the two elements. The balance is the changing portion obliged by an individual and supported by the instructor utilizing abilities as the affiliation fragment between the two methods, Azemikhah (2005) equally stated that the competency improvement process in the model as connected with the Mental Reflection procedure is equivalent to physical activity process. The twofold techniques change the students by utilizing capacities as the correspondence parts and it depends upon the individual advancement of importance with the target that experience and learning are inconsistency, Stevenson (2000).

The competency development strategy merges the two phases. The central stage is the point the students perceive the key idea from the required information and components accessible in the competency unit. The middle is to interface the key ideas inserted in, or prescribed from, the issue to the variables and performance criteria in the unit of competency. The fundamental stage is finished by posting the key thoughts of the issue. The fitting factors from the Unit of Competency will be captured and recorded on the conceptual side and Figure 2.1 shows the exhibition criteria recorded on the left (Physical) side. The significant abilities or competencies are recorded in the inside. The key ideas are then associated with variables and factors are connected with skills,

capacities to performance criteria. At this point, the subsequent stage stretches out to all the three sections of the primary stage. For instance, it stretches out into the associated side by seeing important theories and ways of thinking patterns.

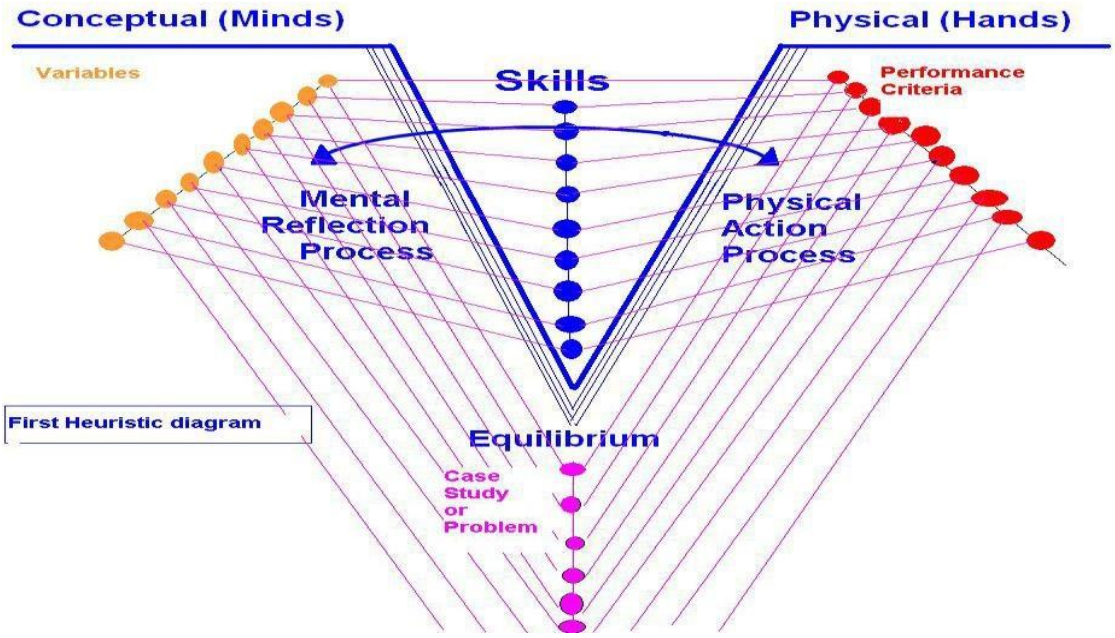


Fig: 2.1 Competency Theory Source: Azemikhah (2005)

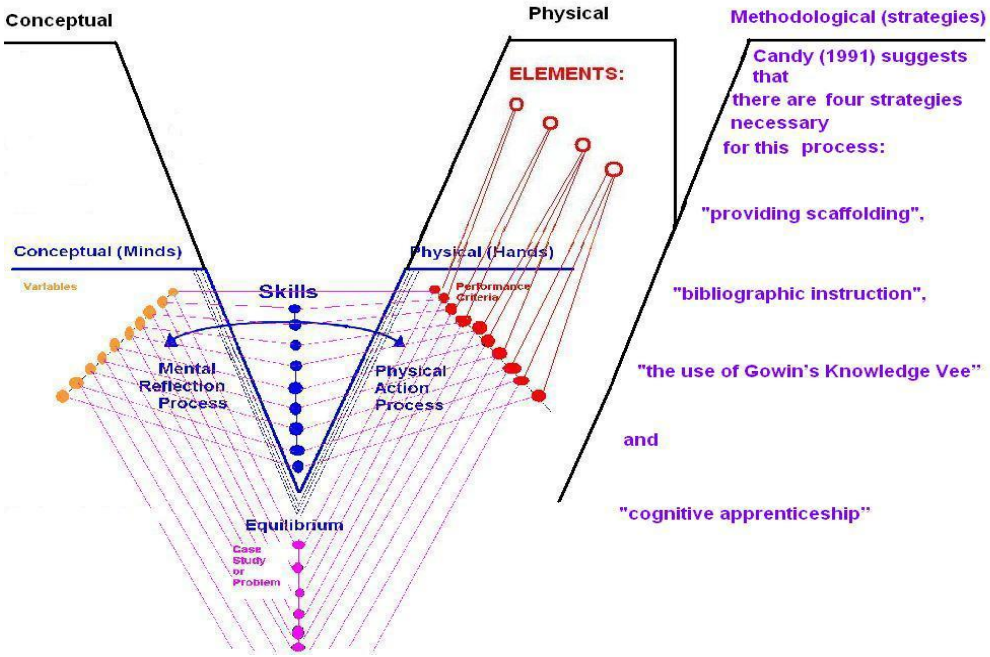


Fig: 2.2 Source: Azemikhah (2005)

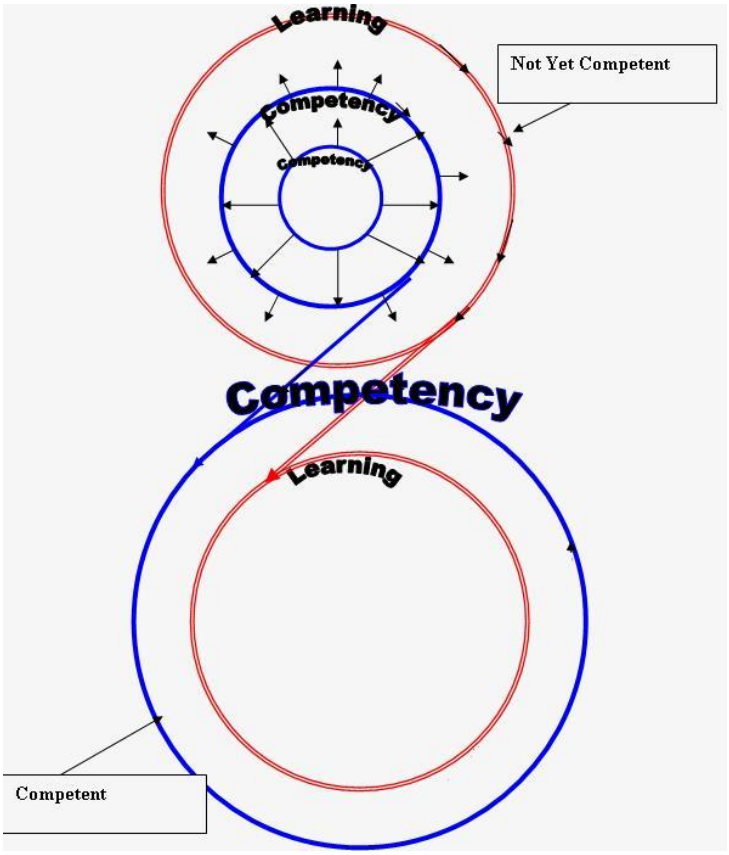


Fig: 2.2.3 Competency Theory: Transposition Source: Azemikhah

The competency advancement procedure is emphasized for various occasions, utilizing simple to complex issues, until the student has accomplished strength in the unit of competency. At every improvement, is appeared by extending floats in the competency theory, the students' degree of competency and demonstrable skill derricks to a higher level. This technique proceeds until the student touches the base of the motivation behind the transposition of competency and learning. Now, the student is viewed as gifted and equipped. At whatever point, competency and learning are transposed, the student moves from the Not Yet Competent position to the Competent position, Azemikhah (2005).

The relevance of this theory to the present study lies in the ability of learners to master any unit of competency in the TVET programme which is anchored on the extent to which the teacher is competent in that area. This is because the lecturers' ability to strike a balance between the use of the mind (the conceptual element) and the hands-on also referred to as the physical elements is dependent on the ability of the teacher to use skills as an interplay element. This implies that if TVET lecturers are not ICT competent, the vision and mission of the TVET programme may not be achieved owing to the critical role of the TVET teachers in the building of a 21st century-based national economy.

2.2.2 Engagement theory

The construct of engagement is defined in general as involvement, participation, and commitment to some set of activities. It is currently argued that engagement can be defined as a reflection or manifestation of motivated action and noted that action incorporates emotions, attention, goals, and other psychological processes along with persistent and effortful behavior (Skinner, Kindermann, Connell, and Wellborn, 2009a, According to Fredricks, Blumenfeld, and Paris (2004), that school engagement contains behavioral, emotional, and cognitive aspects.

This study is dependent on Engagement theory as proposed by Fredricks, Blumenfeld, and Paris (2004). The tenet of their hypothesis is that the engagement of learners toward improving academic performance is divided into three however overlapping levels. The levels are behavioral, emotional, and cognitive engagement. Behavioral engagement is related to activities that range from learners' class-room activities to participate in extracurricular exercises. The emotional engagement is equally related to responses to peers, educators, the curriculum content, and school that impacted learners' ability to be engaged with exercises inside and outside of the classroom.

The last tenet which is cognitive engagement is related with whether learners are interested to "apply the exertion" that is required to comprehend "complex ideas and ace difficult skills, having exhibited that hands-on exercises could help secure competency required in the field of TVET, this theory is applicable, because it considers what learners produce after the ICT Competency training, and draw in their cognitive domains during practical and active exercises. Engagement theory has been discovered valuable to clarify how TVET pre-administration instructors can utilize ICTs skills and connect learning to resolve practical problems.

2.3.0 Empirical Review

2.3.1 ICT Competence and ICT policy in Education

ICT integration among teachers or professionals from all other fields requires first that they understand there is a policy that supports the use of ICT for various activities, and when this understanding is not in place there is a possibility that ICT usage will not be effective. Studies like Yusuf (2005), Hooker, Mwiyeria and Verma (2011), Badau and Sakiyo (2013) have shown that teachers' ability to implement ICT based curriculum is connected to their policy awareness which has been reported to be very low. This then means that if teachers do have adequate knowledge of ICT policy, a mother-tongue teacher will not understand the basic principles of using ICT in teaching, so she will not consider how to make the best use of an ICT tool like for example an Interactive White Board that has been installed in the classroom to facilitate the effective lesson delivery among the learners. Therefore, understanding ICT policy will speed up the rate at which teachers make use of ICT for their duties. UNESCO (2008) concurs ICT strategy competence for instructors should imply that educational practitioners be able to master skillfully the ICT-CFT structure and explicitly explain its classroom application.

The finding of Yusuf (2005) disagreed that understanding ICT policy is not sufficient to positively affect the Nigerien system of education. Adequate ICT policy awareness among teachers will help them to reflect on how best they could leverage ICT to change the attitude of learners in their various subjects (UNESCO 2008). There is no doubt to the fact that using ICT to facilitate the learning of students could change their attitude to learning and directly affect their academic performance. On the other hand, the effective use of ICTs as teaching-learning resources has been associated with a significant increase in students' achievement, and students' attitude to learning has been greatly increased. In that, Students gain confidence as they get engaged by their teachers

and sometimes work together with teachers as coworkers in an attempt to solve some technological problems (Grabe and Grabe 2007). Equally, students also get engaged in activities of searching the web, solving problems and conducting other class activities with aid of technology which they find exciting and complete their learning tasks which they sent back to the teacher through email. Effective use of ICTs as teaching-learning resources has been found to significantly increase students' achievement and attitude Bitner and Bitner (2002).

The use of ICT integration also promotes a student's critical thinking and problem-solving skills needed in life. (So and Kim, 2009). The study of Kisirkoi (2015) equally affirms that where schools make use of ICT as a learning tool, there is an improvement of learning environment and outcomes and therefore, schools should emulate these best practices. In such schools as this, teachers is expected to initiate the leadership role in establishing an ICT-based project that allow students' collaboration with all other teachers in school., when such activity is carried out or sponsored either by the school leadership or teachers' initiatives it can be attributed to teachers have acquired adequate knowledge of ICT policy that supports the use of ICT in their locality. (UNESCO 2008)

2.3.2 ICT Competence and Curriculum and Assessment

One of the basic and beneficial outcomes of sufficient learning of ICT approach among educators is the educational plan and Assessment. Educators need sufficient and profound learning of the educational plan as it identifies with a branch of knowledge. For instance, an instructor who has understood that utilizing MS Word applications on the intuitive White Board would offer another way to deal with the problem of aptitudes by improving text editing and sentence construction would attempt in guaranteeing ICT is utilized to show themes in the educational program by subject-based. The discoveries of Badau and Sakiyo (2015) show the low skill of ICT instructors in educational plans to actualize ICT educational programs in optional schools.

What it means is instructors could not use devices for course structure and exercise arranging; usage of ICT devices to plan of educating learning materials; apply ICT tools to support students' understanding; apply ICT for developmental and final evaluation; use ICT devices to access and students to the world outside the classroom, and use ICT resources and help advancements for impactful educational program delivery. The importance of this skill system establishes that instructors must possess amazing information on the educational program principles for their subjects, similarly to learning of standard assessment procedures.

Besides, educators as reported by Iwuamadi and Ajeka (2010) that should probably integrate technology into the educational program with understanding some teachers especially Social Studies teachers lack adequate ICT competencies to apply ICT applications in teaching and learning of their subject.

The Physical Education educator would almost certainly utilize ICT to concentrate on issues of wellbeing which he had not had the option to make striking and connecting previously. Presently he is additionally ready to incorporate into the educational program data about human physiology. These subjects had recently been excessively conceptual and hypothetical to clarify effectively, however now he can demonstrate them PC reenactments (recordings and movements) of the physiological procedures which make them straightforward. In these ways, the learners accomplish more profound learning of PE. He is likewise ready to do developmental evaluation considerably more productively because he would now be able to record learners' exhibition in the rec center with an advanced camcorder. He demonstrates these video accounts to the learners to enable them to see how to move their appendages unexpectedly. Learners who already could not comprehend what they were fouling up in specific movements would now be able to see in a flash what they have to do. (UNESCO 2008).

2.3.3 ICT Competence and Pedagogy

As presented by Mishra and Koehler (2006) the push of successful guidance has three pieces; Content (CK), Pedagogical (PK) and Technological Knowledge (TK), regardless of the collaboration that created TPACK. The relationship between these three, accomplishes Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical and Content Knowledge (TPCK). These seven bits are encased together to shape a Total load of the structure. (Furthermore, Koehler and Mishra (2008) added setting to the structure, asset decides to an enormous degree how where innovation can be utilized in educational practice. Although most examinations on TPACK appear to negligence setting in the manner, TPACK can be utilized. (Koh, Chai, & Tay, 2014). It makes the structure tremendously available to a wide extent of settings. The examination of Agyei and Voogt (2012) for example showed that access to equipment and programming in a nation, for example, Ghana is phenomenal and classes commonly tremendous. They as such natural pre-service science instructors with spreadsheets, usually open application programming.

Pre-service instructors sorted out Mathematics practice in which spreadsheets were solidified utilizing a development-based approach to manage game plan with finding that fit, as it were, classroom. Regardless, the divulgences of Badau and Sakiyo 2013 show a low capacity of ICT educators' instructional system for executing ICT instructive programs in schools. Educators having the choice to utilize ICT to finish the instructional system is basic to utilizing it in the classroom. It is clear in UNESCO (2008), educators with ICT capability ought to have the option to address some relevant factors like the area of ICT usage, expected ICT clients and when to execute. Every one of these territories must be discovered by any educators that are keen on utilizing ICT to make learning exercises.

Findings like Hooker, Mwiyeri and Verma (2011c); Akudolu (2006) concurred that when such ICT skills are absent in instructor, which reports or discoveries demonstrated that such ICT capabilities are absent among educators, ICT incorporation into classroom learning exercises will be inconceivable. Be that as it may, a lot of discoveries have demonstrated that pre-service educators are set up to utilize innovation related applications to facilitate the teaching procedure. Supporting this report, Swarts and Wachira (2010) showed that paying little mind to how that educators have the essential data of ICT, a broad piece of instructors does not possess an idea of how ICT is composed of learning. For teachers to possess the alternative to apply ICT into a teaching technique for exercise arrangement, training, assessment and re-structure, opportunities to share in master improvement ventures must be supervised. (Kafyulilo, Fisser, Pieters, and Voogt, 2015)

2.3.4 ICT Competence and ICT Tools

The ICT competence expected of Technical education teachers and every single other teacher ought to be able to perform the following as presented by Hogenbirk (2006) that the ICT capabilities of teachers should bolster the educational goals by making teaching adaptable, creating individual learning path, improving the academic performance of part-time studies, creating engaging and interactive learning spaces, adopting new concepts in teaching, advancing teacher-student relationships, promoting and supporting community-based learning among others. The ramifications of this attestation by Hogenbirk (2006) is that there is such a great amount to ICT skills of a teacher than simply utilizing PC or ICT to encourage the teaching-learning process. Moreover, Simon and Rubens (2003) referenced that ICT competencies of teachers should

incorporate the following; invigorating imagination, conceivable outcomes for contacts among specialists and students, animating students, making learning process straightforward, invigorating students to learn, developing competences of students.

The perspective on Simon and Rubens (2003) appears to concur with the situation of (Kirschner, Wopereis, and Van den Dool 2002) about the outline of teachers' ICT competence. It is therefore articulated that ICT competence of teachers in training should incorporate fundamental competencies in Microsoft office applications and applying these skills to enhance communication. Also, ICT as a mind tool, teachers are expected to be able to utilize MS office applications to help in reasoning. Taking ICT as academic tool should improve teachers' insights, abilities, and involvements in teaching and learning process, most especially in research projects ICT as teaching tool, teacher should know the educational potential outcomes and difficulties of ICT; social parts of the utilization of ICT, teachers should not exclusively know about ICT yet besides purposely use ICT.

The ICT capable educator reinforces this by giving the perfect ICT gadgets. Accordingly, these instruments are not extra yet rather joined in the professional performance of educators, Zwaneveld (2005). The capability of the structure of teaching-learning courses is the skill which is to have the option to design and make materials and techniques for working with the new media. This basic ability implies that these perspectives: the teacher knows which application programming and equipment are open, how he can use them, what their suggestions are and what the outcomes are. It similarly joins to make the right assurance for this item and hardware, to use them in the teaching practice and to professionalize himself reliably to have the option to choose these devices for effective use.

The use of technology in learning helps in setting up the pre-service teachers to deal with 21st-century learners which are known as the 'Y' age. Studies uncovered that pre-service teachers who have acquired a bigger measure of technology abilities are moreover prepared to use innovation in the classroom, Paraskeva, Bouta, and Papagianna (2008). The report represented that pre-service teachers who had been prepared in ICT have a more grounded sentiment of self-adequacy to apply Personal computers (PC) (Brown and Warschauer, 2006; Lee, Chai, Teo and Chen, 2008). Notwithstanding of the findings, various gaps exist in the training program of pre-service towards the implementation of ICT (Haydn and Barton, (2007); Lawless and Pellegrino, (2007); Mishra, Koehler, and Kereluik (2009). The inadequate preparation of teachers to use ICT

for teaching-learning has drawn a worrisome concerns among researchers and scientists., Kay (2006); Swain (2006).

The planning of pre-service teachers for ICT combination in the classroom practice is an astounding errand considering the dynamics of ICT and the various wellsprings of information that ought to be consolidated. The reasonability of pre-service preparation for ICT is furthermore influenced by an enormous gathering of applicable elements, for instance, university educators' usage of ICT, school accessibility, guide instructors' outlook and among others (Lim et al., 2010). One fundamental issue in planning that affects preservice teachers towards ICT usage is that using ICT in the classroom requires more than arbitrarily training that is connected to a teacher's duties at various levels or the other. (Brown and Warschauer, 2006; Lim et al.,2010). Some of them acknowledge that having individual ICT tools and devices subsequently convert into using such for teaching and much of the time, the use of tools is not related to the instructional method and content consequently treating the usage of innovation in complete isolation from the content and pedagogy.

In any case, teaching ICT skills alone does not adequately get ready satisfactorily the pre-service teacher for its application in the classroom. (Lawless & Pellegrino, 2007; Mishra, et al., 2009). Such affirmation has made various pre-service ICT training courses to be handled as consolidated training materials and modules where its delivery and methodologies are a bit of the educational plan. (Angeli and Valanides, (2005); Lisowski, Lisowski, and Nicolia, (2006).

This specific student who can be made to consider new ideas when teachers are educated on how they can utilize technology to enable students to accomplish this change – moving from the period of non-utilization of ICT in education to real utilization of ICT, really exudes based on what is, for the most part, called the Net-Generation. The Net Generation students are digitally proficient and enamored by utilizing digital tools (Pittman, McLaughlin, and Bracey-Sutton, 2008; Short and Reeves 2009). The purported "Y" Generation students have been recognized to have short-attention span and technology has been distinguished to have the ability to boost fixation level in the classroom, Mayes, Calhoun, Bixler, and Zimmerman (2009). Coggshall et al. (2011) additionally announced that "Y" generation teachers were born between 1977 and 1995, this group of teachers is the most learned when contrasted with teachers born before these periods, because "Y" teachers possess high enthusiasm for technology. It is fascinating to take note of that teachers born between 1977 and 1995 are labeled the most learned instructors contrasted with the past age

all because the past age did not utilize technology, one would consider what might befall this 'Net age teachers if technology has meshed into the textures of the different daily activities.

However, ‘Y' (Net) Generation teachers still feel hesitant to utilize technology in their teaching-learning process, although they were born in the period of technology explosion. This circumstance was likewise recognized and upheld by studies like M.Al-Muz-Zammil and Abd. Muezzam Shah (2010) discovered that although the utilization of ICT for individual purposes and shared digital literacy among teachers and potential teachers is high, the pace of utilization in the learning process, in any case, is still at a moderate level. This hesitance that these 'Y' generation teachers display could be because of some underlining elements influencing their utilization of technology for encouraging the learning process although they frequently use it for individual purposes.

Mishra and Koehler (2006) emphasize that using ICT in the classroom would require teachers to blend technologies with pedagogy. These discoveries have not excluded teachers in TVET programs. Iteku (2015) proposed that TVET teachers should be supported more frequently to attend technical training, specialized pieces of training, workshops, classes, and conferences to be familiar with the most recent information in the technology space and how they can leverage affordances of technology to improve the teaching-learning of TVET courses. This will empower them to be prepared to utilize technology in the teaching-learning process and thereby address some related issues in the TVET program.

Notwithstanding, the finding of Badau and Sakiyo (2013) for teachers’ ICT competence is considered low in the implementation of ICT curriculum. As stated by UNESCO, 2005 that ICT teacher competence framework should include hardware and hardware operations with an emphasis on productivity tools, internet browsers, presentation tools, programming, and management applications. However, three years earlier, a study carried out by Titilayo (2010) agreed that the number of ICT teachers with fundamental ICT skills and usage is low. It is therefore established that nothing truly has changed in correlation with Hooker, Mwiyeri and Verma (2011a) findings, which equally revealed a year after that ICT technology space, for example, the competence to utilize ICT open-ended software applications proper to subject matter, the competence to utilize authoring tools to create digital resources is considered very low.

2.3.5 ICT Competence and Organisation and Administration

According to Badau and Sakiyo (2015), the report indicates that the required ICT competencies for teachers to integrate full-stream of ICT into the educational sector is considerably low. This finding cannot help contradicting the declaration of UNESCO (2008) that educator's competency structure which exhibits that instructor organization competency should in all likelihood ensure that the whole class teaching and learning is facilitated by technology, as well as, little classes, and equally make individualized exercises available to all students across levels. When these ICT competencies are not applied to organize learning activities which are usually because of a low level of ICT skills among teacher as reported by Hooker, Mwiyeri, and Verma (2011c) and Adeyinka, Adedeji, Majekodunmi, Lawrence, and Ayodele (2005), ICT integration in schools will be practically impossible. Therefore, teachers are the major drivers of ICT use in schools.

A normal educator during the subsequent exercise would use PCs on carts that allow access to a student to apply MS Word independently. The instructor would devise the two activities directly connected to a student should perform. Access to the school's PC provides opportunities for instructors to record students' activities and the records will be equally accessible to school administrators. (UNESCO 2011). So also, a comparable instructor of Physical Education has an individual workstation and a projector in the rec-center community for playing video material, anyway by getting the students to help with the videoing in the rec-center and by playing back the video clips on both the camera screen and the PC screen he can make PE practices so all of the students can see a video clasp of themselves in the exercise center at any rate once the video has been recorded. This can be utilized for week by week examination of each student.

The teacher would then utilize the individual workstation to monitor the students' entries on their community-oriented spreadsheet and to post on the social networking site engendering remarks and additional data on work out schedules. (UNESCO 2011). By doing this, the teacher makes conditions using the Learning Management System of the school to enable students to collaboratively work together with files shared. Shared records, wikis, and discussion boards are typical examples of how the process could be implemented. (UNESCO 2011)

2.3.6 ICT Competence and Teacher Professional Learning

The discovering Badau and Sakiyo (2013) show that the teacher ICT professional competence to utilize ICT educational program is worrisome because their skills are generally low. The studies of Rodden (2010) and Naugue (2011), Badau and Sakiyo (2013) and Regina (2013) also show a reliable agreement In an attempt to ensure the teachers' ICT competence on the professional development meets the international standards, UNESCO (2008) declares that teacher interested in implementing ICT use in school or for teaching-learning must have the ICT skills that involves the ability to access web assets necessary to access more educational information on contents or topics. The teacher browses different websites for subject matter experts to have access to assets and activities that be used to teach different topics more effectively. These activities could include composed assignments, boost material and thoughts for exercises. The educator normally visits an Internet discourse gathering facilitated by the expert relationship for subject-based instructors. The discussion is a valuable wellspring of new thoughts on the best way to get students increasingly inspired by subject-based exercises. He, for instance, posts an inquiry question for specialized presentation on a part of another and workout schedule the students would need to effectively apply what has been learned in the classroom. The teachers normally indicate different educators' works and projects how the task utilizes ICT to empower students to produce learning while at the same time concentrating their school subjects and discloses to colleagues, UNESCO (2011).

2.3.0 Appraisal of Related Literature

The literature reviewed has shown significant effects of ICTs use in the process of teaching and learning, also the need for teachers to have competencies that will enable him/her to always update himself in the changing world of technologies. The nature of technologies is ever-changing, it, therefore, brings teachers to a point where they must be updating their ICT competencies/skills from time to time if they must prepare students for the future and not for the past. The results of the past findings show that teachers generally are lacking in the expected ICT competencies as contained in the UNESCO document, ICT-CFT, 2011. It shows that teachers generally are operating on the average on the technological literacy approach scale to ICT competencies. Whereas the ICT competencies expected of teachers in this 21st century should enable them to

occasion knowledge deepening and ultimately create knowledge that will transform the societies more effectively more effectively, students must also be prepared to have specialized knowledge in their respective course of study that will ultimately help them to create new knowledge domains that have not existed before.

The demands from the world of work has shown that the only workers that will survive trend of societal needs in the 21st century and beyond are workers with sellable skills, 21st-century skills and ultimately creative skill, all because new challenges are emerging almost every time and to be able to survive, it requires skills and creativity needed for sustainability of the national economy. The current situational report of TVET teachers shows that they are below this standard and the question is, should this continue?

When Technical or Engineering Education is mentioned anywhere in the world, the responsibility to raise and build/train a skilled-based workforce is always on the shoulders of Technical Education or Engineering Education instructors, this is evident in the literature reviewed on TVET program; the reason is not far-fetched. It is because TVET or engineering education program have been seen as the only panacea to the problem of economic development and that no nation rises above the skill level of its technical educators/engineers; and for sustainable development, TVET is crucial to salvage the dwindling economy of a nation if well planned for by the stakeholders.

In Nigeria, the solutions to come out of the economic recession is to invest in the TVET programme. This has been unanimously agreed on by researchers in the field of TVET and other stakeholders. Reason being that the nature of the TVET programme and the changing world of technologies are posing difficult challenges to TVET instructors, thereby making it difficult to cope with the changing world of works in terms of skills demanded by the companies. Literature has shown that most TVET institutions do not have the required infrastructures, facilities, consumables, competencies needed to stay afloat in the world of work, the expected tasks are not becoming achievable by TVET instructors. The literature has shown that various problems have made the TVET program to fail in this aspect. A cursory look at the literature and studies, the consensus among the researchers is that ICT competency is key in driving the goals of the TVET program into a marketable point where graduates from TVET program will be able to solve impending problems.

However, the situation report of TVET instructors in the use of ICTs in South-west Nigeria is still very below the average, TVET instructors are found below the ICT standards contained in the UNESCO document on ICT. With the importance of ICT tools for TVET teachers capable of improving knowledge, and how it affects the TVET program and its use in teaching and learning. Literature reveals that TVET teachers lack knowledge and skills for presentation of ICT teaching materials, lack of TVET instructors' competency, and their slowness to adopt ICT for TVET programs have affected the use of ICT, thinking it is not possible to use ICT for TVET. The studies have also revealed that TVET teachers do not just show repelling attitude towards the use of ICTs in TVET program but that they are not even aware the affordances of ICTs in the field, and besides with the fact they lack appropriate training that could help them to use ICTs for TVET program. Again, past studies also show that few of the TVET instructors that use ICT that are at the technology literacy level do not know how to blend the skill with both the content and pedagogy. The Majority of TVET teachers in our secondary schools, technical colleges, Universities, and Polytechnics appear not to have a fundamental knowledge of ICT tools. This invariably jeopardizes the fundamental objectives of TVET's vision, mission and policy of ICT use as stated in the National Policy on ICT (2013) which is to produce ICT skilled-based graduates.

It is therefore very important for this study to conduct a study that involves the training of TVET instructors with UNSECO ICT-CFT framework and also develop a training template that could be used by any TVET institution in ICT usage by providing workable frameworks and principles that will encourage the use of ICT by TVET teachers. This is the gap the study is set to fill.

CHAPTER THREE

METHODOLOGY

3.1 Research Design

This study adopted Design-Based Research approach. Design-Based Research is not a methodology, neither is it an experimental research method, but a research approach that could adopt both qualitative and quantitative methods. The study was conducted in four phases, and different qualitative and quantitative methods were used at different stages of the study, and therefore, the general research design for this study was a mixed-methods research design using the Design-Based Research approach (DBR). The design-based research approach has been succinctly summarized into four phases (see figure 3.1). In figure 2.1, the stages of the study are linearly connected and each stage represents the different phases of the study. Therefore, the study would have four phases.

3.2 Phase One

Figure 3.1 shows the first phase of this study: Analysis of the practical problems by researcher and practitioners in collaboration. Phase one has two stages: First was to assess the ICT competency level of Technical Education teachers. To establish the problem that the study sets out to solve, qualitative and quantitative approaches were used to collect data. Hence, phase one had been accomplished in DBR, which investigated the Assessment of Information and Communication Technology (ICT) competency level of Tertiary institutions Lecturers of Technical and Vocational Education (TVET) Programmes in South Western Nigeria, the method used is descriptive survey research Appendix 1 shows the results. The rationale behind using quantitative method is that Technical education programme in south west has low enrolment and to get an acceptable universal sample, the study covered the entire Technical and vocational education institutions (Government-owned) running the programme in the Southwest.

The second stage of the Phase one of the study found out what could be responsible for low level ICT competency among Technical Education teachers across the Southwest and how to solve this problem. The data collected was qualitative in nature, an interview guide was used. See

Appendix 2 for reference. The rationale behind qualitative method is that one can learn in-depth and have wide coverage about the research theme. Table 3.1 shows how Phase one was carried out.

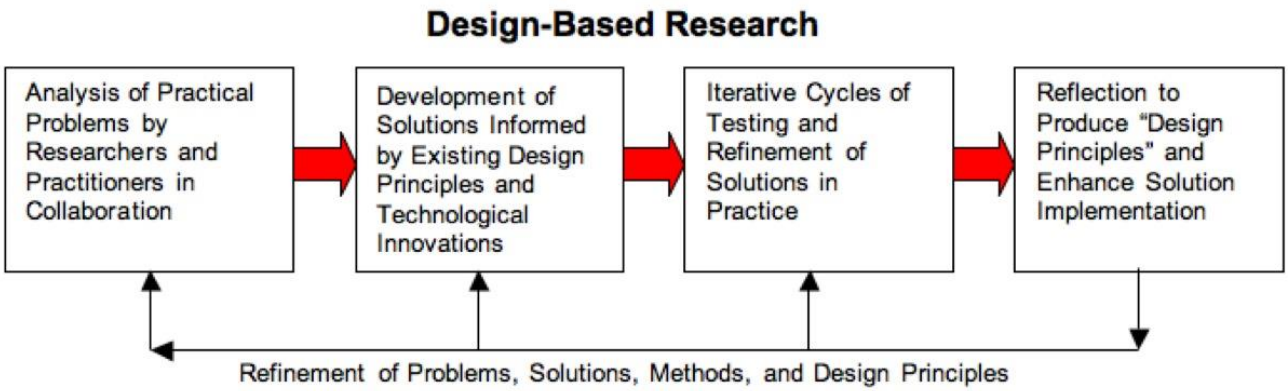


Figure 3.1 Design-Based Research (DBR) (McKenney and Reeves (2013))

Table 3.1 Showing research method used in carrying out Phase 1 of DBR

Stage	**Phase 1**	**Methods**	**Instruments**
Stage One	With Technical Educators	Quantitative	Questionnaire)
Stage Two	With Technical education Teachers	Qualitative	Unstructured Interview Guide
	With Technical education students	Qualitative	Interview (FGD)
	With Engineering students	Qualitative	Interview (FGD)
	With Technical Drawing Teachers	Qualitative	Interview
	With Technical drawing Students	Qualitative	Interview (FGD)

3.2.1 Selection of participants for Phase One

Phase One has two stages: Stage One covered the entire Technical education institutions running the programme. Purposive sampling was used to select the sample of teachers/lecturers used for the study. Stage two: Ijebu-ode Local government was selected and precisely Tai-Solarin University of education, four secondary schools in Abeokuta were randomly selected to collect data around Technical Drawing. Issues gathered from the students and Teachers were used to interview Technical Drawing teachers in each school.

Phase Two

Based on the problems gathered and analyzed in phase one, the study embarked on phase two, which involves design and development of principles based on problems identified and solutions suggested by practitioners. At Phase two it comprised of two stages. The first stage adopted design and development of proposed intervention. The second stage adopted qualitative case-study design, which provides tools for researchers to study complex phenomena within their contexts (Baxter and Jack, 2008). It is helpful to develop theory, evaluate programs, and develop interventions.

Generally, since the phase two is usually informed by the results obtained from problems identified by both the researcher and practitioners, it is required that a training template on ICT competency should be developed and used to train Technical Education pre-service teachers based on the UNESCO ICF-CFT 2011 document.

Technology Literacy

The purpose of this methodology is to empower learners, productivity workers to utilize ICT to help social advancement and improve economic efficiency. All other related objectives include an increase in school enrolment, producing high-quality resources which will be made available to all, that will, in turn, affect the acquisition of basic and technology literacies

Knowledge Deepening

The workforce needs to increase the ability to add more value to the output of world economy. The competencies acquired from school subjects will now be applied to solve complex problems.

Knowledge Creation

The policy goal of this approach is to increase productivity by producing pre-service teachers that are continually engaged in, and benefits from, knowledge creation, social development and cultural development.

APPLICATION OF KEMP MODEL TO TECHNICAL DRAWAING

STEP 1. INSTRUCTIONAL PROBLEM: Students finding the subject difficult to understand, understanding the concepts of Engineering /Technical drawing and changing of attitude towards the fundamental principles underlying the foundational topics in the subject.

STEP 2. LEARNER CHARACTERISTICS: The learners are tertiary students of first year (100l); ND1 and PART 1 covering universities, polytechnics and colleges of education offering Engineering/Technical drawing. Therefore, learners are above 16years of age. The contents in this instructional package includes all the topics covered in the first year of students in Engineering and Technical education courses in Nigerian tertiary institutions

STEP 3. SUBJECT CONTENTS: (A)

1. Safe working habits: Use and care of drawing instruments
2. Lines and lettering: Types of lines; uses of lines; line diagrams; types and styles of lettering
3. Material symbols: Conventional Representation of various materials- Glass, wood, concrete, earth, stone, rubber and ceramics.
4. Principle of projection
    a. Free hand sketching

   b. Descriptive geometry
   c. Orthographic project
   d. Dimension
5. Geometrical Construction/ plane geometry
   a. Division of lines
   b. Bisection of lines and angles
   c. Construction and uses of scales
   d. Construction of circles and arcs
   e. Construction of regular polygons
6. Principle of tangency
   a. Circles touching lines; circles touching circles; arc touching arc; straight lines touching an arc and circles touching circles and points
7. Loci
   a. Construction and applications of ellipse; helices; parabola; hyperbola; cycloid; involute and loci of point on simple link mechanism
8. Principle of projection:
   a. Drawing office and board practice
9. Pictorial views
   a. Isometric views
   b. Oblique views
   c. Orthographic views
10. Solid Geometry:

a. Sectional views
b. Auxiliary views
c. Intersection and development screw heads

STEP 3. TASK COMPONENTS: (B)

Table 3.2.1 Task Components

S/N	**Subject contents**	**Task components**
1	Safe working habits	1. Use and care of drawing instruments
2	Lines and lettering	Types of lines; uses of lines; line diagrams; types and styles of lettering
3	Material symbols	Conventional Representation of various materials- Glass, wood, concrete, earth, stone, rubber and ceramics
4	Principle of projection: a. Free hand sketching	Pictorial and orthographic forms of elementary building and details, machines parts and tools
	b. Descriptive geometry	**Points and line relationship**: location of points and lines in space; true length and angles of a line; parallel and intersecting lines; perpendicular lines and measurement of angles **Plane Relationship**: types of planes; plane representation; edge-view of plane and intersection and visibility Line-plane measurement: line piercing plane; line making angle with plane, visibility; **Revolution:** True length and angle of line in space; true shape of space
	c.Orthographic projection	First and Third angle projections of building bricks, blocks, machines, engines components: pistons, connecting rod
	d.Dimension	Dimensioning techniques (horizontal, vertical, angular dimensions; extension and dimension lines; arrows heads; unit of measurement; selection of dimensions
5	Geometrical Construction/ plane geometry	a. Division of lines b. Bisection of lines and angles c. Construction and uses of scales

		d. Construction of circles and arcs e. Construction of regular polygons
6	Principle of tangency	Circles touching lines; circles touching circles; arc touching arc; straight lines touching an arc and circles touching circles and points
7	Loci	Construction and applications of ellipse; helices; parabola; hyperbola; cycloid; involute and loci of point on simple link mechanism
8	Principle of projection	Drawing office and board practice standards: Recommendations as to standards and convections drawing layout, lines and lettering in drawing title block and border's lines
9	1. Pictorial views a. Isometric views	a. Introduction and construction of isometric scales, axes, lines and non-isometric lines b. Construction of curved profile and circles in isometric coordinate and 4-centre methods box c. Uses and construction of isometric section d. Isometric views of simple building and machine and engines components from orthographic views e. Drawing isometric drawing
	b. Oblique views	a. Introduction and construction of oblique axes b. Positioning of objects on the oblique axes c. Construction of arcs, circles and sections of oblique d. Oblique views of simple models' orthographic views cabinets and cavalier
	c. Orthographic views	First and Third angle projections of building bricks, blocks, machines, engines components: pistons, connecting rod
10	Solid Geometry: a. Sectional views	a. Cutting planes 1st and 3rd angles at angles other than 45^0 b. Parts and components not sectioned c. Types of sections (removed, revolved, aligned, half, full broken d. Sections through different materials e.g. wood, rubber, etc

		e. Ground lines/traces
	b. Auxiliary views	a. Auxiliary elevations and planes of simple objects b. Solids cut by inclined plane e.g.: hexagonal pyramid cut by an inclined plane, right cone cut by a plane inclined to horizontal plane, prism cut by inclined plane cylinder plane c. Determine true length and angle of a line
	c. Intersection and development screw heads	Intersection: a. Intersection of two planes b. Intersection of two prism c. Intersection of two cylinders d. Intersection of two right-circular cones e. Intersection of plane and prism f. Intersection of prism and cone g. Intersection of prism and pyramid h. Intersection of a line and cylinder i. Intersection of cylinder and prism Development: a. Principle and rules of development b. Methods of development (parallel, radial and triangular development) c. Right and oblique prism d. Right and oblique pyramid e. Right and oblique cylinders f. Right and oblique cones and square prism g. Truncated square prism h. Square prism with truncated ends i. Intersecting cylinders j. Practical applications of development like boxes and trays, funnels, oil measuring can, dust pan
	d. Screw thread	a. Terms and profiles b. Screw-thread forms (vee and square) convectional c. Representation (internal and external)

		d. Thread construction (single and muilti-start) right- and left-hand threads.

Table 3.2.4 Instructional Objectives

STEP 4 INSTRUCTIONAL OBJECTIVES:

S/N	CONTENT	INSTRUCTIONAL OBJECTIVES	CRITERIA	CONDITION
1	Safe working habits	Demonstrate proper handling of drawing instruments and safe working habit towards self and others	Proper handling of instruments	In the class
2	Lines and lettering	Identify different lines and state their applications in the real world. Draw simple lines and diagrams accurately Identify various types of lettering	Lines given in the lesson and as used for various applications Accurately Various	As given in the lesson With pencil As given in the lesson
3	Material symbols	Identify five materials by their respective symbols	Five materials	By their respective symbols
4	Geometrical Construction/ plane geometry	1. Divide a line into any number of parts proportionally 2. Construct scales and use scales for measuring length 3. Construct circles and arcs accurately 4. Construct regular polygons with given sides using appropriate lines	1. A given line 2. A given scale 3. As given in the lesson	1.Number of parts proportionally 2.For measuring length

			4. Given sides	3.Without mixing circles with arcs 4.With lines
5	Principle of tangency	Construct circles and arcs with accuracy using the principle of tangency	A given circles and arc	With principle of tangency
6	Loci	Construct simple four (4) examples of loci with practical applications of each stated.	Any four of these: Hyperbola, ellipse, helices, parabola, cycloids and involutes	With practical applications
7	Principle of projection: a. Free hand sketching	Prepare pictorial and orthographic drawing of simple building parts and machine parts / tools with a given scale accurately.	Forms of elementary building details and machines	With given scales
8	Descriptive geometry	State the 2 properties of a point, a line and a plane with sketches	Two properties of points, lines and planes	With sketches
9	Descriptive geometry	Make a projection of line and plane in space accurately	True length	As given in the lesson
10	Descriptive geometry	Obtain true length and single of a line by showing the seven typical positions of a straight line.	Seven typical position of straight line	As given in the lesson using board practice
11	Descriptive geometry	Show the seven typical positions of a plane surface	Seven typical position	Plane surface
12	Principle of projection	Prepare drawing in accordance with conventional, specifications and standards	Drawings with conventional,	In the lesson as given in the class

			specifications and standards	by emphasizing conventions as contained in ISOR 128. BS 308A and 1192
13	Principle of projection	Draw simple 5 objects in isometric views	5 objects in isometric views	Use models, workshop tools and machine parts where possible to identify solids
14	Oblique views	Draw simple 6 objects in oblique views	6 objects in oblique views	Use models where possible to identify solids
15	Orthographic views	Define the principles of orthographic projection accurately as they apply to real world examples	Principles of orthographic projections	On different models as given in the lesson
16	Orthographic views	Produce orthographic drawing of simple building and machine parts accurately	As given by the scales	Give examples of differences in 1^{st} and 3^{rd} angle projections
17	Lines and lettering	Produce correct lettering and positioning of the dimension lines on drawings.	Correct lettering and positioning	Place figures in accordance with BS 308A and 1192 (metric 1972)

18	Solid Geometry: Sectional views	Select appropriate sectioning method by preparing drawings to show the interior details of simple and intricate objects.	Different types of sections	Through the use of models
19	Auxiliary views	Draw the first auxiliary elevation and plan of simple objects	Specific contents topic as given in the lessons like: Hexagonal pyramid cut by an incline plane	Use auxiliary planes
20	Intersection and development screw heads	Draw appropriate lines or curves of intersection of surfaces or objects penetrated by lines and other objects	Practical contents on specific contents, axes offsets and incline	Axes of intersecting solids to be at right angles and in the same plane but intersection of two cylinders should be at any angle
21	Intersection and development screw heads	Layout surfaces of simple objects	Practical application of development	Display different developed and folded objects.
22	Screw thread	Identify the types and draw them in accordance with the conventional standards	Practical screw threads construction	Display the various thread forms

Table 3.2.3 Sequencing Content

STEP 5. SEQUENCING CONTENT (order the instructional content)

S/N	CONTENT	INSTRUCTIONAL OBJECTVES	PREREQUISTE LEVEL	CONTENT SEQUENCE
1	Safe working habits	Demonstrate proper handling of drawing instruments and safe working habit towards self and others	Students have been able to handle different drawing instruments in their previous classes	1. Students will play drag and drop games on identification of drawing instruments 2. Students will watch a 5 minutes video clips on the proper ways of handling drawing instruments 3. Students will watch 5 minutes video clip on the safe working habits towards self and others 4. Students will match the drawing instruments with their respective functions 5. Student will watch a 5 minutes video clip on the summary of the content as taught in the lesson showing animated and annotated pictures of these instruments using a computer system
2	Lines and lettering	Identify different lines and state their applications in the real world. Draw simple lines and diagrams accurately	Students have been able to identify drawing instrument and match their respective uses	1. Students will interact with the different types of lines with their application in real world in text and pictures and they are applicable outside the classroom 2. Students will watch 5 minutes of video clips showing how to draw simple lines and diagram accurately 3. Students will watch 5 minutes video clip of different letterings that can be used in engineering/ technical drawing

		Identify various types of lettering		4. Match names of lines as the scroll on the computer screen
3	Material symbols	Identify five materials by their respective symbols	Students have been able to identify lines and match them with their respective applications in the real world.	1. Students interact with all the materials used in technical drawing with their names 2. Students will play drag and drop games on identifying material symbols. 3. Students will watch a 5 minutes video clip on the summary of the lesson.
4	Geometrical Construction/ plane geometry	1. Divide a line into any number of parts proportionally 2. Construct scales and use scales for measuring length 3. Construct circles and arcs accurately 4. Construct regular polygons with given sides using appropriate lines	Students have been able to identify lines and match them with their respective applications in the real world	1. Students will watch a 5 minutes of video clips on dividing line into different part proportionally e.g. to divide a straight line into a given number of equal parts 2. Students will watch a video clip of how scales are constructed based on the scales used for measuring length 3. Students will watch video clips on construction of circles and arcs accurately like inscribing circle and circumscribe circles 4. Students will watch how circles and arcs are constructed clearly 5. Students will be given assignment based on the topics covered in the lessons. 6. Students will watch a summary of the whole lessons. 7. Students will watch a 5 minutes video of how to construct regular polygons using appropriate lines.

5	Principle of tangency	Construct circles and arcs with accuracy using the principle of tangency	Students have been able to construct circles, arcs and polygons	1. Students will watch a 5 minutes video clip showing lives examples of spanners, anchors, hooks, fan blades etc. with a particular reference to point of tangency 2. Students will watch video clips on points of angle of tangency of articles 3. Video clip showing different ways of arriving at angle of tangency 4. Video clip on the summary of steps in constructing principle of tangency
6	Loci	Construct simple four (4) examples of loci with practical applications of each stated.	Students have been able to construct angle of tangency	1. Students will interact with definition of loci with examples like ellipse, cycloid and parabola 2. Students will watch video clips of steps of constructing loci examples with their respective applications. 3. A video clip showing slope/travel and regular displacement 4. A video clip showing how to construct ellipse with different methods; helices with different methods; parabola; hyperbola; cycloids; epicycloids and hypocycloids 5. A video clip showing different applications of loci in real world 6. A video showing loci of points on simple links mechanism. 7. Students will match different pictures of loci with respective names
7	Principle of projection:	Prepare pictorial and orthographic drawing of simple building parts and machine	Students have been able to construct loci examples as given in the lessons	1. A video clip of buildings and machine parts/tools 2. A video clip showing different angles of building of all types and machine parts/tools

	a.Free hand sketching	parts / tools with a given scale accurately.		
8	Descriptive geometry	State the 2 properties of a point, a line and a plane with sketches	Students have been exposed to different pictorial articles with their orthographic views.	1. Students will interact with different properties of lines and planes by clicking on each 2. Students will do a drag and drop activities on the properties of lines and planes.
9	Descriptive geometry	Make a projection of line and plane in space accurately	Students have been able to associate lines and planes with their respective properties.	1. A video clip showing a projection of lines and plane in space accurately
10	Descriptive geometry	Obtain true length and single of a line by showing the seven typical positions of a straight line.	Students have been able to make projections of lines and planes.	1. A video clip showing how to obtain true length of single lines 2. A video clip showing seven typical positions of a straight line.
11	Descriptive geometry	Show the seven typical positions of a plane surface	Students have been able to make projections of lines and planes	1. A video clip showing how to obtain true planes of single lines 2. A video clip showing seven typical positions of a plane surface 3. A video clip showing the applications of lines and planes in real world
12	Principle of projection	Prepare drawing in accordance with conventional, specifications and standards	Students have been able to make projections of lines and planes	1. A video clip showing different conventions, specifications and standards in drawing 2. A video clip showing how to make drawings with convections, specifications and standards. 3. Summary of the lesson in an interactive mode

13	Principle of projection	Draw simple 5 objects in isometric views	Students have been able to construct articles with lines.	1. A video clip showing objects drawn in isometric views 2. An interactive lesson in basic principles and facts about isometric views laying emphasis on what and what on how to make isometric views 3. A video clip on how to draw objects in isometric views with reference to angles 30 and 60^0 4. A video clip containing the summary of important points to remember in isometric views
14	Oblique views	Draw simple 6 objects in oblique views	Students have been able to make drawing in isometric views with particular reference to angles like 30 and 60	1. A video clip showing objects drawn in oblique views 2. An interactive lesson in basic principles and facts about isometric views laying emphasis on what and what on how to make oblique views 3. A video clip on how to draw objects in oblique views with reference to angles 45^0 4. A video clip containing the summary of important points to remember in oblique views
15	Orthographic views	Define the principles of orthographic projection accurately as they apply to real world examples	Students have been able to construct objects in oblique and isometric views.	1. A video clip on drawing objects in first angle projection 2. A video clip showing projections in third angle projections 3. A video clip showing why 1^{st} and 3^{rd} angle projections 4. Students will do matching games on 1^{st} and 3^{rd} angle projection
16	Orthographic views	Produce orthographic drawing of simple building and machine parts accurately	Students have been able construct orthographic views in	1. A video clip on orthographic views on building parts like front elevation, plan, right and left side views of parts like the foundation, walls, windows, doors, roofs etc.

			both 1st and 3rd angle projection	2. A video clip on orthographic projections of machine parts like connecting rod, pistons and crank shaft and cam shaft 3. A video clips showing the orthographic views of machine and building parts.
17	Lines and lettering	Produce correct lettering and positioning of the dimension lines on drawings	Students have been able to make drawings of building parts in orthographic views.	1. Students will interact with different types of lettering and how they can be used in technical drawing 2. A video clip showing how to write lettering in drawing 3. An interactive lesson on different types of dimension used in drawings and they could be applied in the real world 4. Students a drag and drop games on lettering and dimensions in engineering and technical drawing. 5. A video clip showing the summary of the whole lesson
18	Solid Geometry: Sectional views	Select appropriate sectioning method by preparing drawings to show the interior details of simple and intricate objects.	Students have been able to produce letterings and dimensions	1. A video clip showing examples of different types of sections with concrete examples 2. A video clip showing the removed, revolved, aligned, half and full broken 3. A video clip showing the applications of these types of sectioning.
19	Auxiliary views	Draw the first auxiliary elevation and plan of simple objects	Students have been able to make drawings in isomeric, orthographic and oblique	1. A video clip with incline planes 2. A video clip showing the use auxiliary planes 3. A video clip showing an hexagonal pyramid cut by an incline plane, a right cone cut by a plane inclined to horizontal/plane and prism cut by inclined plane. 4. A video clip showing how to determine true length and angle of line.

				5. A video clip showing the summary of the lesson
20	Intersection and development screw heads	Draw appropriate lines or curves of intersection of surfaces or objects penetrated by lines and other objects	Students have been able to make auxiliary views of inclined planes.	1. A video clip of intersection of two planes 2. A video clip on intersection of two prism 3. A video clip on the intersection of two cylinders 4. A video clip on the intersection of two right-circular cones 5. A video clip on the intersection of solids 6. A video clip on the applications of these intersections of solid in the real world.
21	Intersection and development screw heads	Layout surfaces of simple objects	Students have been able to draw lines or curves of intersection of surface or objects.	1. A video clip on the principles, methods and rules of development 2. A video clip on the parallel, radial and triangulation of development 3. A video clip of a truncated square prism 4. A video clip on practical applications of development like boxes trays funnels oil measuring can and dust pan
22	Screw thread	Identify the types and draw them in accordance with the conventional standards	Students are familiar with the use of lines in drawing	1. Video clip showing different types of thread forms 2. A video clip showing forms of thread drawn and constructed with accordance with specifications 3. A video clip containing the practical construction of thread making in the real world

Table 3.2.4 Instructional Strategies

STEP 6. INSTRUCTIONAL STRATEGIES

S/N	CONTENT	INSTRUCTIONAL OBJECTIVES	INSTRUCTIONAL STRATEGIES
1	Safe working habits	Demonstrate proper handling of drawing instruments and safe working habit towards self and others	1. Review and check for prior knowledge 2. Observe as each student draws in the class 3. Represent the lesson
2	Lines and lettering	Identify different lines and state their applications in the real world. Draw simple lines and diagrams accurately Identify various types of lettering	1. Observe as each student draws to see if drawn accordingly 2. Review students' work 3. Presentation of the lesson to the students
3	Material symbols	Identify five materials by their respective symbols	1. Allow students to individually interact with the contents 2. Discovery based learning
4	Geometrical Construction/ plane geometry	1. Divide a line into any number of parts proportionally 2. Construct scales and use scales for measuring length 3. Construct circles and arcs accurately 4. Construct regular polygons with given sides using appropriate lines	1. Directive learning
5	Principle of tangency	Construct circles and arcs with accuracy using the principle of tangency	1. Directive learning

6	Loci	Construct simple four (4) examples of loci with practical applications of each stated.	1. Directive learning
7	Principle of projection: a. Free hand sketching	Prepare pictorial and orthographic drawing of simple building parts and machine parts / tools with a given scale accurately	1. Directive learning
8	Descriptive geometry	State the 2 properties of a point, a line and a plane with sketches	1. Game based learning
9	Descriptive geometry	Make a projection of line and plane in space accurately	1. Directive/Expository analogy
10	Descriptive geometry	Obtain true length and single of a line by showing the seven typical positions of a straight line.	1. Directive/Expository analogy
11	Descriptive geometry	Show the seven typical positions of a plane surface	1. Directive learning
12	Principle of projection	Prepare drawing in accordance with conventional, specifications and standards	1. Directive learning
13	Principle of projection	Draw simple 5 objects in isometric views	1. Reteach the students 2. Drill and practice strategy
14	Oblique views	Draw simple 6 objects in oblique views	1. Directive/Expository analogy
15	Orthographic views	Define the principles of orthographic projection accurately as they apply to real world examples	1. Game based learning 2. Directive learning
16	Orthographic views	Produce orthographic drawing of simple building and machine parts accurately	1. Drill and practice 2. Directive learning 3. Reteach the lessons 4. Use of graphic organizer

17	Lines and lettering	Produce correct lettering and positioning of the dimension lines on drawings	1. Drill and practice 2. Game based learning
18	Solid Geometry: Sectional views	Select appropriate sectioning method by preparing drawings to show the interior details of simple and intricate objects.	1. Directive learning
19	Auxiliary views	Draw the first auxiliary elevation and plan of simple objects	1. Directive learning
20	Intersection and development screw heads	Draw appropriate lines or curves of intersection of surfaces or objects penetrated by lines and other objects	1. Directive learning
21	Intersection and development screw heads	Layout surfaces of simple objects	1. Directive learning
22	Screw thread	Identify the types of screw thread and draw them in accordance with the conventional standards	1. Directive learning

Step 7

Develop the instruction:

At this stage, pre-test must be conducted, instructional objectives must be stated clearly, overview of the instruction must be presented to the learner and determine the instruction to the audience.

3.3 Research Design for Phases Two and Three

The study adopted case study strategy, because it is very effective to aid researchers, first, to seek to answers on questions of how and why of ICT incompetency, and second, it is very effective also because researchers have little control over the activities, and third, the focus is on an existing phenomenon within some real-life context.

While the study was adopted, the DBR approach, phase two and phase three adopted case study design. Case study can be approached in different ways, such as explanatory, exploratory, descriptive, multi (single) case, intrinsic, instrumental, or collective case study design. But generally, according to Rose, et al (2015), cases study is appropriate for research when:

- Cases are studied in their real-life context; understanding how the case influences and is influenced by its context;
- Cases are naturally occurring in the sense that they are not manipulated as in an experiment;
- The use of multiple sources of data including interviews, observation, archival documents and even physical artefacts are allowed for triangulation of findings.

The study was mainly concerned with providing on ICT training for ICT competency using the UNESCO template for ICT competency that engages all the domains of learning (cognitive, affective, and psychomotor). In view of that, the training would increase students' ICT skills, and data was collected through interviews, observation, and physical artefacts (Digital portfolio, Software).

Conduct Case study: In this phase, pre-service teachers were trained on ICT competency using the framework of UNESCO ICT-CFT document, 2011. And students developed software packages that can be used to teach and learn Technical Drawing (TD). The training had three parts. In the first part, the training was on the Technology Literacy (TL) and relevant competencies were acquired by the pre-service teachers of Technical Education; the second part exposed pre-service teachers on Knowledge Deepening (KD). The workforce needs to increase the ability to add more value to economic output, by applying the knowledge gained from the school subjects to solve complex problems. The focus of this stage in the policy establishes it through ICT knowledge and skills. The third part is Knowledge Creation (KC), the policy goal of this approach is to increase

productivity by producing pre-service teachers that are continually engaged in, and benefits from, knowledge creation, social development and cultural development.

3.4 Selection of Participants for Phase Two

Purposive sampling was adopted to select one institution running Technical education program out of eleven government-owned institutions running Technical Education in South west (College of Education).

3.5 Variables in the Study

The variables in the study were:

Independent variable - (ICT competency Instruction)

Dependent variables:

1. Students project output (Digital Software-Artefact)
2. Creativity
3. ICT Competence
    a. **Technology Literacy (TL)** (Policy Awareness; Basic knowledge; Integrating Technology; Basic Tools; Standard Classroom and Digital literacy)
    b. **Knowledge Deepening (KD)** (Policy Understanding, Knowledge Application, Complex problem solving, Complex tools, Collaborative groups, and Manage and guide
    c. **Knowledge Creation (KC)** (Policy Innovation, Knowledge society skills, Self-management, Pervasive Technology, Learning organization, and Teacher as a model learner)

3.6 Phase Three

In view of the position of DBR, the implementation of proposed intervention was executed. After carrying out the stages in the second phase which involved design and development of a training template based on the UNESCO ICT-CFT 2011 document, and training of research assistants (Educational Technologists and Technical Educators), the implementation of proposed intervention was carried out. The data gathered was analyzed both quantitatively and qualitatively. The results obtained in these analyses were used to embark on the third phase of DBR, which was about testing and refinement of applied intervention results. Some of the expected results from the intervention are, but not limited to:

- ICT competencies cutting across the five duties of teachers;
- Creativity
- Factors that could determine how to implement training of TVET educators or instructors
- Effectiveness of ICT skills in instructional delivery of Technical Drawing
- Production of software packages that could be used to teach and learn Technical Drawing

The study used the results to review and re-design the intervention/training templates.

Table 3.3: Plan for Phase Three

1	Selection of Participants	Pre-service Technical education teacher were selected in a College of education. And the intervention/training was used to train the Technical education pre-service teacher.
2	Research Design	As applicable in Phase two
3	Variables	Independent variable - (ICT competency Instruction) Dependent variables: 1. Students project output (Digital Software-Artefact) 2. Creativity 3. ICT Competence a. **Technology Literacy (TL)** (understanding ICT in education skill; curriculum and assessment skill; pedagogical skill; organizational and administrative skill; ICT skill, and teacher professional learning skill) b. **Knowledge Deepening (KD**) (understanding ICT in education skill; curriculum and assessment skill; pedagogical skill; organizational and administrative skill; ICT skill, and teacher professional learning skill) c. **Knowledge Creation (KC)** (understanding ICT in education skill; curriculum and assessment skill; pedagogical skill; organizational and administrative skill; ICT skill, and teacher professional learning skill)
4	Research Instruments	Same as phase two
5	Data to be collected	Same as phase two
6	Data Analysis	Same as phase two

3.7 Selection of participants for Phase Three:

The target population for this study consisted pre-service teachers studying Technical Education program in part two (2)/ 200/300 level at the College of Education in Lagos state Nigeria. These categories of students are the potential Technical Education teachers that would, in turn, teach Technical Drawing and all related Technical subjects like: woodwork, Metal Work, Automobile, Ceramics etc. They are the ones who would be saddled with the responsibility of exposing students to all Technology related courses in the nearest future, as few of them would practice the profession and they would become Technicians, technologist, and also work in the educational sector like tertiary education as lecturers. The 200/300 level students at the College of Education would have also been exposed to Technical Drawing as well. All of these students either at the University and College of Education, are expected to have in-depth knowledge of Technical drawing before they would go for teaching practice.

Multi-stage sampling technique was used to select participants for the study: First, simple random sampling was used to select one (1) College of Education in South west states. All Colleges of Education operate the same curriculum as spelt by the governing body (NCCE) and furthermore, teachers from these Colleges of education are employed by both governments and private institutions to teach either Basic Technology or Technical Drawing.

Purposive sampling technique was then used to select the students that participated in the selected College of education. The selection of students was based on these criteria: They must be in their second or third year, as the case may be; they must be running Technical Education program; they must have undergone Technical Drawing course(s) in the previous years; access to computer accessory (Desktop nor Laptop) is compulsory, and ability to operate computer basically, are added conditions.

The reports from the field work were used to implement phase four, which is about reflection on the entire findings from phase one to phase three. Phase four was about reflection to produce design principles, enhance solution to solve ICT incompetence towards its use for TVET program. The reflection was to conclude the study, and to establish indigenous design principles, theories, or models that could be used to address related problems in TVET in the area of ICT usage and competence and even in other disciplines. Issues gathered from findings from phases

two and three, literature review, and comments columns were used to develop indigenous principles and framework for future implementation of ICT in TVET program at every level.

3.8 **Research instruments**

The following instruments used were. The first five instruments had been used for baseline survey and for phase one of design-based research:

1. Interview Guide for ICT competence of Technical drawing Students (ICT-CTDS)
2. Interview Guide for ICT competence of Technical drawing Instructors (ICT-CTDI)
3. Interview Guide for Technical drawing Students (IGTDS)
4. Interview Guide for Technical drawing Instructors (IGTDI)
5. ICT competency level of Technical education Instructors (ICTTEI)
6. Skill Acquisition Rubric of each Trainee (SAR)
7. Creativity Component Rubric for Student's Artefact (CCRSA)
8. Student's ICT Artefact Package Rubric on Technical Drawing (ICT-APRTD)
9. Technological Literacy Assessment Sheet (TLAS)
10. Knowledge Deepening Assessment Sheet (KDAS)
11. Knowledge Creation Assessment Sheet (KDAS)
12. UNESCO ICT Competency Framework for Teachers (ICT-CFT)

3.8.1 Interview Guide for ICT competence of Technical drawing Students (ICT-CTDS)

This instrument was self-designed by the researcher to investigate the problems associated with students offering Technical Drawing as a course or subject at both university and secondary school levels. It was an interview guide for the focus group discussion. The instrument was divided into six (6) sections covering the typical domains of teachers' duties in teaching and learning process according to UNESCO, 2017: (a) understanding ICT in Education, (b) Curriculum and Assessment, (c) Pedagogy, (d) ICT, (e) Organization and administration, (f) Teacher professional learning.

Validation of ICT-CTDS

ICT-CTDS was subjected to criticisms by the lecturers in the department of Science and Technology education (educational technology experts), and experts in Curriculum and Guidance and Counselling. The comments noted by these experts were used to produce the final version of

the instrument. The comments were used to calculate the inter-rater reliability coefficient (Cohen Kappa) which gave a value of 0.81. The instrument is therefore valid and reliable.

3.8.2 Interview Guide for ICT competence of Technical drawing Instructors (ICT-CTDI)

This instrument is self-deigned by the researcher to investigate the problems associated with Instructors teaching Technical Drawing either as a course or subject at both university and secondary school levels. It is an interview guide for the focus group discussion. The instrument is divided into six (6) sections covering the typical domains of teachers' duties in teaching and learning process according to UNESCO, 2017: (a) understanding ICT in Education, (b) Curriculum and Assessment, (c) Pedagogy, (d) ICT, (e) Organization and administration, (f) Teacher professional learning.

Validation of ICT-CTD

ICT-CTDI was subjected to criticisms by the lecturers in the department of Science and Technology education (educational technology experts), and experts in Curriculum and Guidance and Counselling. The comments noted by these experts were used to produce the final version of the instrument. The comments were used to calculate the inter-rater reliability coefficient (Cohen Kappa) which gave a value of 1.00 which indicates perfect measure of agreement. The instrument is therefore valid and reliable.

3.8.3 Interview Guide for Technical drawing Students (IGTDS)

This instrument was self-deigned by the researcher to investigate the problems associated with students offering Technical Drawing either as a course or subject at both university and secondary school levels. It was an interview guide for the focus group discussion. The instrument focuses on problems related to the teaching and learning of Technical drawing at each level.

Validation of ICT-CTD

ICT-CTD was subjected to criticisms by the lecturers in the department of Science and Technology education (educational technology experts), and experts in Curriculum and Guidance and Counselling. The comments noted by these experts were used to produce the final version of the instrument. The comments were used to calculate the inter-rater reliability coefficient (Cohen

Kappa) which gave a value of 1.00 which indicates perfect measure of agreement. The instrument is therefore valid and reliable.

3.8.4 Interview Guide for Technical drawing Instructors (IGTDI)

This instrument was self-deigned by the researcher to investigate the problems associated with the instructors teaching Technical Drawing either as a course or subject at both university and secondary school levels. It was an interview guide for the focus group discussion. The instrument focuses on problems related to the teaching and learning of Technical drawing at each level.

Validation of IGTDI

ICT-IGTDI was subjected to criticisms by the lecturers in the department of Science and Technology education (educational technology experts), and experts in Curriculum and Guidance and Counselling. The comments noted by these experts were used to produce the final version of the instrument. The comments were used to calculate the inter-rater reliability coefficient (Cohen Kappa) which gave a value of 1.00 which indicates perfect measure of agreement. The instrument is therefore valid and reliable.

3.8.5 ICT Competency level of Technical education Instructors (ICTTEI)

The instrument was adapted from Badau and Sakiyo (2013). There are 40 items which were divided into six areas of teachers' duties according to UNESCO ICT-CFT, 2008, and they were in 5-likert scale. Changes made on the first version were to ensure the relevance of it to TVET programme. The items were modified to the suitability of TVET programme in southwest. The first version was used to assess the ICT competency level of teachers in the North-Eastern part of Nigeria, the adapted version will now be used for Technical Education pre-service teachers in Lagos state, South-west.

Validation of ICTTEI

ICTTEI instrument draft was given to 15 Technical education pre-service teachers in Ekiti state University for validation and reliability coefficient was determined using Cronbach Alpha, and the value was found to be 0.97. The instrument is therefore valid and reliable.

3.8.6 Skill Acquisition Rubric of each Trainee (SAR)

The instrument is a Skill Acquisition Rubric of each Trainee (SAR) adopted from, the professional standards for conservation, Institute of Conservation (London) 2003 based on the Dreyfus model of skill acquisition. The instrument is a rubric designed to assess the degrees of skill acquisition (Novice, Beginner, Competent, Proficient and Expert) based on five categories which are: Knowledge, Standard of work, Autonomy, Coping with complexity and Perception of Context. The scales are intended to measure levels of skill acquisition by the participants/trainees going through a particular Skill training program. Hence the instrument is designed to be used at the end of every stage of the training.

Validation of SAR

SAR was subjected to criticisms by the lecturers in the department of Science and Technology education (educational technology experts), and experts in Curriculum and Guidance and Counselling. The comments noted by these experts were used to produce the final version of the instrument. The comments were used to calculate the inter-rater reliability coefficient (Cohen Kappa) which gave a value of 0.72 which indicates substantial measure of agreement. The instrument is therefore valid and reliable.

3.8.7 Creativity Component Rubric for Student's Artefact (CCRSA)

The instrument Creativity Component Rubric for Student's Artefact (CCRSA) is adopted from Grant Wiggins 2012, which had been used to measure students' creativity. The component of students' output after the training. The instrument has six levels in two sections, which measured creativity with a caption that says you can measure anything.

Validation of CCRSA

CCRSA was subjected to criticisms by the lecturers in the department of Science and Technology education (educational technology experts), and experts in Curriculum and Guidance and Counselling. The comments noted by these experts were used to produce the final version of the instrument. The comments were used to calculate the inter-rater reliability coefficient (Cohen Kappa) which gave a value of 1.00 which indicates perfect measure of agreement. The instrument is therefore valid and reliable.

3.8.8 Student's ICT Artefact Package Rubric on Technical Drawing (ICT-APRTD)

The instrument is a Student's ICT Artefact Package Rubric on Technical Drawing (ICT-APRTD). The instrument was self-designed to measure the usability and acceptability of the software designed, developed and produced for instructional delivery. It has two sections: Section A has 66 items covering content items; Ease of use; documentation and support; Ability levels; Engagement/Interactivity; Assessment; Technical Quality; Fun and Adaptability. Section B: is a Rubric with 12 components (Curriculum content; Interactivity; Critical thinking;, the items are on 5-likert scale: The instrument is considered relevant and suitable based on the fact that the final software packages that would be developed by the pre-service teachers after the training would be assessed by experts in the fields of Engineering/Technical Education and Educational Technology. The scales are intended to measure levels of students' ICT Artefact package on Technical Drawing. Hence the scales are designed to be used at the end of the training.

Validation of ICT-APRTD

ICT-APRTD instrument is a standardized instrument that has been used over time to measure the suitability of software developed in Educational Technology unit of the department of Science and Technology Education. Content and face validation were carried out by the expert in educational technology unit. Clarity of content, content specifics, and objectives were ascertained. The instrument is therefore valid and reliable.

3.8.9 Technological Literacy Assessment Sheet (TLAS)

The instrument is a check-list for Tool-Skill Based Assessment, the instrument is self-developed based on the competencies that should be acquired by TVET teachers in ICT use, with the suggestions of UNESCO ICT-CFT document 2011. Technology literacy is the first stage of the training and items in the instrument are meant to assess students' skills after each Tool has been taught. The instrument aimed to evaluate all the six areas of duty by a typical ICT teacher in TVET program. The six sections are as follow: Section A Policy awareness which has six items both open and closed ended items; Section B: Basic Knowledge with 3 open ended items which would be responded to after the training at technology literacy; Section C: Integrate Technology with 2 open ended items; Section D: Basic Tools with 7 items on 8-likert scale; Section E: Standard Classroom with 5 closed items on 8-likert scale and Section F: Digital Literacy with 7 items of which the first two items are open ended and the last 5 items are closed ended.

Validation of TLAS

TLAS was submitted for criticism by the experts in the department of Science, Mathematics and Technology Education (Educational Technology unit), Technical education experts and Computer science departments, and their comments and suggestions were used to produce the final version. Also, the draft was given to some 15 pre-service teachers in the University of Ibadan to check the reliability coefficient of the instrument, and it was calculated using Cronbach Alpha and the value was found to be 0.98 which shows an internal consistency of the instrument (Check Appendix XI)

3.8.10 Knowledge Deepening Assessment Sheet (KDAS)

The instrument is a check-list for tool-skill based assessment, the instrument is self-developed based on the competencies that should be acquired by TVET teachers in ICT use as suggested in UNESCO ICT-CFT document 2011. Knowledge deepening is the second stage of the training and items in the instrument are meant to assess students' skills after each Tool, and how they would use the skills and knowledge acquired in all the five area of duties of a TVET teacher. The instrument aims to evaluate all the six areas of duty by a typical ICT teacher in TVET program. The six sections are as follow: Section A Policy understanding which has 4 items both open and closed ended items; Section B: Knowledge Application with 3 open ended items which would be responded to after the training at knowledge deepening; Section C: complex problem solving with 7 items of both open and closed ended items; Section D: complex tools with 7 items on 8-likert scale; Section E: collaborative group with 4 closed items on 8-likert scale and Section F: manage and guide with 5 items of which the first items are open ended and the last 4 items are closed ended of yes or no type

Validation of KDAS

TLAS was reviewed by the experts in the department of Science, Mathematics and Technology Education (Educational Technology unit), Technical education experts and Computer science departments, and their comments and suggestions were used to produce the final version. Also, the draft was given to some 15 pre-service teachers in the University of Ibadan to check the reliability coefficient of the instrument, and it was calculated using Cronbach Alpha and the value was found to be 0.87 which shows an internal consistency of the instrument

(Check Appendix XII)

3.8.11 Knowledge Creation Assessment Sheet (KCAS)

The instrument is a check-list for tool-skill based assessment, the instrument is self-developed based on the competencies that should be acquired by TVET teachers in ICT use as suggested in UNESCO ICT-CFT document 2011. Knowledge creation is the third and the last stage of the training and items in the instrument are meant to assess students' skills after each tool, and how they would use the skills and knowledge acquired in all the five area of duties of a TVET teacher. The instrument aims to evaluate all the six areas of duty by a typical ICT teacher in TVET program. Check Appendix XIII)

The six sections are as follow: Section A Policy innovation which has 3 items which are open ended items; Section B: Knowledge society skills to measure trainees ability to create unit of lesson based on ASEI lesson plan which would be responded to after the training at knowledge deepening; Section C: self-management with 5 items of closed ended items which are on 8-likert scale; Section D: pervasive technology with 15 items on 8-likert scale; Section E: learning organization with 4 closed ended items on 8-likert scale and Section F: teacher as a model learner with 5 items of closed ended.

Validation of KCAS

KCAS was reviewed by the experts in the department of Science, Mathematics and Technology Education (Educational Technology unit), Technical education experts and Computer science departments, and their comments and suggestions were used to produce the final version. Also, the draft was given to some 15 pre-service teachers in the University of Ibadan to check the reliability coefficient of the instrument, and it was calculated using Cronbach Alpha and the value was found to be 0.94 which shows an internal consistency of the instrument

3.8.12 UNESCO ICT Competency Framework for Teachers (ICT-CFT)

This is the training module developed by UNESCO 2011 for ICT framework for teachers. The booklet/module would serve as a training guide for the ICT training exercise. The module has three different approaches cross-linked with typical duties of teachers.

Validation of ICT-APRTD

UNESCO ICT-CFT instrument is a standardized instrument designed and developed by the United Nations Educational, Scientific and Cultural Organization to be used by institutions, research institutes, researchers and agencies concerned with the use of ICT for economic activities. This framework was designed for teachers in order to acquire a progressive ICT competency skill that are related and connected to teachers' typical duties. It is therefore valid and reliable.

3.9 Procedure: Method of data collection

3.9.1 Data Collection Procedures: First Iteration

1. The training of Research Assistants according to the UNESCO ICT-CFT Framework for two weeks (2)
2. Administration of pre-test instruments to the participants for pre-assessment
3. ICT-Competency based instruction is administered based on the UNESCO ICT-CFT document: Technology Literacy, Knowledge deepening and Knowledge creation for 6 weeks
4. Participants developed an ICT-based instructional package on Technical Drawing on the selected topics
5. Administration of Post-test instruments to the participants for post-assessment
6. The developed software packages by students were evaluated ad reviewed by experts in the field of Technical drawing/Engineering drawing for review and assessment
7. Focus group discussion

3.9.2 Data Analysis Method: First iteration

The data collected was analysed using thematic analysis for the open-ended part of the instruments and Quantitative artifact analysis for the developed ICT-Based instructional package for all the research questions raised where applicable. One sample t-test was used to analyze one hypothesis formulated was tested at $p \leq 0.05$ level of significance. The details is on table 3.9

Table 3.9: Research questions, data collection methods, and data analysis techniques

	Research Questions/Hypothesis	Data collection methods	Data to be collected	Data analysis technique
1	What is Pre-service teachers' ICT skills for Curriculum and assessment after the training across: a. Technology Literacy, b. Knowledge deepening and c. Knowledge creation?	ICT Assessment Sheet (Post-survey)	Questionnaire self-assessed data	Thematic analysis
2	What is Pre-service teachers' ICT skills for Pedagogy after the training across: a. Technology Literacy b. Knowledge deepening c. Knowledge creation?	ICT Assessment Sheet (Post-survey)	Questionnaire self-assessed data	Thematic analysis
3	What is Pre-service teachers' ICT skills for Organizational and Management after the training across: a. Technology literacy b. Knowledge deepening c. Knowledge creation	ICT Assessment Sheet (Post-survey)	Questionnaire self-assessed data	Thematic analysis
4	To what extent would the students' output that have been developed meet the competency standards after the training?	ICT Assessment Sheet (Post-survey)	Questionnaire self-assessed data	Thematic analysis
5	What is the level of creativity of the students' output work after the training?	ICT Assessment Sheet (Post-survey)	Qualitative self-assessed data	Thematic analysis
6	Are Pre-service teachers able to acquire development skills in developing the interactive computer package for Technical Drawing after the training?	ICT Assessment Sheet (Post-survey)	Questionnaire guide	Thematic analysis
7	What is the level of creativity of the students' output work after the training?	Artifacts analysis In-class observation	• Students artifacts/projects • Description of classroom practical activities Opinions about their hands-on activity	• Quantitative artifact analysis • Qualitative data analysis Qualitative data analysis
8	There is no significant difference in pre-service teachers' ICT skills before and after the training across: a. Technological Literacy, b. Knowledge deepening c. Knowledge creation	ICT Assessment Sheet (Post-survey)	• Questionnaire self-assessed data	• One sample t-test (Inferential statistics

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This analysis was based on the number of participants that attended all the sessions of the study. The pre-service teachers of Technical Education were exposed to ICT-Training based on the UNESCO ICT-CFT frame work.

4.1 Answers to the Research Questions

Research Question 1: What is the Pre-service teachers' awareness of the national policy that supports ICT use for teaching and learning after the training at the following levels?

a. Technological Literacy,

b. Knowledge deepening and

c. Knowledge creation

4.1.1 Pre-service Teachers' awareness of policy that supports the use of ICT

(a). **Technology Literacy Level**

Table 4.1.1 Pre-service's awareness of ICT policy for Technical education Program

S/N	**STATEMENT**	**YES**	**NO**	**IDK**	**MEAN**	**STD.D**
1	The implementation of ICT policy in school is describable	12 (85.7%)	2 (14.3%)	-	2.86	0.363
2	ICT policy strengths and weaknesses are describable	9 (64.3%)	4 (28.6%)	1 (7.1%)	2.86	0.770
3	If the policy is put to use, it would promote the use of ICT to create student-centered learning?	14 (100%)	-	-	3.00	0.000
4	It can be mainly be used for efficient presentation	14 (100%)	-	-	3.00	0.000
5	ICT policy is beneficial to classroom	14 (100%)	-	-	3.00	0.000
	Weighted mean	**2.94 (98.0%)**				

Decision Rule: 2.00

Table 4.1.1(a) showed that Pre-service teachers' awareness of ICT policy usage in schools for the Technical Education program has been indicated the level of their agreement. All this indication shows that the level of their ICT policy awareness after the training is high, 85.7% and 64.3% of pre-service teachers in TE program would be able to describe the implementation of ICT policy in their institutions as well as the positive and weaknesses of the policy respectively, after the training.

The findings further indicated that if the policy is applied, it would promote the use of ICT to create student-centered learning. It can be mainly be deployed for efficient presentation but with insufficient capacity to benefit the classroom (Mean= 4.71). This result implies that, if the ICT policy is fully implemented for the Technical Education program, student-centered learning environment can be created especially when it is used as a tool for presentation, and because of its effectiveness to benefit classroom activities, Technical Education course presentation and delivery would be efficient. Therefore, ICT policy level of awareness of Technical Education pre-service teachers is high after the training.

(b) Knowledge Deepening Level

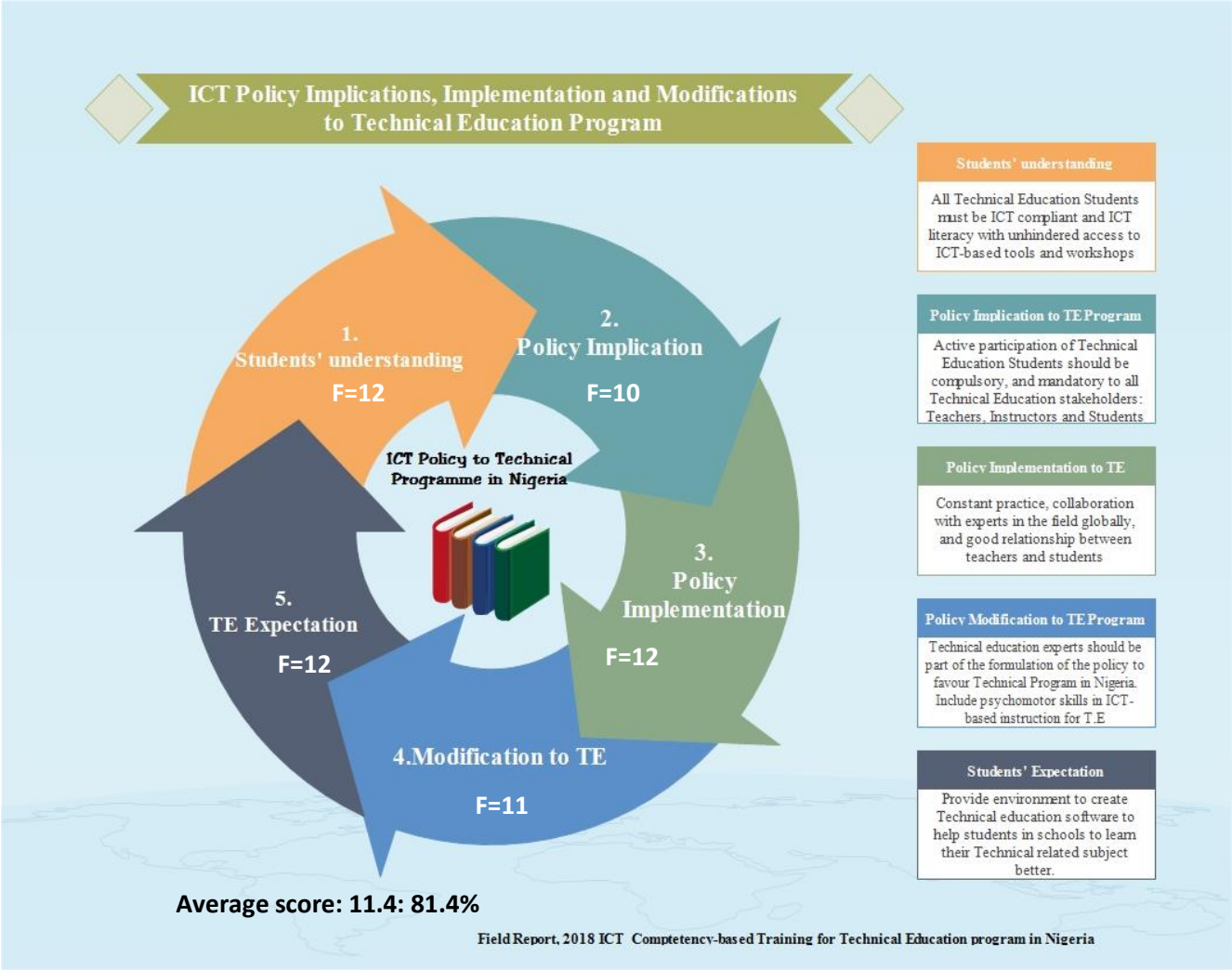


Figure 4.1.1b: Responses of students along thematic areas of research

Figure 4.1.1(b) showed the responses of students after the training which have been grouped into five thematic areas of research, which are: Students' understanding of the policy; Policy implication; Policy implementation; Policy modification and policy expectation. The figure showed first the understanding of pre-service teachers (Technical Education program) about the ICT policy usage after the training. It can be deduced that the high level of ICT policy awareness obtained from Technology literacy stage might have resulted in a better understanding of the policy at this stage. The implication of figure 4.1.1(bi) is that pre-service teachers' understanding of ICT policy as it applies to Technical Education is well articulated.

Table 4.1.1(bii) Responses of students' Knowledge deepening level

S/N	Items	VLE	LE	VFE	FE	AE	VAE	GE	VGE	Mean	STD.D
1	that ICT policy could change the face of Technical education as a course	- 0.0	- 0.0	- 0.0	1 7.1	1 7.1	5 35.7	3 21.4	4 28.6	6.29	1.437
2	that ICT policy could change the practices of TE in the classroom	- 0.0	1 7.1	- 0.0	1 7.1	1 7.1	2 14.3	3 21.4	6 42.9	6.50	1.871
	Weighted Mean	**6.39 (79.9)**									

Decision rule is 4.5

Table Keys

VLE: Very Low Extent

LE: Low Extent

VFE: Very Fairly Extent

FE: Fairly Extent

AE: Averagely Extent

VAE: Very Averagely Extent

GE: Great Extent

VGE: Very Great Extent

In addition to the findings collected from the students, Table 4.1.1(bii) further showed that Pre-service teachers' level of awareness of ICT policy usage in schools for Technical Education program has furthered indicated that: ICT policy could change the practices of TE in the classroom, and the fact that ICT policy could change the face of Technical Education as a course. The implication of this is, at Knowledge deepening level (KD), awareness is higher and deeper.

(C) Knowledge Creation Level

Figure 4.1.1(b), it indicated the policy innovations the pre-service teachers in Technical Education program contributed to the Nigerian IT policy usage after the training. It can then mean that the understanding of the ICT policy obtained from the knowledge deepening stage might have resulted in a better understanding of the policy at this stage. At this stage, questions related to policy modification and implementation were asked. Figure 4.1.1(b) showed the various domains or themes of participants' responses which are: Students' understanding; policy implication; policy implementation; policy modification, and the expectation of the policy to Technical Education program. Among the thematic areas that are responsible for knowledge, creation is Policy implementation, policy modification, and policy expectation. The implication of figure 4.1.1(b) is that pre-service teachers were able to make suggestions to how the National ICT policy can be implemented to engender Technology Integration in Technical Education program. This is reflected in the responses as captured in fig 4.1.1b

4.1.2 Research Question 2: What is the level of Pre-service teachers' ICT skills for Curriculum and Assessment after the training at the following levels?

a. Technological Literacy,

b. Knowledge deepening and

c. Knowledge creation

Table 4.1.2(a) Students' Responses of ICT Tool as applied to Curriculum and Assessment

a. Technology Literacy Level:

S/N	Focal Questions	Themes	Sampled Evidences/Statements	Frequency
1	Based on the knowledge of the tools at this stage, mention one topic in TD alongside with the appropriate tool in TE that this tool can help you teach very effectively	Subject	Types of lines, Construction of circles and Triangles Construction of Epicycloid, involute	10
		ICT Tools	Microsoft word document PowerPoint Angles with power point, Isometric Drawing with Power point	10
2	Identify objectives of the chose topic that this tool can teach effectively	Objectives	a. identify all the types of lines, b. use the types of lines in drawing, c. apply the types of line in drawing	10
3	How can this tool be used for assessment of the chosen topic	Assessment	Practice with the tools in class and give students assignments to be submitted in the format of the tool Yes, it can be used to teach the sequential process of lines. AutoCAD gives descent, discreet, accurate and better drawing than paper and pencil drawing. Give a copy of isometric drawing and then ask them to redraw	10
			Average score	10(71.4%)

Table 4.1.2(a) showed the participants' responses based on the open-ended questions presented after the training. The responses were grouped under four domains/themes: Subject in Technical Drawing; ICT tools that can be used to teach and learn the chosen topics; Instructional objectives, and Assessment with ICT tools.

The results imply that pre-service teachers in the Technical education program were able to match topics with ICT tools after the ICT training at the Technology literacy stage of the UNESCO ICT-CFT benchmark. Equally, pre-service teachers were able to identify appropriate ICT tools that can teach or learn the chosen topics in Technical drawing. Furthermore, pre-service teachers were able to generate instructional objectives, as well as, how to use the ICT tools mentioned to assess the teaching and learning of the topic in Technical drawing. At the Technology literacy level of the UNESCO benchmark of ICT-CFT, it is expected that participants would go through ICT training to acquire basic knowledge of ICT tools accurately, which could now be deployed to teach concepts in the curriculum. They should also be able to assess knowledge acquired through ICT tools. It then implies that participants were able to acquire basic knowledge of tools that can be deployed for content delivery and assessments.

Table 4.1.2b Knowledge Deepening Level

S/N	Focal Questions	Themes	Sampled Evidences/Statements	Frequency
1	Based on the knowledge of the subject related tools at this stage, mention one topic in TD alongside with the appropriate tool in TE that this tool can help you teach very effectively	Subject	Electrical wiring, Orthographic projection Building drawing	12
		ICT Tools	PowerPoint and AutoCAD; Angles with power point, Isometric Drawing – AutoCAD	13
2	How can this tool help in implementing the teaching of the topic more effectively	Implementation	To construct a plan of electrical wiring circuit of a building. AutoCAD makes it easy and quick to achieve this process. Upgrading materials from time to time. For ease of views. It helps in rapid transfer of knowledge	10
3	Mention one subject-related tool that can be used for assessment	Assessment	PowerPoint and AutoCAD; Angles with power point, Isometric Drawing – AutoCAD	13
			Average Score	12(85.7%)

Table 4.1.2b showed the pre-service teachers' responses based on the open-ended questions asked after the training. The responses were grouped under three domains/themes: a subject with relevant ICT tools in Technical Drawing; Implementation and Assessment using the ICT tools. At Knowledge deepening of ICT-CFT UNESCO benchmark, participants would need to acquire knowledge application using ICT tools to deepen the concepts in Technical drawing. Pre-service teachers were able to acquire skills in ICT-related Tools such as skills in AutoCAD, Edraw, and Smart Draw to teach and learn selected topics in Technical drawing. Therefore, the implications of figure 4.1.2(b) to pre-service ICT skills is that they were able to acquire ICT skills in ICT tools that are related to Technical Drawing, which can be used to implement and assess the teaching of the selected topics

c. Knowledge Creation Level

Table 4.1.2(c) showed the sample of two lesson note guides for the teaching of topics in Technical drawing. These lessons note guides were created by the pre-service teachers in Technical Education after the ICT training. The template was adapted from (ASEI). At first, a participant would need to identify a topic in Technical drawing and show how students would be assisted to acquire a deeper knowledge of the topic through ICT tools like Internet searching techniques which will lead to knowledge economy. Table 4.1.2(c) showed the sample of students' work using the ASEI format. The format addresses the following areas: A chosen topic, generation of learning objectives; provision of the rationale for teaching the topic; generation of pre-requisite knowledge; stating learning materials. The format will have equally the following headings: Introduction: (Teacher activities; Learner's Activity, and Learning points); Development: (Teacher activities; Learner's Activity, and Learning points); Evaluation: (Teacher activities; Learner's Activity, and Learning points), and Conclusion: (Teacher activities; Learner's Activity, and Learning points). Each of the lesson contents will have three sets of activities that would guide both the teachers and the students. The students were able to create this lesson note guides effectively.

Table 4.1.2(c) Sample of ASEI Lesson note formats on TD

Items	Frequency
Group 1: Topic: Types of lines ***Learning Objectives:*** *To be able to identify types of lines in a drawing* ***(4marks)*** ***Rationale:*** *identifying types of lines in a drawing having been taught would help in applying lines in drawing practices* ***(3marks)*** ***Previous knowledge:*** *Students can construct title block* ***(2marks)*** ***Learning materials:*** *drawing sheet, sets, board and charts drawn with PowerPoint* ***(3marks)*** ***Introduction:*** a. ***Teachers' Activity:*** *the teacher introduces the lesson by showing the students some of the charts of lines drawn with PowerPoint* ***(2marks)*** b. ***Learner's Activity:*** *Learner sit and write out what they can see in the chart projected on the projector's screen* ***(1marks)*** c. ***Learning Points:*** *Mention the types of lines* ***(1marks)*** ***Development:*** a. ***Teacher's Activity:*** *Teacher draws or constructs types of lines on the board with the use ICT tools available to the teachers* ***(3marks)*** b. ***Learners' Activity:*** *Students draw as teacher draws* ***(2marks)*** c. ***Learning Point:*** *Students have now acquired the knowledge of types of lines in drawing* ***(3marks)*** ***Evaluation:*** a. ***Teachers' Activity:*** *teacher asks question* ***(3marks)*** b. ***Learners' Activity****: Students answer the question* ***(2marks)*** c. ***Learning Point****: Students learn how to answer question in class about types of lines* ***(2marks)*** ***Conclusion:*** a. ***Teacher's Activity:*** *Teachers concludes the lesson by summarizing the lesson again* ***(2marks)*** b. ***Learners' Activity****: Students compare what the teacher is saying with what they have written down about the topic: types of lines* ***(1marks)*** ***Group 1: Total score: 34/50: 68%*** ***Group 2: Topic: Building Drawing***	

Learning Objectives: *to be able to use computer to draw effectively* ***(4marks)***

Rationale: *Since not so many people are using computer aided design to make their drawings* ***(4marks)***

Previous knowledge: *Students must have known how to manually draw* ***(3marks)***

Learning materials: *computer system and samples of computer aided designs* ***(3marks)***

Introduction:

d. ***Teachers' Activity:*** *the teacher introduces the lesson by teaching the basic tools used in the environment* ***(2marks)***
e. ***Learner's Activity:*** *students follow with their computer* ***(1marks)***
f. ***Learning Points: Nil*** ***(0marks)***

Development:

d. ***Teacher's Activity:*** *Teacher goes more deeply into the course by introducing technical terms in building drawing* ***(3marks)***
e. ***Learners' Activity:*** *Students draw as teacher draws* ***(3marks)***
f. ***Learning Point:*** *Students have now acquired the knowledge of types of lines in drawing* ***(4marks)***

Evaluation:

d. ***Teachers' Activity:*** *teacher asks question* ***(3marks)***
e. ***Learners' Activity****: Students answer the question* ***(2marks)***
f. ***Learning Point****: Students learn how to answer question in class about types of lines* ***(1marks)***

Conclusion:

c. ***Teacher's Activity:*** *Teachers concludes the lesson by summarizing the lesson again* ***(2marks)***
d. ***Learners' Activity****: Students compare what the teacher is saying with what they have written down about the topic: types of lines* ***(1marks)***
e. ***Learning Points:*** ***(0marks)***

Group 2: Total score: 36/50: 72%

Total Average: 68+72 140/2 = 70%

4.1.3 Research Question 3: What is the level of Pre-service teachers' ICT skills for Pedagogy after the training at the following levels?

a. Technological Literacy,

b. Knowledge deepening and

c. Knowledge creation

4.1.3 Pre-service teachers' ICT skills for Pedagogy

a. Technology Literacy level

Table 4.1.3a Students' Responses ICT Tools usage for Pedagogy

S/N	Focal Questions	Themes	Sampled Evidences/Statements	Frequency
1	Choose a particular tool, what teaching strategies/methods can this tool help to implement?	Teaching strategies/Methods	Discussion, demonstration and project methods, field trip, experimental	12
		ICT Tools	PowerPoint and AutoCAD; Angles with power point, Isometric Drawing – AutoCAD	12
2	How would use the tool to implement the strategies/methods to teach a topic in TE (5 sentences)	Implementation	Discuss the topic Demonstrate the topic Ask questions Give project to students Give reinforcement to students	12
			Average Score	12(85.7%)

Table 4.1.3 showed the students' responses based on the open-ended questions asked after the training. At the Technology literacy level of the UNESCO ICT-CFT benchmark, students are expected to demonstrate how to use ICT skills and competencies for the implementation of pedagogy as applied to Technical Education. Achieving these skills and competencies, students were requested to identify one particular ICT tool they have been exposed to during the training, and also identify strategies that can be implemented with the ICT tool. Students were able to identify several strategies/methods that can be implemented with ICT tools. The following

pedagogies were identified as applicable to Technical Education program: discussion; demonstration; project method; field trip; experimental; practical and demonstration. The students were able to identify steps that could be used to implement these pedagogies when deployed in the teaching and learning process. Therefore, the result shows a high level of ICT competence for pedagogy after the training.

b. Knowledge deepening level

Table 4.1.3b Students' Responses ICT Tools usage for Pedagogy

S/N	Focal Questions	Themes	Sampled Evidences/Statements	Frequency
1	Identify a complex problem and an ICT tool to teach the chosen problem, what teaching strategies/methods can this tool help to implement?	Teaching strategies/Methods	Practical and demonstration methods	12
		Complex Problem	Draw orthographic and sectional drawings epicycloid, involute	12
2	How would use the tool to implement the strategies/methods to teach a topic in TE (5 sentences)	Implementation	Discuss the topic Demonstrate the topic Ask questions Give project to students Give reinforcement to students	12
			Average Score	12(85.7%)

Table 4.1.3(c) Pre-service teachers' level of ICT usage for complex problem solving

S/N	Items	VLE	LE	VFE	FE	AE	VAE	GE	VGE	Mean	STD.D
1	adopt collaborative learning in classroom	- 0.0	2 14.3	1 7.1	1 7.1	4 28.6	-	3 21.4	3 21.4	5.71	2.128
2	adopt project-based learning in classroom	1 7.1	- 0.0	2 14.3	- 0.0	3 21.4	1 7.1	4 28.6	3 21.4	5.86	2.143
3	design on-line materials to support your students	- 0.0	2 14.3	2 14.3	1 7.1	2 14.3	- 0.0	5 35.7	2 14.3	5.50	2.210
4	applicable to real-world problems	1 7.1	- 0.0	1 7.1	2 14.3	3 21.4	1 7.1	3 21.4	3 21.4	**5.71**	**2.091**
	Weighted Mean	**5.69 (71.1%)**									

Decision rule is 4.5

Table Keys

VLE: Very Low Extent

LE: Low Extent

VFE: Very Fairly Extent

FE: Fairly Extent

AE: Averagely Extent

VAE: Very Averagely Extent

GE: Great Extent

VGE: Very Great Extent

The decision rule is 4.5 average. Tables 4.1.3 (b and c) showed the extent to which Pre-service teachers would use ICT skills and competencies to implement subject-related strategies in Technical Education. Pre-service teachers of Technical Education program agreed that to a large extent they would adopt collaborative learning in the classroom, also adopt project-based learning. Furthermore, they also agreed with the fact that they would design on-line materials to support their students' learning. These findings imply that when teachers are trained to use ICT tools that are related to content-based, they would use ICT tools to implement teaching strategies/methods in the Technical education course. Therefore, students can use ICT skills and competencies acquired to implement collaborative learning; implement project-based learning for students' projects, and deal with practical problems of people in terms of building and creating hands-on projects they also would be able to create online materials to support student's learning. It is, therefore, appropriate to imply that Technical Education preservice teachers were able to acquire ICT skills and competencies needed to implement pedagogy to create in-depth and subject-related knowledge.

c. Knowledge Creation level:

Table 4.1.3c Pre-service teachers' level of ICT usage for Pedagogy (Self-management)

S/N	Items	VLE	LE	VFE	FE	AE	VAE	GE	VGE	Mean	STD.D
1	create synchronous activities capable to engender creativity	- 0.0	4 28.6	- 0.0	2 14.3	3 2.4	1 7.1	4 28.6	- 0.0	4.79	2.082
2	use social media networks to support students' learning	1 7.1	1 7.1	- 0.0	- 0.0	2 14.3	3 21.4	4 28.6	3 21.4	5.86	2.143
3	apply web 2.0 tools to create students' support for digital materials	- 0.0	1 7.1	2 14.3	1 7.1	4 28.6	2 14.3	3 21.4	1 7.1	5.36	1.781
4	allow your classroom be involved in learning projects with other institutions using online communication in TE programme	- 0.0	1 7.1	2 14.3	2 14.3	2 14.3	1 7.1	4 28.6	2 14.3	5.50	1.990
5	help students create multimedia production, web production and publishing technologies acknowledged	- 0.0	- 0.0	2 14.3	3 21.4	2 14.3	1 7.1	3 21.4	3 21.4	5.71	1.858
	Weighted Mean	**5.44 (68.0%)**									

Decision rule is 4.5

Table Keys

VLE: Very Low Extent

LE: Low Extent

VFE: Very Fairly Extent

FE: Fairly Extent

AE: Averagely Extent

VAE: Very Averagely Extent

GE: Great Extent

VGE: Very Great Extent

Table 4.1.3 (c) showed the extent to which Pre-service teachers would use ICT skills and competencies at the knowledge creation level of ICT-CFT UNESCO benchmark. Pre-service teachers agreed with the fact they would be able to use social media networks to support students' learning. This implies that the level at which they would use ICT tools to achieve self-management is high.

4.1.4 Research Question 4: To what extent would the students' work output that has been developed meet the competency standards after the training?

Table 4.1.4 a

In this section, the criteria to measure the effectiveness of students' work output have been categorized into nine (9) criteria: Content; ease of use; Technical quality; fun; assessment; documentation, ability level, Engagement/Interactivity, and adaptability. Table 4.1.6a showed the content being assessed by five (5) experts in the field of Technical drawing and educational technology.

Table 4.1.4b: **Raters' Responses on Content of Students' Artefact**

S/N	Items **Content Development**	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	The content is accurate	4	4	3	4	3	3.6	V.A
2	The content is factual	4	4	3	4	3	3.6	V.A
3	The content is educationally appropriate	2	3	2	3	3	2.6	V.A
4	The content is free of errors in grammar, spelling and punctuation	4	4	3	3	3	3.4	V.A
5	The content meets learning goals and objectives	4	4	2	3	3	3.2	V.A
6	Screen content would not confuse the learner	4	2	3	3	4	3.2	V.A
7	The content is age appropriate	4	4	4	3	3	3.6	V.A
8	Content illustrates moral and ethical issues	4	4	3	0	0	2.2	N.A
9	Program depicts accurately the real world	3	4	3	0	2	2.4	N.A
10	The content is free of stereotypes	4	4	3	4	3	3.6	V.A
	Weighted mean	3.14 (78.5%)						

Decision rule is 2.5

Table Keys:

VA: Very Accurate

NA: Not Accurate

In Tables 4.1.4c (a-i), Table 4.1.4c showed that the students' artifacts developed after the ICT training is accurate in content; content is factual; content is age-appropriate; content is free of stereotypes; content is free of errors in grammar, spelling, and punctuation; content meets learning goals and objectives; content is educationally appropriate, However, content does not illustrate moral and ethical issues, as well as, program not reflecting the true reflection of what is obtainable in reality. It, therefore, means that the content is appropriate and can be used to teach and learn Technical drawing.

Table 4.1.4 d Raters' Responses on Ease of use of Student's work output

S/N	Items Ease of use	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	Directions are clear	3	4	4	4	2	3.4	V.E
2	Students can exit the program at any time	4	3	4	4	2	3.4	V.E
3	Students can restart the program where they stopped	3	4	4	4	3	3.6	V.E
4	Software is easy to use for first -	3	3	4	4	2	3.2	V.E
5	Software Icons are accessible and appealing	3	3	4	4	2	3.2	V.E
6	Printing is simple	0	4	4	0	0	1.6	N.E
7	Software is controlled by users or learning	4	3	3	4	3	3.4	V.E
8	Further learning materials are available	3	4	3	4	2	3.2	V.E
9	Instructions can be viewed onscreen	3	4	3	4	3	3.4	V.E
10	Easy to manipulate through the program	3	2	3	4	2	2.8	V.E
11	Easy to install	4	4	4	0	4	3.2	V.E
12	The software is reliable and free of disruption by system errors	0	4	4	4	2	2.8	V.E
13	Learner knows if error has been made	3	3	4	0	2	2.4	N.E
	Weighted mean	3.05(76.3%)						

Decision rule is 2.5

Note: VE: Very Easy, and NE: Not easy

Table **4.1.4 d** indicated, that the following items showed the ease of use of the ICT-software: Directions are clear; Students can exit the program at any time, Students can restart the program where they stopped, users or learners can independently browse through the software with access to additional learning materials, Instructions can be viewed onscreen, manipulate and install The artifact is reliable and free of disruption by system errors. However, printing is not easy, also it is difficult for learners to know if errors have been made. The analysis showed that the level of ease of use of the artifact is high according to the rating.

Table 4.1.4e Raters' Responses on documentation of Student's work output

S/N	Items **Documentation**	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	The instructional manual is clear for teachers	4	4	3	4	3	3.6	V.E
2	Installation manual for operations is easy to follow	1	4	3	1	3	2.4	N.E
3	Summary of content and objectives are clear written	1	4	3	4	3	3.0	V.E
4	Technical support and toll-free service are available	1	3	3	4	3	2.8	E
5	The software has a support number	0	4	3	0	4	2.2	N.E
6	Online technical support is available	0	4	4	0	4	2.4	N.E
7	Help manual and video tutorial are available and clear	0	4	3	0	2	1.8	N.E
8	Bibliographies and other helpful materials with weblinks are suggested	0	4	4	0	2	2.0	N.E
9	Classroom activity templates for lesson plan are supplied in both printable and online formats	0	4	3	0	1	1.6	N.E
10	Additional helps and cues are accessible with ease of understanding.	3	4	2	0	1	2.0	N.E
	Weighted mean	2.38 (59.5%)						

Decision rule is 2.5

Note: VE: Very Easy, and NE: Not easy, E: Easy

Table **4.1.4e** showed the documentation features of artifact that: additional materials for online support is made available in the software; software with a support number; online technical support should be available; help and tutorials should be clear and easy to use; also, weblinks and bibliographies are equally suggested and provided in the software; classroom activity templates for lesson plan are provided to enrich teaching-learning process of technical drawing subject. However, the teacher instructor manual is clear and thorough, as well as, a summary of content and learning objectives.

Table 4.1.4f Raters' Responses on ability level of Student's work output

S/N	Items Ability level	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	The user level can be set by the teacher	3	4	2	4	3	3.2	V.A
2	Targeted audience can read directions and can progress logically as they use the software.	1	4	3	0	3	2.2	N. A
3	Teaching strategies used in the software is appropriate for the students	2	4	3	0	3	2.4	N. A
4	Software allows user's level to advance automatically	2	3	2	4	2	2.6	V.A
5	The software covers a variety of ability/skill levels	4	4	3	2	1	2.8	V.A
	Weighted mean	2.64 (66.0%)						

Decision rule is 2.5

Note: VA: Very Accurate, NA: Not Accurate

Table **4.1.4f** showed that the artefact produced and developed by the students after the training can be used for various ability levels of the intended users.

Table 4.1.4g Raters' Responses Engagement/Interactivity of Student's work output

S/N	Items Engagement/Interactivity	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	Feedback and timely engagement of learners are included in the software	3	3	3	2	1	2.4	N. A
2	Motivation to continue using the software is built into the software.	3	3	3	4	3	3.2	V.A
3	Software layout of screen content is logical and consistent.	3	3	3	4	3	3.2	V.A
4	Screen directions are provided and easy to follow.	0	3	3	4	3	2.6	V.A
5	User's pace option is determined with option to pause and play at will.	1	3	3	4	3	2.8	V.A
	Weighted mean	2.84 (71.0%)						

Decision rule is 2.5

Note: VA: Very Accurate, NA: Not Accurate

Tables **4.1.4g** indicated the interactivity and engagement level of the artifact developed by Technical Education preservice teachers after the training. It, therefore, means that the program is effective for any age bracket that is learning Technical drawing concepts, as well as, the level of engagement and interactivity that has been incorporated in the artifact.

Table 4.1.4h Raters' Responses on Assessment of Student's work output

S/N	Items Assessment	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	Software has built in assessment and reporting tools	0	4	4	0	2	2.0	N. A
2	Tracking system to capture individual and group data of student is available.	0	4	3	0	1	1.6	N. A
3	Feedback system promotes the learning content further and it is not negative.	0	4	4	0	1	1.8	N. A
4	Evaluation methods are suitable	0	3	4	4	2	2.6	V.A
5	Software documents and records student's progress	4	4	4	4	1	3.4	V.A
6	Teachers easily can assess student' progress by evaluating progress reports	4	4	3	0	2	2.6	V.A
	Weighted mean	2.33 (58.3%)						

Decision rule is 2.5

Note: VA: Very Accurate, NA: Not Accurate

Table **4.1.4h** showed that quite several features are still not incorporated into the program. However, assessment features like software documents and recording student's progress are incorporated**.**

Table 4.1.4i Raters' Responses on Technical quality of Student's work output

S/N	Items Technical Quality	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	Animation and graphics are used well	3	4	3	0	2	2.4	N. A
2	Quality graphics elements, audio and video clips are provided.	4	3	4	4	3	3.6	V.A
3	Texts at the background are readable and simple.	4	4	3	3	3	3.4	V.A
4	Media elements in the software like texts and images are not gender biased nor culturally implied.	4	4	3	4	3	3.6	V.A
5	Option to save your work and progress locally without internet access is possible.	0	4	2	3	2	2.2	N. A
6	To save user's activity to track the progress is possible.	0	4	2	0	2	1.6	N. A
7	Option to print and download user's work are included.	0	4	2	0	0	1.2	N. A
8	The use of Audio element is appropriate	0	4	3	0	2	1.8	N. A
9	Prompts and cues are appropriate	0	4	3	3	2	2.4	N. A
10	Branching is possible in the software	4	3	3	0	2	2.4	N. A

11	Keys work independently	4	4	3	0	1	2.4	N. A
	Weighted mean	2.45 (61.3%)						

Decision rule is 2.5 Note: VA: Very Accurate, NA: Not Accurate

Tables **4.1.4i** showed that few technical issues are still missing in the program. It therefore necessary to incorporate missing technical and assessment features for more effectiveness. However, technical quality features incorporated but few

Table 4.1.4j: Raters' Responses on Fun of Student's work output

S/N	**Items** **Fun**	**Rater (1)**	**Rater (2)**	**Rater (3)**	**Rater (4)**	**Rater (5)**	**Mean**	**Remark**
1	Learning is meaningful and interesting	4	4	4	0	1	2.6	V.A
2	Learning content is captivating	4	4	4	2	2	3.2	V.A
3	Activities are randomly generated	1	4	4	4	3	3.2	V.A
	Weighted mean	3.0 (75.0%)						

Decision rule is 2.5

Note: VA: Very Accurate, NA: Not Accurate

Table **4.1.4j** captured the fun features of the artefact, weighted mean score of the table is quite well above the average mean score (2.5**).** It therefore means that the program is capable of inducing fun

Table 4.1.4k: Raters' Responses on Adaptability level of Student's work output

S/N	Items Adaptability	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	Compatibility issue with system file is resolved.	4	4	4	0	4	3.2	V.A
2	Software works fine on all operating systems.	1	4	4	0	3	2.4	N. A
3	Software is adaptable and assistive in nature.	1	4	4	1	2	2.4	N. A
	Weighted mean	2.67 (66.0%)						

Decision rule is 2.5

Note: VA: Very Accurate, NA: Not Accurate

Tables **4.1.4k** captured the adaptability features of the program, weighted mean score of the table is quite well above the average mean score (2.5**).** It therefore means that the artefact can be adapted for learners' needs as the case may be.

4.1.5 Research Question 5: What is the level of creativity of the students' output work after the training?

Table 4.1.5: Raters' Responses on Creativity level of Student's work output

S/N	Items Creativity	Rater (1)	Rater (2)	Rater (3)	Rater (4)	Rater (5)	Mean	Remark
1	Criteria 1	1	6	4	4	5	4.0	V.C
2	Criteria 2	2	5	3	3	5	3.6	V.C
	Weighted mean	3.8						

Decision rule is 2.5

Note: VC: Very Creative

Table 4.1.5 disclosed the creativity level of students' artefact developed to teach and learn some concepts in Technical drawing. The creativity was assessed by the experts based on two major criteria in the creativity rubric. There are two criteria for which students' output is adjudged. The Table 4.5 showed that students' artefact is a product of creativity. It therefore means that the work is creative.

4.1.6 Research Question 6: What is the level of students' ICT-Skills after the training?

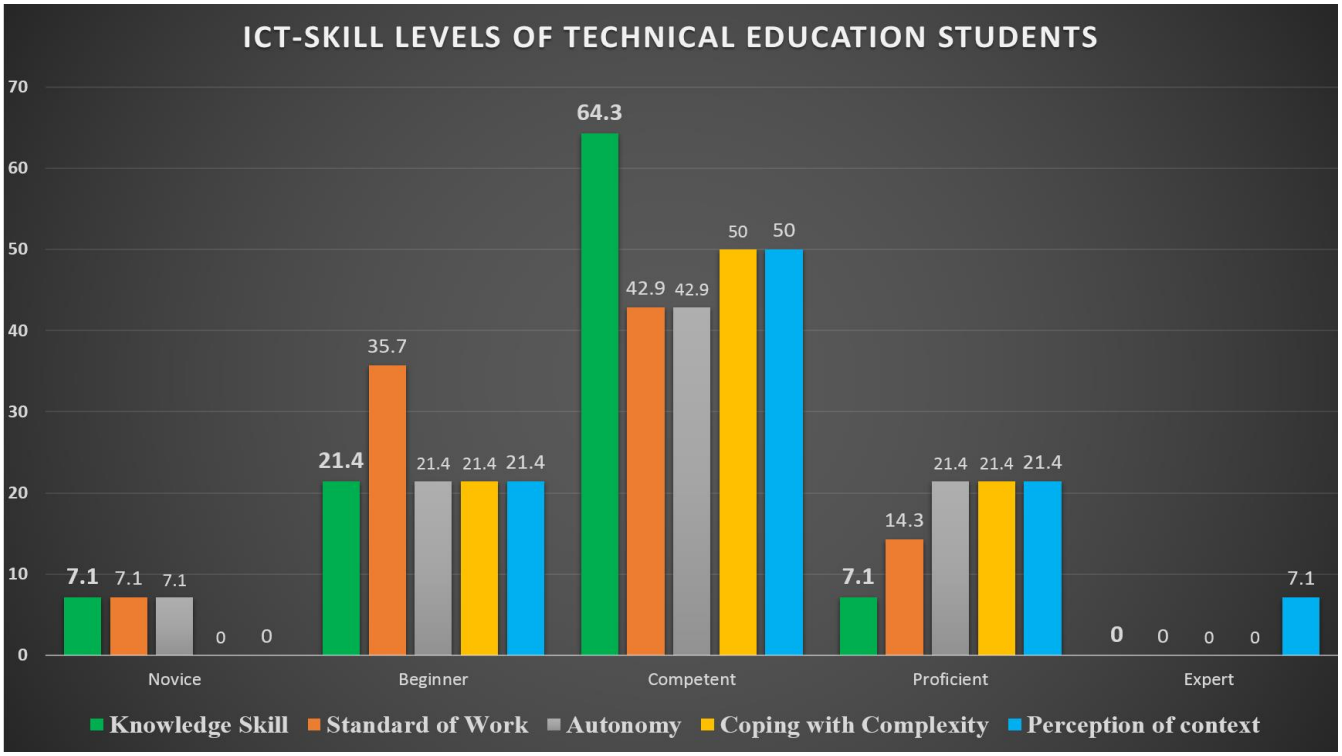


Figure 4.1.6 Pre-service teachers' ICT skills level after the training

Figure 4.1.6 indicated the skills levels of pre-service teachers of technical education program after the ICT training, the skills level is thematic in nature. The graph indicates the level at TVET pre-service teachers are after the ICT training. It shows the summary of ICT skills and competencies of TVET pre-service teachers acquired after the training. Each component of Figure 4.1.6 is captured in Figures 4.1.6a-4.1.6e

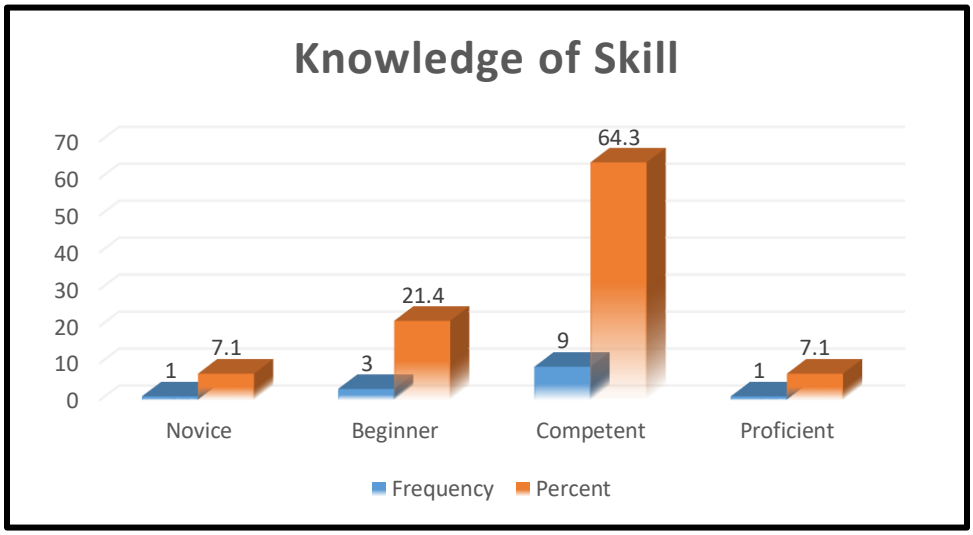


Figure 4.1.6a: ICT Competence at Knowledge Skill

At the knowledge or skill level, 71.4% of pre-service teachers were considered competent based on the skill acquisition rubric, and 10 students out of 14 students that attended all the sessions were considered competent concerning knowledge of ICT tools, the students were exposed to, during the training. It then implies that TVET pre-service teachers acquired cognitive knowledge of the skills deployed in the production of the software for Technical drawing.

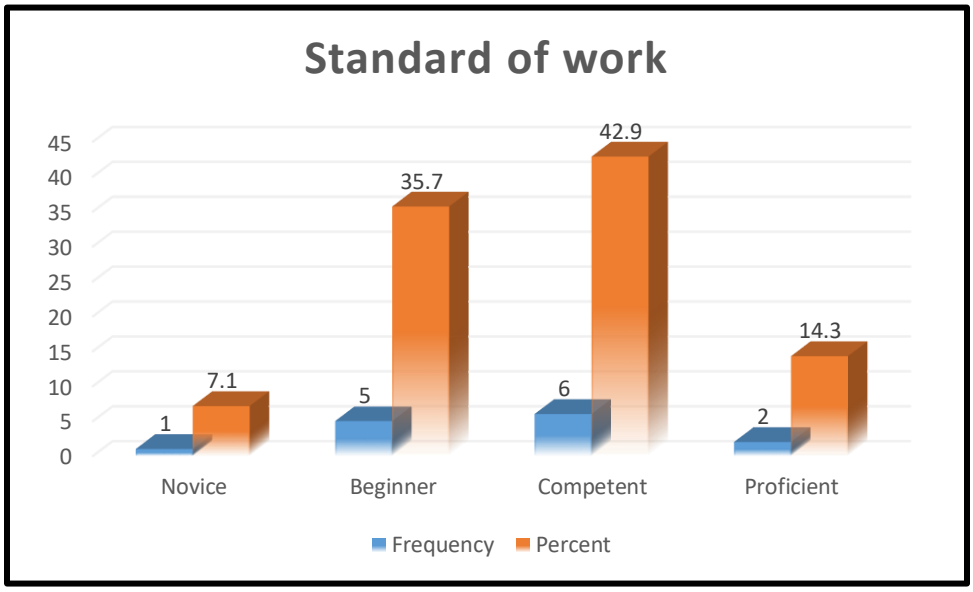


Figure 4.1.6b: ICT Competence in standard of work

At Standard of work, the percentage is somewhat above the average of 57.2%, and 8 students were considered competent in terms of the standard of work the students created during the training. It is, therefore, appropriate to state that more than an average of the students was competent: their works were according to the standards.

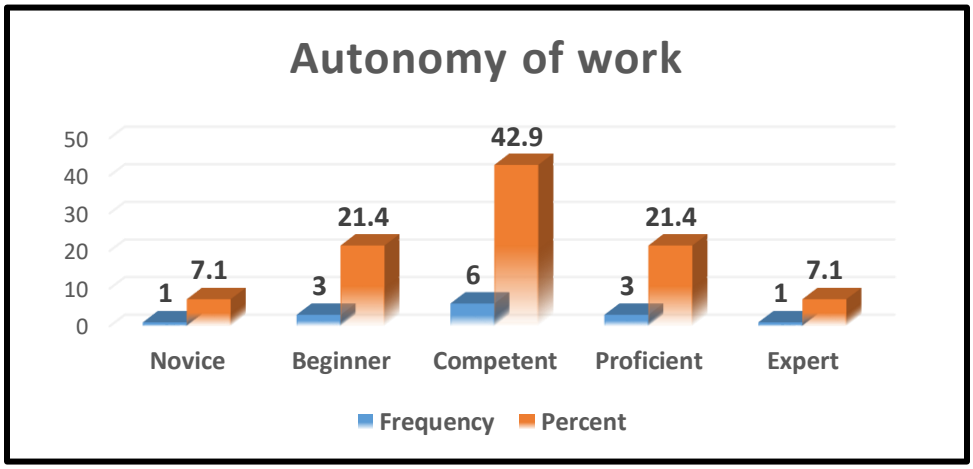


Figure 4.1.6c: ICT Competence in Students' Work Autonomy

At the autonomy level, 71.4% of participants are considered competent in handling ICT tools to execute teaching and learning tasks. TVET pre-service teachers demonstrated autonomy of work in the design and development of the software. TVET pre-service could demonstrate the use of ICT tools for knowledge creation independently.

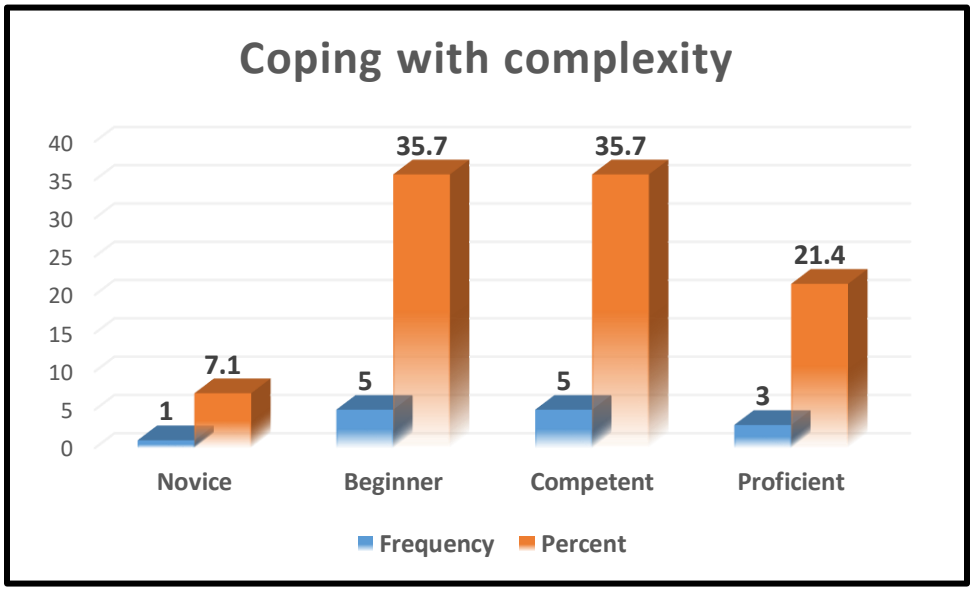


Figure 4.1.6d: ICT Competence in Coping with complexities

At coping with complexity level, 57.1% is considered to be competent in handling complexities concerning ICT skills and competencies. The nature TVET programs require that TVET pre-service teachers understand adequately the complexities involved in the TVET teaching-learning process before deploying ICT skills. Figure 4.1.6d indicates slightly above average, the percentage of TVET pre-service teachers that could deploy ICT tools to create knowledge across the domains of TVET program, this due to the practical nature of the TVET programs and courses.

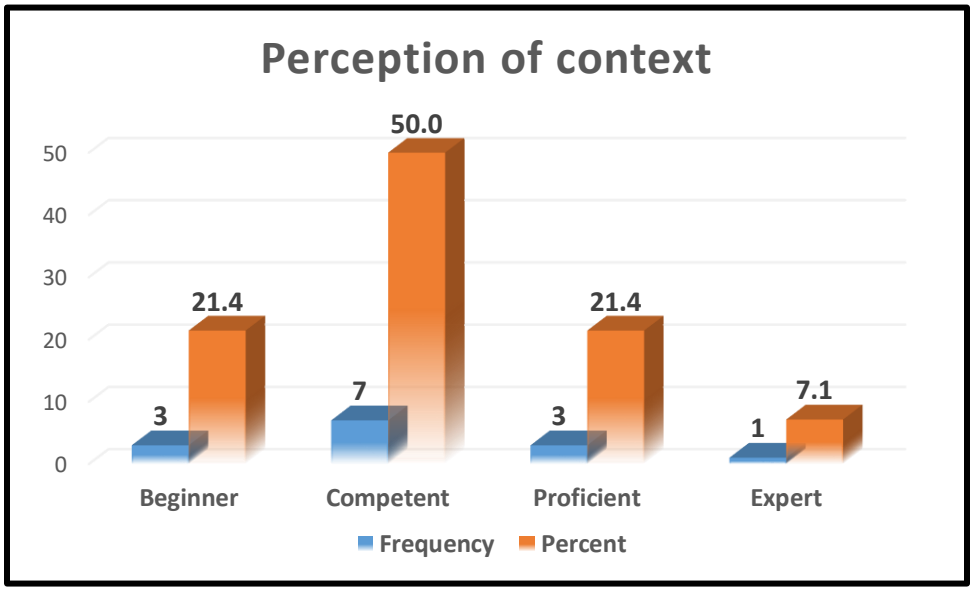


Figure 4.1.6e: ICT Competence in Perception of context

At the perception of context, 78.5% is considered competent in deploying ICT tools to the Technical Education context. Figure 4.6.5 indicates accurately the ICT competency level of pre-service teachers concerning their work. It, therefore, showed that the pre-service teachers have acquired ICT skills and competencies needed in the Technical Education context.

4.2. Testing the Hypothesis

4**.2 HO_1**: There is no significant mean difference in pre-service teachers' ICT Competency level before and after the training.

Table 4.2: Paired Sample statistics on Students' ICT-Skills Acquisition during ICT-CFT Training

	Paired Difference						
Variables	**Mean**	**N**	**SD**	**t**	**df**	**Value**	**Remark**
ICT_LEVEL Post	**142.5000**	**14**	**31.60757**	**5.302**	**13**	**.000**	**Significant**
ICT_LEVEL Pre	**80.0714**	**14**	**42.35830**				

Table 4.2: indicated that significant difference between variables (ICT Skill level Pretest and ICT skill level Posttest), t (13) =5.302; DF=13 $p<0.005$. This means that there is a significant mean difference in pre-service teachers' ICT Competency levels before and after the training. Therefore, the hypothesis is rejected. It, therefore, means that ICT training significantly affected ICT skills and competencies acquired by the pre-service teachers in the Technical education program.

4.3 Discussion of Findings

4.3.1Technology Literacy level of Technical Education Pre-service Teachers

4.3.1.1 Understanding ICT Policy in Education (Policy awareness)

The main truss of this study is to implement an ICT competency-based training for pre-service Technical Education teachers, and pre-service teachers' ICT competencies were measured in terms of ICT skills deployed when creating software that could be used to learn and teach Technical drawing, as a subject. UNESCO ICT-CFT states that ICT competencies of teachers incorporate technology literacy, knowledge deepening and creation. In this study, TVET pre-service teachers' ICT competencies and skills were measured in the knowledge creation stage of ICT-CFT. The ICT competency-based training is crafted from UNESCO ICT-CFT, published in 2011. The ICT framework shows the interrelatedness of teachers' duties to ICT tools. These duties are categorized into six themes: Understanding ICT policy in Education; Curriculum and Assessment; Pedagogy; ICT; Administration and Management, and Teacher Professional Learning.

Therefore, based on the findings, the following observations are made on the first duty of a typical teacher in the classroom. The finding shows that Technical Education Teachers that participated in the ICT competency-based training reflect a high level of awareness of an ICT policy available whether locality or at the National level.

This knowledge is demonstrated in the participants' ability to be able to describe the positive effects of the ICT policy and how each section of the policy is being implemented in their school. The effect of this knowledge is beneficial to the effective presentation of lesson content and delivery. The very first stage of understanding ICT usage in education is stemmed from the awareness of the ICT policy. Instructors/facilitators of Technical education should demonstrate a high level of awareness of the ICT policy, and the finding of the study has shown that TE pre-

service teachers have a high level of awareness of ICT policy. Teachers need to be substantially aware of the existence of ICT policy that supports the use of ICT schools.

The pre-training studies conducted between 2015-2016, indicated that TE instructors show the low level of awareness of the ICT policy which is consistent with the findings of Badau and Sakiyo (2013). However, after the training, it could be deduced that the possibility of ICT competency-based training being responsible for the high level of awareness of TE pre-service teachers is conceived. UNESCO (2011) asserts that the very important competency that a typical teacher should acquire first in the competency framework is the awareness of the existence of the ICT policy that supports ICT usage. Technical education (TE) pre-service teachers are not only aware of the ICT policy, but equally, can describe the positive effect of the ICT policy on the effective presentation of TE contents as well as how each part of the ICT policy is being implemented in their school. However, there is a mixed response among TE pre-service teachers on whether the use of ICT in the classroom is limited in terms of benefits it could offer to classroom teaching, this might be due to the fact that general ICT tools and applications may not be beneficial to Technical Education courses if they are not related to the program, obviously because of the practical nature of the course.

Therefore, some ICT tools may not be applied directly to Technical Education program unless they are taught by TVET professionals and practitioners who themselves had been trained in the Content knowledge (CK) of TVET, which will be applied to teaching-learning process of TVET courses and subjects, hence the reason for the mixed feelings of TE pre-service teachers towards the benefits of all ICT tools to Technical Education program. It is therefore right to assert that using ICT for the TE program is very appropriate. The practical nature of the program, therefore, requires a careful selection of suitable and appropriate ICT tools.

4.3.1.2 Curriculum and Assessment ICT Competency level of TE Pre-service teachers

The findings of the study articulated the needed skills, Technical education pre-service teachers have acquired during the process of ICT competency training. The Pre-service teachers of TE acquired ICT skills that can be applied to curriculum content. The policy goal of UNESCO ICT-CFT standards as stipulated in the document requires that any teachers at the stage of Technology, should possess ICT competencies to match curriculum standards with relevant ICT tools, and apply as appropriate. TE pre-service teachers can identify various topics of Technical drawing as stipulated in the curriculum concerning ICT tools needed to implement the curriculum.

The responses of pre-service teachers of TE are grouped under four themes, which is denoted by 4Is: Identification of Technical drawing Topics; Identification of Relevant ICT tools; Identification of instructional objectives, and Identification of ICT Assessment methods.

The required skills in Technical drawing curriculum content are expected to be acquired by pre-service teachers of TE. The reason is not far-fetched, it is due to ICT competency-based training. The training is not responsible for the identification of the curriculum content/topics, participants have been trained and taught already the Technical drawing curriculum content. The integration of ICT related skills and competencies is the focus of the training. The training is based on the UNESCO ICT-CFT framework. This negates the findings of Badau K. M and Sakiyo J (2013) which identified that Teachers' ICT competency level is low to implement the curriculum of their subject. Contrariwise, the findings of this study have indicated that teachers, especially TE teachers have the full grasp of content knowledge (CK), that the problem of ICT integration in TVET program is not a question of Content knowledge but rather the relevant ICT training that ensure the concurrent acquisition of ICT skills and competencies. It then implies that the UNESCO ICT-CFT framework is effective in ensuring related and integrated ICT skills which could be used to train any teachers. The Pre-service teachers of Technical Education do not only possess ICT skills to implement the content of Technical drawing but equally the skills to deplore ICT skills for curriculum assessment.

The Pre-service teachers of TE were able to identify the Technical drawing topics; ICT tools that could be deployed to teach the topics, objectives and choose assessment method that can be implemented with ICT skills. Furthermore, it supports the findings of Tasir, Abour, Halim and Harun, (2012) that teachers in Malaysia have a high level of ICT competency and confidence that helped them to able to practice ICT tools effectively such as using computers, preparing lesson notes, querying the internet for restructured information, designing simple websites. and they can integrate these tools into their preparations to create high levels of satisfaction toward ICT training programs. These ICT skills provide them with relevant knowledge of ICT, which in its role, results in the effective preparation of course content. Assessing Technical Education content could be made effective and efficient just as stipulated by the findings of the study, that TE pre-service can identify different means of assessing Technical drawing with ICT, this supports the findings of Tikam, (2013) that ICT not only does it help in the teaching and learning process, it also assists in assessment and evaluation, as well as in supporting inclusive education, because it can provide

better access to educational resources, which in turn will improve the quality of learning, expand teachers' productivity and help to connect the digital world.

The policy goal of UNESCO 2011 stipulates that teachers' literacy ICT skills and competencies should be able to produce high-quality resources and make them available. The most effective means to achieve this policy is for teachers to able to first identify curriculum content in a particular subject, identify relevant ICT tools that can be deployed to teach the topics, raise instructional objectives, as well as, identify assessment tools concerning ICT tools. Prior to this, teachers already would have acquired knowledge of pedagogical knowledge as well as content knowledge, but the Technology knowledge is still missing especially among Technical Education instructors. However, with proper, effective and related ICT training, the problem would be gradually eliminated. The ICT skills and competencies acquired by pre-service teachers of TE have initiated the process of eliminating the problem of lack of ICT skills and competencies among Technical Education instructors.

4.3.1.3 ICT Pedagogical level of TE Pre-service teachers

At the Technology literacy level of the UNESCO ICT-CFT benchmark, participants are expected to demonstrate how to use ICT skills and competencies for the implementation of pedagogy as applied to Technical education. Participants were able to identify several strategies/methods that could be implemented by one or two ICT tools. The following pedagogies were identified as applicable to Technical Education program: discussion; demonstration; project method; field trip; experimental, and practical, as well as steps that could be used to implement these pedagogies when deployed in the teaching and learning process.

The findings of the study have indicated that pre-service teachers of TE were able to itemize five different strategies that are commonly employed by Technical educators, these teachers have no difficulty in identifying these strategies probably because of two reasons: they have been taught under a methodology course usually undertaken at 100 level and secondly, these strategies have been implemented quite several times whenever they are being taught by their teachers. With these two reasons in view, a conclusion could possibly be drawn that the ICT competency-based training might not be responsible for the identification of the strategies usually, which are effective and suitable for technical courses. It then means that teachers across levels have adequate knowledge of relevant strategies they could deploy to teach their various subject, however, using ICT to implement these strategies requires a requisite Technological knowledge

(TK) which has been offered to Pre-service teachers of TE to inform them that leveraging the affordances of technology, could assist in implementing most effectively, the designated strategies.

It is on this basis that, the finding of this study is hinged. It is generally agreed that all the designated strategies could be implemented with ICT tools. In a bid to provide the answer to this observation, participants outlined a step-by-step process of implementation with respect to ICT tools, that topic can be achieved more effectively by a PowerPoint presentation of the topic where all the intricacies of the topic like sectioning in the Technical drawing can be outlined more vividly with different features. This can be achieved with PowerPoint by using colours, broken lines, animations, transition.

Equally, the demonstration of the topic could be achieved more effectively with Video presentation which usually includes the combination of multimedia elements, this can be uploaded on YouTube, Edmodo, Facebook, Schoology, and at the same time, and ask students to respond to questions after they must have viewed the video clips. Assigning a project for students could easily be achieved with a learning management system (LMS) like Edmodo, Moodle, Schoology, where due dates can be attached, and attendance can be taken. Finally, given feedbacks to students which has been impossible several times as a result of some unforeseen factors, but with ICT tools like instant messaging platform, immediate knowledge of result (IKR) can be administered. LMS platforms could also achieve this with a little effort. All these steps can be easily be implemented with technologies. Therefore, participants all agreed that there is no method of teaching employed in Technical education that cannot be implemented with ICT tools, it all depends on the quality of ICT skills and competencies possessed.

The findings of the study agreed with following scholars who had carried out different research works in technical courses with ICT tools as teaching strategies: Otunla, (2015); Oppong, Vivian, and Eunice (2013), Lilia, Ruhizan and Azaman (2012), Abd-El-Aziz (2014), Oyebode, Adebayo, and Olowe, (2015), and Gambari, Yusuf and Balogun (2015) which have shown positive effects of using ICT for the teaching and learning of Technical Drawing. These studies reported high performance of students in achievement when they were exposed to one type of technology used to teach some selected TD topics. Therefore, using technology for courses/subjects like TD could be of great benefit. The advent of ICT has provided many options and alternatives to teaching strategies and techniques in Technical related courses. The reasons cannot be far-fetched, the ICT-CFT framework provides an integrated approach to how ICT skills and competencies should be

deployed especially to the Technical Education program, domain that is predominantly practical hands-on activities. It is generally believed that ICT tools do not have any role to play. Solving this requires not just only one ICT tools, but an integrative ICT tool. Only one ICT tool cannot be effective in content delivery of Technical related courses: video-based, audio-based, text-based, graphic-based, animation-based, LMS-based and simulation-based tools must all be integrated to effectively address the practical nature of Technical Education program. Therefore, at the Technology literacy stage of the UNESCO IC-CFT framework, findings have indicated that designated instructional strategies for the Technical Education program could effectively be addressed with ICT tools especially when TVET instructors are trained to acquire the related ICT skills and competencies.

4.3.2 Knowledge deepening level of Technical Education Pre-service Teachers

4.3.2.1 ICT Policy in Education

At Knowledge deepening of UNESCO ICT-CFT (2011) framework for teachers, the policy goals focus on the need for teachers to acquire requisite competencies with respect to ICT skills, the policy, therefore, states adequate knowledge of national policies that support the use of ICT in education is required by teachers which are applied to create and modify classroom practices and activities that support the policies. The findings of the study indicate the understanding of pre-service teachers of Technical Education program about the ICT policy usage after the training. It can be deduced that the high level of ICT policy understanding obtained would have emanated from the Technology literacy stage, it is therefore responsible for the understanding of the policy at this stage, where knowledge deepening is expected of the ICT policy. The participants' understanding of ICT policy has been captured under five headings: Student's understanding; Policy implications; Policy implementation; Policy modification, and Technical Education teachers' expectation of the ICT policy. The first three themes apply to policy understanding while the remaining two themes are for the third phase of the ICT-CFT UNESCO, (2011), knowledge creation (KC). A section of the Nigeria ICT policy was presented to the participants: 'To empower Nigerians to participate in software and ICT development'. It is to this effect that pre-service teachers' understanding was collected. The response of the participants is therefore captured beneath.

'All Technical education students must be ICT compliant and ICT literacy with unhindered access to ICT-based tools and workshops' (Participants' conclusion)

The consequent effect of this response from pre-service teachers of TE would be, to mandate all the training institutions running Technical Education in the country to be responsible for ICT training of Technical education instructors. The ICT policy statement should produce ICT compliant individuals in the society that could flexibly explore the domain of ICT in the profession. ITU-UNESCO, (2017) states that with ICT policy in place, it provides opportunities to acquire ICT skills and competencies, required of teachers especially Technical education, applying ICT policy on education is belt from the understanding of the policy by the drivers of policy implication. Teachers need to understand the ICT policy prior to implementation. Not only should teachers have an in-depth understanding of the policy, they must as well be able to interpret in relation to their context. The pre-service teachers of Technical Education articulated what the ICT policy of Nigeria means to them. It then lays a responsibility on the constituting body to communicate the ICT policy properly and clearly. This will assist teachers' implementation of the policy, UNESCO (2011). The implication of pre-service teachers' understanding of the IC policy is further strengthened in their statement of implication: that making Technical education Instructors ICT compliant requires:

Active participation of Technical Education instructors should be compulsory and mandatory, and this could be achieved with constant practice, collaboration with experts in the field of Technical education around the world, and good relationship between teachers and students (Participants' conclusion).

At the knowledge deepening level, the policy goal is centered on teachers being able to manage information, structure problem tasks, integrate open-ended software tools, and collaborate with projects through the ICT skills and competencies. The first step is for teachers to be able to interpret the ICT policy. This attests to the tenets of competency theory applied in the study, that competency starts from the conceptual understanding of the variables underpinning the belt of competence, Azemikhah (2005).

"a quality that needs to be developed by the learners both conceptually and physically." It needs to be conceptually developed in the minds of the learners based on the constituents of competence (underpinnings and attributes), and physically developed and perfected by performance (based on performance criteria) resulting in a balanced hands and minds equilibrium"

The indicators of this statement are further explained by the findings, that the ICT policy of Nigeria is capable of changing the face of Technical Education if actively implemented in the

program. Over the years the Technical Education program has been labeled as the type of education for the intellectually deficient people in the society, and low status in TVET, UNESCO (2015). The effect of the thesis reflected in the attitude of, parents who do not usually encourage or guide their wards to undertake a course in Vocational and Technical related courses, Edeta, Abutu, and Jimoh (2010). The finding also indicates that applying the Nigerian ICT policy to the Technical education program could affect the practices of the program in the classroom positively. Effective ICT policy, which is a crucial institutional management tool can facilitate the effective implementation and integration of ICTs in TVET institutions. This supports the findings of Maina, (2016) that the ICT Policy strongly and positively correlates with effective integration of ICTs in TVET institutions in Kenya, and TVET instructors lack proper institution ICT policy documents, ICT work plans or ICT guidelines for effective integration of ICTs. It results in a low level of confidence in the relevance of existing ICT policies and institutional capacity for policy implementation.

4.3.2.2 Curriculum and Assessment ICT Competency level of TE Pre-service Teachers

At knowledge deepening (KD) level of ICT-CFT UNESCO benchmark, (2011). Findings show that participants had acquired ICT skills and competencies that would help them to deepen the knowledge of students using ICT tools in Technical drawing concepts. This is because the participant was able to acquire skills in ICT-related Tools such as skills in AutoCAD, Edraw, and SmartDraw, all these can be used to teach and learn topics in Technical drawing. The policy goal of this stage in UNESCO ICT-CFT document (2011) states that teachers should be able to exhibit skills in different of software applications in the subject area (such as scientific visualisation, data analysis applications in Electronics, role-play simulations in Technical education-related courses, and references resources in crafting).

This possible when teachers engage experts via online forums and communities. They should be able to make participants analyze specific packages in their subject area and describe how they support concepts and complex problem-solving in a learner-centered environment. What the participants were able to do was to make use of subject-specific software tools like AutoCAD, SmartDraw, Edraw, and PowerPoint to create the animated video on drawings. This is possible because of Technical related ICT tools that were deployed to train the pre-service teachers. At this point, the two theories that underpin the study come to play a crucial role that attests to the acquisition of ICT skills and competencies in these ICT tools. Azemikhah (2005) of competency

theory states that there are two stages in the competency theory that explains what it means for an individual to be competent in a particular belt of competence: *'The first stage is where the learners recognize the key concepts in the problem in the light of required knowledge and variables in the competency unit. The focus is to link the embedded in or implied from, variables and performance criteria in the unit of competency. The relevant variables from the Unit of Competency are recognized and listed on the right side (Conceptual), the performance criteria are listed on the left (Physical) side'*

The relevant skills are listed at the center. (Fig 2.1). The key concepts are then connected to variables; variables are connected to skills, skills to performance criteria, and performance criteria to the key concepts. Then the second stage expands to all the three dimensions of the first stage. In this case, participants were able to identify key areas Technical drawing by listing out various topics in the subject, and equally acquired skills that assisted them to identify the relevant ICT tools like AutoCAD and SmartDraw. Furthermore, objectives are raised based on the availability of ICT tools and selected topics as well as the choice of assessment techniques. The teachers do not only acquire competencies in pedagogical knowledge but equally in technological knowledge which Mishra and Koehler (2006) termed Technological Pedagogical knowledge (TPK). It then means that Technical education teachers could update their ICT skills and competencies through an integrated approach to ICT training without altering their pedagogical knowledge (PK), and in fact, PK tends to be effective when combined with Technological knowledge (TK). The finding of the study supports the finding of Chua and Jamil (2012) and Guthrie, et al. (2009) that TVET instructors could acquire proficient knowledge by attending Professional development program either On-Job Training or Off-Job Training., and equally supports the idea that a good relationship with the industry provides opportunity to instructors to enhance their knowledge and skills.

4.3.2.3 ICT Pedagogical level of TE Pre-service teachers

At knowledge deepening level (KD), the findings of the study show that the level at which the participants would use ICT skills and competencies to implement collaborative learning; implement project-based learning for assigned students' projects, and deal with practical problems of people in terms of building and creating hands-on projects that solve the needs of the society, is high. The policy goal at Knowledge Deeping with respect to using ICT skills and competencies to deplore pedagogy is to solve a complex problem within a context, UNESCO (2011). The context

here is Technical education pre-service teachers, where ICT skills and competencies are expected to be required by the participants. Having participated in ICT training, the training provides information on how to implement pedagogies that will foster collaboration with either their colleagues or experts in the field. The findings indicate that, the level at which they would deplore ICT tools to adopt collaborative strategies in the classroom; project-based learning, e-learning strategies and solve real-world problems is prominently high. This could be as a result of what they experienced themselves during the ICT training.

The ICT training allowed them to collaborate with experts in the field of Technical education by watching several related video clips on YouTube, Vimeo and TED-Video, these platforms are accompanied with features that provide an opportunity to chat and make comments on the video clip watched, also send comments by mails. Furthermore, it could be as a result of the opportunity that allowed them to view online materials on the various subjects they are currently offering in schools. This agrees with the policy goal of UNESCO ICT-CFT (2008, 2011), that teachers need to acquire collaborative strategies by using ICT tools to ease the means of collaboration. Conversely, they would not be able to create online materials to support student's learning. This might be because, Technical Education course is practical- oriented, and often requires physical demonstration of completed projects. It is, therefore appropriate to submit that Technical Education participants were able to acquire ICT skills and competencies to implement pedagogy, which could be deployed to create in-depth knowledge in Technical related subjects.

4.3.3 Knowledge creation level of Technical Education Pre-service Teachers

4.3.3.1 Understanding ICT Policy in Education (Policy innovation)

The policy goal of UNESCO ICT-CFT, (2008 and 2011) states the expected competencies that teachers should acquire. It states that teachers at all levels should adequate knowledge of national policies and make effective contributions to the policies that can reform the educational sector. Teachers at this level should engage in professional practices that support the policies innovatively. The implication of that statement to pre-service Technical education teachers is that TE instructors should be able to contribute to the ICT national Policy, having understood the implications of the policy. It is to this effect, that the finding of the study presents the contributions of the pre-service teachers. Therefore, the following contributions should be considered in the ICT policy with respect to the Technical education program in Nigeria: Technical education experts should be part of the formulation of the policy to maximally benefit Technical education program

in Nigeria, this is possible by including psychomotor skills in ICT-based instruction. The policy would equally assist in providing the environment that assists in creating Technical education-based software. This will help students and teachers in schools, who are involved in the teaching-learning process of Technical-related subjects, more effectively. This finding agrees with the policy goal of the UNESCO ICT-CFT framework, 2008 and 2011.

4.3.3.2 Curriculum and Assessment ICT Competency level of TE Pre-service teachers (Knowledge society skills)

At the knowledge creation (KC) level, the finding of the study shows that participants were able to create a unit of a lesson using ASEI lesson format. ASEI means A-Activities, S-Students, E-Experiments, and I-Improvisation. Past studies that have applied ASEI format to create a unit of a lesson, have reported that ASEI format of lesson note guide contains intricacies that will accomplish effectively the policy goal, and equally, assist participants to implement them. Also, teachers should be able to integrate the acquisition and demonstrate one or more of these skills in a lesson plan, and ultimately, assist participants to reflect on executing the lesson plan while offering suggestions for improvement. It is to this effect, that two samples of lesson note guides on the Technical drawing are presented as prepared by the participants. Participants were not only acquiring ICT skills and competencies of ICT tools but equally, able to create a unit of a lesson (ASEI) that would help learners to acquire a knowledge of the society which invariably would assist in solving the most pressing needs of the society.

4.3.3.3 ICT Pedagogical level of TE Pre-service teachers (Self-management)

The finding of the study shows the level at which pre-service teachers of Technical Education would use ICT skills and competencies acquired to create engaging activities that will assist student to be problem-solvers and artistic through online platforms using social media networks to support students' learning is also expected such as web 2.0 could be adopted to support students in creating their digital products is equally expected; allowing community of practice in the classroom, and helping students to create multimedia production, web production, and publishing technologies is expected on a very large scale. This has been found very high in this study. This finding agrees with the policy goal of the stage in UNESCO ICT-CFT (2011) document which stresses that ICT skills and competencies should be deployed for self-management.

4.3.4 Students' Artefact on Technical Drawing

The findings of the study show the extent to which students' joint project measure-up to the standards of effective software, usually deploy for the teaching-learning process. The findings show that the developed software on the Technical drawing by pre-service teachers of Technical education program after the training meets the standards. The software also reflects ICT skills and competencies acquired by the trainees. The standards have been grouped under nine (9) themes, which are: Content; Ease of use; Documentation; Ability level; Engagement and Interactivity; Assessment; Technical quality, and Fun.

The software developed by the pre-service teachers of Technical education on Technical drawing subject is unanimously agreed upon by the raters, that the developed software on Technical drawing has been effectively developed and designed, this might be since the software content is somewhat accurate, factual, and is educationally appropriate based on the curriculum on Technical drawing. The software content does not only accurately present the content but equally free from general errors in grammar, spelling and punctual as well as meet the set objectives. The overall agreement process of validation by experts reflects that the developed software content complies with the curriculum specifications.

Furthermore, the validation process of the developed software also covers the perceived ease of use of the software. The level of agreement among the experts that reviewed the software indicates that the software has been conceived to be found easy to use in that if the software is deployed in schools, both students and teachers would not have challenges in navigating through the software for the process of learning. This is might be due to the fact that directions are clear which helps students or users to exit the program at will. Also, the feature that helps users to restart the program wherever the users stop, could be responsible for the overall agreement among the experts.

The independent use of the program by the users on the first trial also positions the software at a very high level with respect to ease of use, because the program presents the opportunity of software keys, menus, icons which are very intuitive to help users navigate through the program interface. These features help the users to view the content on the screen, easily install the program and prevent the sudden disruption of the program by system errors. However, the level of agreement among the experts does not favor the aspect of the software with respect to features that could help users to print simply as well as help users to be aware if errors have been made or

committed. However, overall, the agreement among the experts indicates that the program is easy to use, manipulate and navigate.

Conversely to the previous positive level of agreement among the experts, the program does not support the documentation process, and this is because the program does not include the instructional manual for installation procedures. Equally, toll-free and online technical support is not covered in the program, as well as, helpful tutorials. However, the ability of the level of the program is consistently agreed upon by the experts to be appropriate all because the teachers could set the level that would be suitable to a set of students, and that the users could advance to the next stage at will. Equally, the level of agreement by the experts indicates that the program has potential features for the user's engagement. However, the level of agreement among the reviewers varies with respect to the assessment feature of the program and Technical quality. This might be because the software has not inbuilt assessment and reporting tools, tracking students' data and managing the data and analyzing the data for content upgrades. Also, on the technical quality, their level of agreement varies because of some features that do not apply to the program, features like save option at regular interval and inappropriate use of animations might be responsible for varied responses from the experts, as well as the area of expertise of the experts. There are two types of reviewers, the content reviewers, and design reviewers and the two types are employed in this review.

However, the program is capable of inducing fun during the learning process as well as adapting the program to any system software. These findings attest to the fact that educational software or program should be validated to verify the compliance to specific specifications and standards, this has been supported by these authors who also carried out the validation process on the products after design and development phases have been completed. (Mooz, Forsberg, and Cotterman (2003); Moura, Silva, Aesh, Lima, Moreira, Silva, (2017); Aremu, Obideyi, and Morakinyo, (2014), Aremu and Ogundolire (2015). All of these authors agreed with the fact after an educational program or software has been designed and developed, validation and verification must be carried out on to test for the face and content validation. All of the authors validated their products after the development phase has been completed.

4.3.5 ICT Skills and Competencies Acquisition level (Dreyfus skill acquisition model)

The findings of the study also show the ICT skill level of participants with respect to knowledge skill; the standard of work; Autonomy; Coping with complexity and Perception of context. The ICT skills and competencies levels of participants were measured based on the Dreyfus skill acquisition model (1984). Participants' knowledge skill level indicates that the participants appreciably acquired knowledge of both the ICT tools taught during the training and the knowledge of Technical education courses. The majority of the participants demonstrated an excellent index of knowledge skill which could be attributed to the structure of the competency framework by UNESCO (2011). Also, standard of work carried out by the participants during the training shows that the participants had slightly above average ICT skills and competencies, this might be since a lot of do not have requisite ICT skills and competencies that are connected to their course of study, but report of the in-depth interview conducted indicates, that participants request for continuous exposure to relevant ICT training which will enable them to reach high skills and competencies level with respect to standard of work. Furthermore, the finding indicates that participants demonstrated slightly above average ICT skills and competencies with respect to autonomy, this might be because most the projects undertaken during the training were executed in groups and collaborative skills were encouraged, but the finding still shows that the level of autonomy is above the average which agrees with expectation after the ICT training. Also, coping with complexity among the participants indicates that the majority of the trainees are excellently and constantly solving problems associated with any assigned projects. The adduced reason for this might be because of the collaborative strategies used to complete any given tasks. This confirms the theory of engagement that underpins this study.

Kearsley and Shneiderman (1998) states that for any creative, meaningful and authentic learning to occur among learners, emphasis must be placed on collaborative efforts among learners, project-based assignments should be assigned and a non-academic focus should be stressed. When participants demonstrate involvement, participation, and commitment to any assigned projects, the possibility of learners to constantly cope with complexity with the assigned project is high. With respect to the perception of context, the participants excellently demonstrated a high level of ICT skills and competencies in relation to the Technical education program. This might be because of the relevance attached to the ICT tools taught during the training. The participants possibly associate the relevance of ICT tools taught to the context of Technical

education. They probably believe that ICT tools could be used to teach some difficult topics in Technical drawing subject, for example, one the participants attest that PowerPoint could be used to teach types of lines in a Technical drawing:

'I think PowerPoint can be used, for instance, you are taking a topic like "Lines" and let's say it is a very large class, you can use PowerPoint in teaching them by showing them the sequential process involved in drawing the lines without any stress'

Another participant: 'Yes, it will help to teach very well, because when the teacher uses these Microsoft tools, the students will be eager to learn and the passion to put their minds in what the teacher is teaching will be enhanced, which in turn helps to improve the students' performance.'

The findings of the study support the tenet of the first theory of this study: Competency theory. The theory posits that for any competency to occur, learners must follow three successive stages: the conceptual knowledge, the skill gaps and the physical demonstration of what has been conceived and have been learned with requisite skills Azemikhah (2005). The creativity component of students' artifact as adjudged by the reviewers, indicates that the level of agreement among the reviewers is on the increasing level. There is no agreement among the reviewers as to whether the work is creative, but their reviews show that there is a creativity index in the program developed by the students/trainees as well as an increasing measure from one reviewer to another.

4.3.6 ICT Skills and Competencies toward ICT tools (Basic Tools, Complex tools, and pervasive tools)

The finding of the study shows that there is significant means difference in the ICT skills of participants of ICT tools taught before and after the training. The extent to which the participants would use ICT tools learned during the training has been responsible for the high level demonstrated after the training. A lot of factors would have been responsible for this high level of use of ICT tools with respect to their course of study. One of the major factors is that the framework used, to deplore the ICT competency training is well structured and adaptable, the framework shows what is expected of each trainee and that the framework does not dissociate ICT tools from teachers 'duties. Teachers' duties are collectively connected to any ICT tools chosen. Also, the selected ICT tools are grouped based on the usage and relevance: Basic tools, Complex and pervasive tools. The policy goal of learning basic tools in the framework is that: 'Teachers must know basic hardware and software operations, as well as productivity applications software, a web

browser, communications software, presentation software, and management applications' UNESCO (2011.p.25).

The participants were exposed to different computer hardware and software that assisted them to fully integrate themselves into the understanding, that ICT tools could assist largely to address problems associated with content delivery and assessment of Technical education courses. Also, at complex tools level, the policy goal of ICT-CFT UNESCO framework (2011) is that 'Teachers must be knowledgeable about a variety of subject-specific tools and applications and be able to flexibly use these in a variety of problem-based and project-based situations. Teachers should be able to use network resources to help students collaborate, access information and communicate with external experts to analyze and solve their selected problems. Teachers should also be able to use ICT to create and monitor individual and group student project plans' UNESCO, 2011.P.31). Specific ICT tools were selected for the training, the in-depth interview conducted show the level at which participants used the complex tools. The following tools were selected: PowerPoint, Edraw, Smart Draw, and AutoCAD. Some of the participants expressed their views about complex ICT tools:

'Yes, I feel software like PowerPoint will make learning a lot easy for students; the most important software for me is the AutoCAD because it pertains to my field of study; PowerPoint Presentation can be used to create Angle like construction lines in teaching; I have learned a lot of things so far and I have tried to improve myself on those things I have learned before like presentation, Microsoft word, AutoCAD, I just learned it but didn't know how to apply it, but during the course of the training I have gained more knowledge on these ICT tools can be applied to the teaching of my course; I have covered Camtasia for editing videos, AutoCAD, for drawing, Microsoft excel for database and data validation, Microsoft word for text, search engines and domains email creation; Using ICT to solve problems associated with Technical education will be a good idea, because many people are lagging because of lack of knowledge of ICT, but with the knowledge of ICT they can be solved'

Participants can learn these ICT tools based on the policy goals of UNESCO (2011) the framework expects to use ICT skills, tools and competencies to create an ICT-based knowledge that could be used to support students' development learning. The findings of the study show that the participants developed an ICT-based program/software on Technical drawing which was reviewed by experts in the field of Technical drawing and Educational Technology. The reviews

indicate that the program developed and created by the participants on the Technical drawing is capable of assisting students to learn better the subject more meaningfully and effectively. The findings indicated that the competency theory (Azemikhah, 2005) and engagement theory (Kearsley and Shneiderman, 1998) have been verified to be effective and further validated**.**

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

Based on the analysis and the interpretation of the data collected in this study, the followings are the summary of the findings after the intervention has been carried out

- ✓ The preservice teachers of Technical education demonstrated a high level of competence at Technology literacy (TL), Knowledge deepening (KD) and Knowledge creation (KC) levels of ICT use for understanding National ICT policy as applicable to Technical Education program
- ✓ The preservice teachers of Technical education demonstrated a high level of competence at Technology literacy (TL), Knowledge deepening (KD) and Knowledge creation (KC) levels of ICT use for to Curriculum and Assessment as it applies to ICT usage in Technical Education
- ✓ The preservice teachers of Technical education demonstrated a high level of competence at Technology literacy (TL), Knowledge deepening (KD) and Knowledge creation (KC) levels of ICT use for pedagogy as it applies to ICT usage in Technical Education
- ✓ The preservice teachers of Technical Education were able to acquire necessary ICT skills and competencies needed to create software/program/ICT-based learning package on Technical drawing
- ✓ The preservice teachers of Technical Education that developed and created software/program/ICT-based learning package on Technical drawing met the standards of creating ICT-based software.
- ✓ The preservice teachers of Technical Education demonstrated a high level of creativity as reflected in the development of ICT-based learning package for Technical drawing
- ✓ The preservice teachers of Technical education demonstrated a high level of ICT skills and competencies according to the Dreyfus model of skills acquisition
- ✓ There is a significant mean difference in the pretest and posttest of ICT tools level of usage of Technical education preservice teachers

5.2 Conclusions

The study has shown that ICT skills and competencies among Technical education instructors, a field of study that is predominantly psychomotor domain-based, can be achieved. These ICT skills and competencies have been grouped into three successive stages according to UNESCO, 2011 ICT-CFT and they are Technology literacy, Knowledge deepening, and knowledge creation. These ICT skills and competencies in these three domains are cross-linked with six typical duties of a teacher. The initial understanding of Technical education instructors (preservice and in-service teachers) was that Technology/ICT tools cannot be leveraged on for Technical education content delivery and assessment, but after the study, the understanding changed. What is probably responsible for the initial perception of Technical education instructors was to lack ICT skills and competencies. Bridging these ICT skills and competencies gap should not just be administered haphazardly. These ICT skills and competencies should be connected to the subject-area of teachers. Also, the findings of the study have indicated to enhance the acquisition of ICT skills and competencies of teachers, they should be aware of supporting policies by Government bodies.

According to the UNESCO ICT-CFT 2011, the first stage in the framework is technology literacy, that teachers at the Technology literacy level (TL) are expected to use ICT tools, skills, and competencies for understanding policy ICT; create basic knowledge in curriculum and assessment of technical education courses; integrate technology into pedagogy; create standard classroom and improve digital literacy of teachers. It can be concluded that if ICT tools, skills, and competencies are connected to teacher's duties, the level at which teachers (especially technical education instructors) would use ICT tools/technologies would be effectively high.

Furthermore, UNESCO ICT-CFT document stipulates that at knowledge deepening (KD) educators should be able to apply ICT tools, skills, and competencies to understand the ICT policy as well as articulate the use of the ICT policy in technology integration; As part of teachers' duties in this level, teachers are expected to use the knowledge of the ICT policy to encourage knowledge application; solve complex problems; form collaborative groups and manage and guide learning activities. The study has established that using subject-related ICT tools Technical education instructors (pre-service and in-service) would understand the need for improving ICT skills and competencies in their subject-areas.

At knowledge creation of the policy, teachers are expected to use ICT tools and skills and competencies innovate policies that support ICT use in education, engender knowledge society skills, self-management, create learning organizations and make teachers a model of the learner. The findings of the study have indicated that teachers can create ICT-based resources that can be used for their subjects in the classroom. This is evident in the development of an artifact. The development was possible because of ICT tools, skills and competencies acquired during the training to design, develop and create an ICT-based software for Technical drawing subject. The software was validated by experts in the field of Technical drawing and Education technology, the reports showed that the ICT-Based software developed by the pre-service teachers of Technical education program is considered valid, useful and capable of inducing learning that has been initially conceived as difficult and abstract. Also, it can be concluded that through, appropriate and subject-area based ICT-training, teachers (whether pre-service or in-service) can acquire requisite and related ICT skills and competencies which they could assist to design and develop technology-based learning. They would also be able to facilitate effective and creative, teaching-learning processes. Furthermore, ICT-based software or program can easily be developed by teachers in T.E.

5.3 Limitation of the study

Limitations of the study include the fact that only one College of Education Technical was used in the study and only preservice teachers offering Technical education were used in the study. Also, the design-based research (DBR) used in this study requires more than one iteration cycle of intervention to ensure the product developed is effective. Also, another limitation is the number of ICT tools that were taught during the fieldwork, which was overwhelming for the students. The fact that all the stages of UNESCO ICT-CFT document 2011 were conceived in the study made it tasking and overwhelming.

5.4 Suggestions for further studies

A study of this nature should be carried out in other Colleges of Education with Technical Education program, as well as, universities and polytechnics. UNESCO ICT-CFT framework can be applied in research in stages at a time Also, the product developed can be used in intervention research with students learning Technical drawing for effectiveness. Other areas in TVET can also be investigated through the lens of UNESCO ICT-CFT

5.6 Recommendations

Based on the findings of the study, the following recommendations were made:

- ICT National policy should be articulated and circulated to the policy implementers. Institutional ICT policy should be drafted from the national ICT policy and an ICT policy in education should be formulated with all the stakeholders of education fully integrated with the policy formulation process
- ICT training that is connected to teachers' duties and area of expertise should be promoted for pre-service teachers and be periodically organized for in-service teachers
- UNESCO ICT-CFT framework should be adapted for training in the acquisitions of ICT skills and competencies.
- ICT Training workshops should also be organized for in-service teachers so that they can be equipped with the necessary ICT skills and competencies that are relevant to their area of expertise. Such training should address Technology literacy, knowledge deepening and knowledge creation.
- Knowledge deepening through ICT skills and competencies should be encouraged among teachers in all areas
- Knowledge creation through ICT tools, skills and competencies should also be mandatory for all teachers as they engage their students in the teaching-learning process
- Achieving ICT skills and competencies should follow competency theory principles: that any skills and competencies should first be conceptualized and transferred to practice concepts through the skills acquired
- Teachers should be encouraged to actively engage their students in collaborative works by following the principles of engagement theory
- Teacher training institutions should adopt the UNESCO ICT-CFT framework as part of the curriculum for technology integration

References

Abd-El-Aziz, A. A. 2014. Effect of PowerPoint presentation on students' pyschomotor achievement and retention in auto-mechanics trade in Oyo state technical colleges JOSTMED, 10 (2), 127-137

Adebakin, A.B, Ajadi, O, T and Subair, S. T. 2015. Required and Possessed University Graduate Employability Skills: Perceptions of the Nigerian Employers. *World Journal of Education* Vol. 5, No. 2; 2015. URL: http://dx.doi.org/10.5430/wje.v5n2p115

Adeola, T.A. 2010 Engineering as Pedestal for National Development. This Day Newspaper. 12th October

Adeyinka, T, Adedeji, T, Majekodunmi, T.O, Lawrence. O.A, and Ayodele, A.A (2005) AN Assessment of Secondary School Teachers Uses Of ICT's: Implications for Further Development of ICT's Use In Nigerian Secondary Schools. The Turkish Online Journal of Educational Technology – TOJET July 2007 ISSN: 1303-6521 volume 6 Issue 3

Agyei, D., and Voogt, J. 2012. Developing technological pedagogical content knowledge in pre-service mathematics teachers, through teacher design teams. *Australasian Journal of Educational Technology*, *28*(4), 547-564.

Ajimotokan, H. A., Ajao, K. R., Adebiyi, K. A., Dainkeh, A. and Oloyede, A. A. 2010: Engineering Education and Sustainable Development in Nigeria. *J. Research Information in Civil Engineering*. (1)93-98.

Ajimotokan, H.A., Ajao, K.R., Adebiyi, K.A. and Dainkeh, A. 2009: Challenges of Sustainable Development in Nigeria: Need for Effective Engineering Education and Training. Paper Presented at the 1st Joint International Conference of the University of Cape Coast, Ghana and the University of Ilorin, Nigeria; Ghana: 28th-30th September.

Akintunde. I (1989), 'Brain Drain in Nigeria: Technological Development Through Self-Reliance, Selected Speeches - The Nigerian Society of Engineers. Vantage publishers (Int'l) Limited 1 5th Edition, Ibadan, Nigeria pp 185 - 198.

Akker, V. Gravemeijer, A. McKenney, S and Nieveen, N 2006. Educational design research. Abingdon, Oxon: Taylor & Francis.

Akudolu, U, (2006) Quest for Teacher Needed Competences for Instructional use of ICT. A paper presented at the 2006 National Conference of Nigerian Primary Teacher Education Association in Enugu State University of Technology, Agbani.

Alade, I.A 2002. The acquisition of Manipulative Skills in Technical Education: an opinion in Survey. *African journal of Education Management*. Pgs 151-160 Vol 10 No 1

Allam, Y. S. 2009. Enhancing spatial visualization skills in first-year engineering students (Doctoral)

Amiel, T. and Reeves, T. C. 2008. Design-Based Research and Educational Technology: Rethinking Technology and the Research Agenda. Educational Technology & Society, 11 (4), 29–40.

Amuche C. I. 2010. "Entrepreneurial and ICT Education as a Means of Achieving the Objectives of vision 20:2020." A paper presented at the 9th conference of the National Association of Research Development held at Nasarawa State University keffi, September, 2010.

Amuche1, C. I and Iyekekpolor-Solomon, A. O. 2014: An Assessment of ICT Competence among Teachers of Federal Unity Colleges in North Central Geo-political of Nigeria. *American International Journal of Research in Humanities, Arts and Social Sciences*. Available online at http://www.iasir.net ISSN (Print): 2328-3734, ISSN (Online): 2328-3696, ISSN (CD-ROM): 2328-3688. AIJRHASS 14-158

Anderson, T., and Shattuck, J. 2012. Design-based research: A decade of progress in education research? Educational Researcher, 41(1), 16-25. doi:10.3102/0013189X11428813

Angeli, C. and Valanides, N 2005 Epistemological and methodological issues for the conceptualisation development and assessment of ICT-TPACK: Advances in TPACK. Computers and Education, 53 154-168

Apagu, V.V and Wakili, B. A 2015. Availability and Utilization of ICT Facilities for Teaching and Learning of Vocational and Technical Education in Yobe State Technical Colleges. American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-0936 Volume-04, Issue-02, pp-113-118 www.ajer.org

Archambault, L. and Crippen, K. 2009. Examining TPACK among K-12 online distance educators in the United States. Contemporary Issues in Technology and Teacher Education, 9(1), 71-88.

Aremu A, and Ogundolire H. 2015. Computer Games in Nigerian primary school Mathematics - Issues of Acceptability, Usability and Achievement. Conference proceedings 17th Annual Conference of the Association of Educational Researchers and Evaluators of Nigeria (ASSEREN) at University of Ibadan, Ibadan. Nigeria. 12th-17th July, 2015 Theme: Emerging Trends in Innovation and Dynamic Education and Examining.

Aremu, A., Obideyi, E., and Morakinyo, D 2014. Using Facebook to enhance Teacher Education in Nigeria: Reflections of Facilitators e-learning Africa 2014, 9th International Conference

on IC for Development, Education and Training Held on May 28-30, 2014 at Speke Resort, Kampala Uganda, 89-92.

Aurelio, A.J, Boado, N.M, Casem, R.Q, and Guba-Lobão, M.A. 2016. Competence in Information Technology of the Faculty of the College of Technical Education. *Social Media and Technology*, 1:1 , 40 ISSN: 2468-2128

Azemikhah, H. 2005. The 21st century, the competency era and competency theory. Open Learning Institute of TAFE. Retrieved on the 10th of June, 2015 from www.avetra.org.au/ABSTRACTS2006/PA%200058.pdf

Badau, K.M and Sakiyo, J 2013. Assessment of ICT Teachers' Competence To Implement The New ICT Curriculum In North Eastern Nigeria. Journal of Education and Practice www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) Vol.4, No.27, 2013

Bassi, S. Y. 2004. The Role of the Directorate of Technical Cooperation in Africa (DCTA) in Technology Transfer and Acquisition in African Countries' Proceeding, 2nd African Regional Conference on Engineering Education, University of Lagos, Nigeria 20th – 22nd September, pp 35 – 42

Bate, F. and Maor, D. 2010. TPACK and the real world: How useful is the framework? Paper presented at the European Association for Practitioner Research on Improving Learning (EAPRIL) Conference 2010, Lisbon, Portugal, 24-26 November, 2010.

Becker, A. 2005. Finding from the Teacher, Learning and Computing Survey. Retrieved 2004 31/05 from http://www.crito.uC.edu/tidfindings/ccsso.pdf

Bertoline, G. and Wiebe, E. 2002. Technical Graphics Communication (3rd Ed.). New York: McGraw-Hill.

Beukes-Amiss, C.M. and Chiware, R.T. 2010. The impact of Diffusion of ICTs into Educational Practices How Good or How Bad? A Review of the Namibia situation.

Bitner, N. and Bitner, J. 2002. Integrating technology in the classroom. Eight Keys to Success. *Journal of Technology and Teacher Development*.

Bixler, E. O., and Zimmerman, D. N. 2009. IQ and neuropsychological predictors of academic achievement. Learning and Individual Differences, 19(2), 238-241. [doi: DOI: 10.1016/j.lindif.2008.09.001].

Brown, A. 1992. Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences*, 2(2), 141-178. doi.10.1207/s15327809jls0202_2

Brown, D., and Warschauer, M. 2006. From the university to the elementary classroom: Students' experiences in learning to integrate technology in instruction. *Journal of Technology and Teacher Education*, 14(3), 599-621.

Bukaliya, R and Mubika A.K 2011. Teacher competence in ICT: implication for computer Education in Zimbabwean secondary schools. *International Journal of Social sciences and Education*, 1, (4), 414 – 425.

Bushra A and Xueping. W .2013. Development of Pakistan's Technical and Vocational Education and Training (TVET): An Analysis of Skilling Pakistan Reforms; *Journal of Technical Education and Training (JTET)*. Vol. 5, No, 2!

Choy, D, Wong, A.F.L and Gao, P 2009. Student teachers' intentions and actions on integrating technology into their classrooms during student teaching: A Singapore study, Journal of Research on Technology in Education, vol. 42, pp.175-195.

Chua, J.H and Jamil, H 2012. Factors influencing the Technological Pedagogical Content

Coggshall, J. G., Behrstock-Sherratt, E., Drill, K., Menon, R., and Cushing, E. 2011. Workplaces that support high-performing teaching and learning: Insights from Generation Y teachers. [Report] American Institutes for Research & American Federation of Teachers.

Collins, A. 1992. Towards a design science of education. In E. Scanlon & T. O'Shea (Eds.), *New directions in educational technology* (pp. 15-22). Berlin: Springer-Verlag.

Collins, A., Joseph, D., and Bielaczyc, K. 2004. Design research: Theoretical and methodological issues. *Journal of the Learning Sciences*, 13(1), 15-42. doi.10.1207/s15327809jls1301_2 Curriculum in a Multi-User Virtual Environment. Graduate School of Education, Harvard University, Cambridge, MA 02138

Cultural Heritage National Training Organisation (CHNTO), 2004, Career development: Introduction, http://www.chnto.co.uk/development/vqhe/VQHE_Tg_HEintro.html, Accessed November 2004.)

Dabalen A., Oni B., and Adekola O.A., 2001. Labour market prospects for university graduates in Nigeria, Higher Education Policy, Vol.14, pp 141-159.

Dabalen, A., Oni, B. and Adekola, O.A. 2000. Labor market prospects for university graduate Development in south west Nigeria. *Mediterranean Journal of Social Sciences*, 4 (3), 409-413.

Diraso, D.K., Manabete, S.S., Amalo, K., Mbudai, Y.D., Arabi, A.S. and Jaoji, A.A. 2013. Evaluation of Students' Performance in Technical and Engineering Drawing Towards

an Effective Career Choice in Engineering and Technical and Vocational Education. Int. J. Educ. Res. Dev. Vol. 2(4), pp. 089-097.

Dreyfus, S.E and Dreyfus, H.I. 1980. A Five-Stage Model of the Mental Activities Involved in Directed Skill Acquisition. Washington, DC: Storming Media. http://www.dtic.mil/cgi bin/GetTRDoc?AD=ADA084551&Location=U2&doc=GetTRDoc.pdf.

Eck, E. van, Volman, M., Kraan, A., and Dijk, E. 2002. Ontwikkeling van ICT-competenties van docenten, Een reviewstudie, SCO-Kohnstamm Instituut, Amsterdam (in Dutch)

Eck, E., Volman, M. Crane, A., Dyke, E. 2002. Development of ICT skills of teachers, a review study, SCO-Kohnstamm Institute, Amsterdam (in English)

Edeta, R., Abutu, J.A., and Jimoh, A.J 2010. The Challenges of Vocational and Technical Education Program in Nigerian Colleges of Education. www.gloabalaacdemicgroup.com

Edu, D.O 2016. Upscaling Technical Vocational education and Training through Collaborative Capacity-Building Strategy for Sustainable Employment and Poverty Alleviation in Nigeria. Proceedings of INCEDI Conference, Accra- Ghana

Ekeh, J.C. 2009. Reinvigorating Engineering Education in Nigeria for Sustainable Development. Proceedings of the 18th COREN Engineering Assembly, Abuja, Nigeria, pp. 7-21

Ekpiken, W E and Edet, A O. 2014. The role of teacher education and Nigerian teachers in national development: The way forward. CS Canada: Higher Education and Social Science

Eze, P. I. and Francis. N.A 2013. Harnessing Information and Communication Technology (ICT) Tools in Instructional Delivery of Secondary School Subjects. *Journal of Information Technology Education*: Research Volume 12, 2013.

Ezenwafor, J.I. 2012. Adequacy of Exposure to information and Communication Technology by graduating business education students of tertiary institutions in Anambra State. *Business education Journal*. 8(2), 45-60

Federal Government of Nigeria (FGN) 2004. National Policy on Education (4thed). Lagos: NERDC Press.

Federal Republic of Nigeria 2013. National Policy on Education. (6th Ed.) Lagos: NERDC press, pp.24, 25, 29-33, 35-36 forward. Business Management Dynamsic, 2 (6), 01-08

Fredricks, J. A., Blumenfeld, P. C., and Paris, A. H. 2004. School engagement: Potential of the concept, state of the evidence. Review of Educational Research, 74, 59-109.

Gambari, A.I, Yusuf, H.T, and Balogun, S.A 2015. Effectiveness of Powerpoint Presentation on Students' Cognitive Achievement in Technical Drawing. *Malaysian Online Journal of Educational Technology* Volume 3, Issue 4

Gao, P., Choy, D., Wong, A. F. L., and Wu, J. 2009. Developing a better understanding of technology-based pedagogy. Australasian Journal of Educational Technology, 25(5), 714-730.

García, A.S, Marcos, J.M, GuanLin, H. and Escribano, J.P (2013), Teacher Development and ICT: The Effectiveness of a Training

Gemade, B.A.I. 2009. Quality of Engineering Education and Training – Key to Infrastructural Development. Proceedings of 18th COREN Engineering Assembly, Abuja, Nigeria, pp. 16

Giwa, A.A. 2011. Professionalism in Teaching Profession in Nigeria. Paper Delivered at the TRCN meeting Abuja October, 2011.

Grabe, M and Grabe, C. 2007. Integrating Technology for Meaningful Learning. 5th Ed. Boston NY. Houghton

Gupta A, 2002.Content Development for eLearning in Engineering Education Interactive Educational Multimedia, number4 (April2002), pp. 12-23

Guthrie, H., Harris, R., Simons, M., and Karmel, T. 2009. Teaching for Technical and Vocational Education and Training (TVET) International Handbook of Research on Teachers and Teaching. In L. J. Saha and A. G. Dworkin (Eds.), (Vol. 21, pp. 851-863): Springer US.

Guthrie, H., Harris, R., Simons, M., and Karmel, T. 2009. Teaching for technical and vocational education and training (TVET). In L.J. Saha & A.G Dworkin (eds). International Handbook of Research on Teachers and Teaching (pp. 851-863)

Hammond, L.D, Wei, R.C, Andree, A., Richardson, N and Orphanos, S. (2009). Professional learning in the learning profession, 9. Washington, DC: National Staff Development Council.

Haydn, T. A., and Barton, R. 2007. Common needs and different agendas: How trainee make progress in their ability to use ICT in subject teaching. Some lessons from the UK. Computers & Education, 49(4), 1018–1036.

Hew, K.F and Brush, T 2007. Integrating Technology into K-12 Teaching and Learning: Current Knowledge Gaps and Recommendations for Future Research. Education Technology Research and Development, 55, 223-252. http://dx.doi.org/10.1007/s11423-006-9022-5

Hogenbirk, P. 2006. Teachers: Click's Professional development for ICT practice, Utrecht: Education Inspectorate (Conversion from Dutch to English)

Hooker, M., Mwiyeria, E & Verma, A. 2011c. ICT competency for Teacher contextualization and piloting in Nigeria and Tanzania. Synthesis Report. Teacher Development for the 21st century (TDev21). A World Bank Ministry of Education and Vocational Training of Tanzania, national Commission for Colleges of Education of Nigeria and GESCI Initiative

Hooker, M. Mwiyeria, E. and Verma, A. 2011a. ICT Competency Framework for Teachers in Tanzania. TeacherDevelopment for the 21st Century (TDV21) Pilot. A Ministry of Education and Vocational EducationTanzania, World Bank and GESCI Initiative.

Hsu, P.-S., and Sharma, P. 2006. A systemic plan of technology integration. Educational Technology & Society, 9 (4), 173-184 https://www.skillsaustralia.edu.au/

Huq Shamim M. R and Raihan, M. A 2016. Effectiveness of Using ICTs to promote teaching and learning in technical education: Case of Bangladesh. International Journal of Vocational and Technical Education Vol. 8(2), pp. 12-19, DOI: 10.5897/IJVTE2015.0177 Article Number: E5A0B2057493 http://www.academicjournals.org/IJVTE

Igbinomwanhia, D. I., and Aliu, S. A. 2013. Investigation of the continuing poor performance in engineering drawing in Nigerian universities – a case study of the University of Benin. *Research Journal in Engineering and Applied Sciences*, 2(5), 346- 350. in Nigeria, Higher Education Policy, 14 (2), pp. 141-159.

Imel, T. C. 1998. Development in information technology in education. Document prepared for the 13th conference of the Common Wealth Education of Ministers in Botswana, July 28-August, 2nd 1999

Iteku, J. A 2015. *Merit Research Journal of Education and Review* (ISSN: 2350-2282) Vol. 3(1) pp.076-080, January, 2015Availableonline

ITU-UNESCO 2017. Working Group on Education: Digital skills for life and work. Broadband Commission for sustainable development

Iwuamadi, F and Ajeka, P. 2010. Assessing social studies Teachers' level of competence in Information and Communication Technology in Nigeria Secondary Schools. *Journal of Teachers perspective,* 11, (2), 55 – 62.

Jallah, M. 2004. *UNESCO-UNEVOC-An International experts meeting "Learning for Work, Citizenship*

Jegede, P.O. 2007. Computer attitudes as correlation of computer self-efficacy among South-Western Nigerian higher education teachers. Paper presented at Sixth International Internet Education Conference, Cairo, Egypt, September 2-4, 2007.

Jurema, A.A. 2007. Towards a pedagogy of informatics: preparing educators to ace challenges. *Journal of American Association Education* 49(1), 22-32.

Kafai, Y.B 2005. The classroom as "living laboratory": Design-based research for understanding, comparing, and evaluating learning science through design. Educational Technology, Jan-Feb, 28-34.

Kafyulilo, A, Fisser, P, Pieters, J and Voogt, J 2015. ICT Use in Science and Mathematics Teacher Education in Tanzania: Developing Technological Pedagogical Content Knowledge. *Australasian Journal of Educational Technology*, Vol. 31 Issue 4. Pg. 38-399 ICT

Karahocaa, D., Duldaa, I., Karahocaa, A., Yücela, A., Gulluoglua, B., and Arifoglua E. 2010. Interactive e-content development for vocational and technical education. Procedia Social and Behavioral Sciences, 2, 5842–5849

Kasworm, C. E., and Londoner, C. A. 2000. Adult Learning and Technology. In Handbook of Adult and Continuing Education. New. ed., edited by A. L. Wilson and E. R. Hayes. San Francisco: JosseyBass.

Kay, R. H. 2006. Evaluating strategies used to incorporate technology into preservice education: A review of the literature. Journal of Research on Technology in Education, 38(4), 383-408.

Kayode, O.G.,Ngozi, A.B. and Irene, W.I. 2014. Competencies of nigerian graduate teachers: the insiders' perspectives. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS),* 5(4): 577-584 ©*Scholar link Research Institute Journals*, 2014 (ISSN: 2141-6990) jeteraps.scholarlinkresearch.com

Kearsley, G and Shneiderman, B. 1998. Engagement Theory: A Framework for Technology-Based Teaching and Learning. Educational Technology, Vol. 38, No. 5 Educational Technology Publications, Inc. https://www.jstor.org/stable/44428478

Khan, M. S. H. 2015. Emerging conceptions of ICT-enhanced teaching: Australian TAFE context. Instructional Science, 43(6), 683-708. https://doi.org/10.1007/s11251-015-9356-7

Khan, M. S. H., and Markauskaite, L. 2017. Approaches to ICT-enhanced teaching in technical and vocational education: a phenomenographic perspective. High Education, 73, 691-707. https://doi.org/10.1007/s10734-016-9990-2

Kiptalam, G.K. and Rodrigues, A.J. 2011 Accessibility and Utilization of ICTs among secondary school teachers in Kenya. Retrieved from tpJLcit.rnakccir 20th, August, 2012.

Kirschner, P. A., Wopereis, I. G. J. H., Van den Dool, P. C. 2002. ICT3: Information and communication technology for teacher training: Pedagogic benchmarks for teacher education. Utrecht: the Netherlands: Inspectie van het Onderwijs

Kisirkoi, F. K 2015. Integration of ICT in Education in a Secondary School in Kenya: A Case Study. *Literacy Information and Computer Education Journal* (LICEJ), Volume 6, Issue 2, June 2015 Integration (LICEJ). Vol 6. Issue 2. Pgs 1904-1909

Koehler, M. J., and Mishra, P. 2008. Introducing TPCK. In AACTE Committee on Innovation and Technology (Ed.), *The handbook of technological pedagogical content knowledge (TPCK) for educators* (pp. 3-29). New York, NY: Routledge.

Koh, J. H. L., Chai, C. S., and Tay, L. Y. 2014. TPACK-in-action: Unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK). *Computers & Education 78*, 20–29. http://dx.doi.org/10.1016/j.compedu.2014.04.022

Larsen, G. 2006. Preparing for new and changing roles: the need for continuing professional development. Research Libraries. 16 (3/4) http://liber.library.uu.nl/

Lawless, K. A., and Pellegrino, J. W. 2007. Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. Review of Educational Research, 77(4), 575-614.

Lee, C. B., Chai, C. S., Teo, T., and Chen, D. 2008. Preparing pre-service teachers for the integration of ICT based student- centred learning (SCL) curriculum. *Journal of Education, 13, 15-28.*

Lee, C. B., Teo, T., Chai, C. S., Choy, D., Tan, A. and Seah, J. 2007. Closing the gap: Pre-service teachers' perceptions of an ICT based, student centred learning curriculum. In ICT: Providing choices for learners and learning. Proceedings ascilite Singapore. http://www.ascilite.org.au/conferences/singapore07/procs/lee-cb.pdf

Lilia, H. Ruhizan, M.Y. and Azaman, I. 2012 Camed: An Innovative Communication Tool in Teaching Engineering Drawing. Wseas Transactions on Information Science and Applications

Lim, C. P., Chai, C. S., and Churchill, D. 2010. Leading ICT in education practices: A capacity building toolkit for teacher education institutions in the Asia-Pacific. Singapore: Microsoft.

Lisowski, L., Lisowski, J. A., and Nicolia, S. 2006. Infusing technology into teacher education: Doing more with less. Computers in the schools, 23(3), 71-92.

M.Al-Muz-Zammil, Y., and Abd. Muezzam Shah, A. 2010. Penggunaan ICT Dalam Kalangan Guru Pelatih Kemahiran Hidup Fakulti Pendidikan, UTM. Retrieved from http://eprints.utm.my/10142/

Maeers, M. 2009. Pedagogically Appropriate Integration of Information Technology in an Elementary Preservice Teacher Education Programme. Paper presented at Annual Conference of SITE, 2009, USA

Maina, T. 2016. The Appropriateness of ICT Policies Framework Formulated towards Achieving Integration of ICTs in TVET Institutions in Kenya Available from: https://www.researchgate.net/publication/317401616

Mayes, S. D., Calhoun, S. L., Bixler, E. O., and Zimmerman, D. N. 2009. IQ and neuropsychological predictors of academic achievement. Learning and Individual Differences, 19(2), 238–241. https://doi.org/10.1016/j.lindif.2008.09.001

McKenney, S. E., and Reeves, T. C. 2012. Conducting educational design research. New York, NY: Routledge. Meta-analysis. Child development, 1479-1498.

McKenney, S., & Reeves, T. C. 2013. Systematic review of design-based research progress is a little knowledge a dangerous thing? Educational Researcher, 42(2), 97-100.

Mishra, P., and Koehler, M. J. 2006. Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054.

Mishra, P., Koehler, M. J., and Henriksen, D. 2011. The Seven Trans-Disciplinary Habits of Mind: Extending the TPACK Framework Towards 21st Century learning. Educational Technology, 11(2), 22-28. NJ: Pearson.

Mishra, P., Koehler, M. J., and Kereluik, K. 2009. The song remains the same: Looking back to the future of educational technology. Techtrends, 53(5), 48-53.

Mooz H, Forsberg K and Cotterman H 2003 Communicating project management: the integrated vocabulary of project management and systems engineering. John Wiley & Sons.

Morrison, G. R., Ross, S. M., and Kemp, J. E. 2007. Designing effective instruction (5th ed.). New York, NY: John Wiley and Sons

Moura I, Silva A, AESH, R., Lima L, Moreira T, Silva A. 2017. Construction and validation of educational materials for the prevention of metabolic syndrome in adolescents. Rev. Latino-Am. Enfermagem. DOI: http://dx.doi.org/10.1590/1518-8345.2024.2934.

Musa, J.M., Jimba, D.N., and Ogundele, M.O 2015 The role of Teachers in Transforming Nigeria: Challenges and the Way Forward. Asia Pacific Journal of Multidisciplinary Research, Vol. 3, No. 2 P-ISSN 2350-7756 | E-ISSN 2350-8442 | www.apjmr.com

Mwamwenda, T. S. 1995. Educational Psychology: An African Perspective. London:Heinemann Bulterworth Publishers Ltd

National University Commission 2004: Labour Market Expectations of Nigerian Graduates. Report of National Needs Assessment Surveys. Nigeria labor market. Ph.D. Dissertation. Nigeria: University of Ibadan.23.

Naugue, C.R. 2011. Guidelines for Successful Integration of ICT in Schools in Cameroon. Nelson Mandela Metropolitan University, South Africa.

Nelson, B., Ketelhut, D. J., Clarke, J., Bowman, c., and Dede, C. 2003. Design-based Research Strategies for Developing a Scientific Inquiry

Nelson, B., Ketelhut, D.J., Clarke, J., Bowman, C., and Dede, C. 2005. Design-based research strategies for developing a scientific inquiry curricu lum in a multi-user virtual environment. Educational Technology, 45(1), 21-27.

Ng, W.K., Miao, F., and Lee, M. 2009. Capacity-building for ICT integration in education (Review). Digital Review of Asia Pacific 2009-2010. Retrieved from http://www.eepsea.org/mimap/ev-140839-201-1-DO_TOPIC.html

Obadara, O. E. and Oyebolu, S. O. 2013. Impact of vocational education on manpower *of Computing in Teacher Education. 24*(2), 38-39.

Okolocha, C. C. 2012. Vocational Technical Education in Nigeria: Challenges and the Way

Okolocha, C.C. and Baba, E. I., 2016. *International Journal of Capacity Building in Education and Management (IJCBEM), Vol. 2, No 4, April, 2016. Website: http://www.rcmss.com.* ISSN: 2350-2312 (Online) ISSN: 2346-7231 *(Print), 2(4):12-24*

Okoro, J. 2013. Assessment of effective communication competencies possessed by university business education graduates for successful running of businesses in South-South Nigeria. *Global Journal of Management and Business Research Administration and Management*, 13 (8). *Global Journals* Inc. (USA) Online ISSN: 2249-4588 & Print ISSN: 0975-5853.

Olkun, S. 2003. Making Connections: Improving Spatial Abilities with Engineering Drawing Activities, International Journal of Mathematics Teaching and Learning, 1-10

Omoniyi, T. and Quadri, A. T. 2013. Perceived competence of Nigerian secondary schools' teachers in the use of Information and Communication Technology (ICT). *Journal of Education and Practice*. 4 (10). Retrieved from www.iiste.org. ISSN 2222- 1735 (Paper) ISSN 2222-288X (Online)

Onasanya, S.A.B. 1999. Effective Personnel Management and Industrial Relations. Lagos: Centre for Management Development.

Onyeachu, J.A.E. 2008. Curriculum Implementation at the Primary Education Level Challenges for the 21st Century in Multidisciplinary. *Journal of Research Development*. 10(1), 38 – 49

Oppong J.A, Vivian, B. & Eunice, A. 2013. Evaluating the Benefits of Computer Aided-Design (CAD) in Fashion Education, the Case of Accra Polytechnic. *Journal of Education and Practice* Vol.4, No.27, 2013. www.iiste.org

Oryem – Origa, S. O. 2005. Vocational Education and manpower Development, Lagos: Nigerian Vocational association monograph series

Otunla, A.O 2015. Integrating Computer-Mediated Learning Tools and Resources into Technical and Vocational Education and Training (TVET) for Education Advancement in the 21st century

Oyebode, O.J, Adebayo, V.B and Olowe, K.O 2015. Assessment of the Use of AutoCAD Package for Teaching and Learning Engineering Drawing In Afe Babalola University Ado-Ekiti. *International Journal of Scientific & Technology Research* Volume 4, ISSUE, ISSN 2277-8616

Oyebolu, O.O 2011. Roles of Technical and Vocational Education (TVE) in Alleviating Poverty in Nigeria. *African Journal for Contemporary Issues in Education*. Retrieved 21 August 2015 from ajeduionline.org/contempor/vol2+9.html

Paraskeva, F., Bouta, H., & Papagianna, A. 2008. Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. Computers & Education, 50(3), 1084-1091.

Passey, D. 2008 The Role of Mobile Technologies in Moving 'Digital Natives' to 'Learning Natives' (p.224-231). In: Proceedings of the MLearn 2008 Conference, 7 - 10 Oct 2008, Ironbridge Gorge, Shropshire, UK.

Pitan, O. S. and Adedeji, S. O. 2012. Skills Mismatch among University Graduates in the Nigerian Labour Market. US-China Education Review A1 (90-98).

Pitan, O.S. 2015. An assessment of generic skills demand in five sectors of the Nigerian

Pitan, O.S. and Adedeji, S.O. 2012. Skills mismatch among university graduates in Nigeria labour Professional Standards for conservation 2003. Institute of Conservation London.

Pittman J., McLaughlin R.T., and Bracey-Sutton B. 2008 Critical Success Factors in Moving Toward Digital Equity. In: Voogt J., Knezek G. (eds) International Handbook of Information Technology in Primary and Secondary Education. Springer International Handbook of Information Technology in Primary and Secondary Education, vol 20. Springer, Boston, MA

Radloff, A. 2001. “Getting online: The Challenges for Academic Staff and Institutional leaders.Available:hhtp://www.asclite.org.au/conferences/melbourne01/pdf/papers/radloffa.pdf.

Reddy, V.K 2008 Test Book of Drawing, BS Publication, Hyderabad, India. 2nd edition.

Reeves, T. C., and Hedberg, J. G. 2003. Interactive learning systems evaluation. Englewood Cliffs, N.J.: Educational Technology Publications.

Reeves, T.C. 2000. Socially responsible educational research. Educational Technology, 40(6), 19-28.

Reeves, T.C. 2006. Design research from a technology perspective. In J. van den Akker, K. Gravemeijer, S. McKenney & N. Nieveen (Eds.), *Educational design research* (pp. 52-66). London: Routledge. Report of National Needs Assessment Surveys.

Regina, O. 2013. The Impact of Information and Communication Technology on Teachers and its implication on Professional Development in Nigeria. *International Journal of Learning and Development*, 3, (2), 35 – 47. 19 11. Journal of Education and Practice ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) Vol.4, No. 27, 2013 www.iiste.org Retrievedfromhttp://www.industry.gov.au/skills/Publications/Documents/SkillsProsperityRoad map-2011.pdf

Rodden, N.B. 2010. An investigation into the barriers Associated with ICT use in the Youth reach Classroom. A Case study of a centre for Education in the Northwest. University of Limesick.

Sa’ari, A.B. and Jegede, J.O. 2005. In-service Teachers’ Views toward Technology and Teaching and their Perceived Competency toward IT. *Journal of Technology* 43(3), 1-14.

Sahito Z and Vaisanen P 2017. ICT are incorporated into educational curriculum to promote and bridge with the digital world. International Journal of Higher Education Vol. 6, No. 4 URL: https://doi.org/10.5430/ijhe.v6n4p122

Short, J. C., and Reeves, T. C. 2009. The graphic novel: A "Cool" format for communicating to Generation Y. Business Communication Quarterly, 72(4).

Simons, R.J. and Rubens, W. 2003 Finally attention for digital didactics, lecture at the I&I conference (Eindelijk aandacht voor digitale dida

Skills Australia. 2011. Skills for prosperity: a roadmap for vocational education and training.

Skinner, E.A., Kindermann, T.A.,Connell, J.P., and Wellborn, J.G. 2009a. Engagement as an organizational construct in the dynamics of motivational development.

Slaouti, D. and Barton, A. 2008. Opportunities for Practice and Development: Newly Qualified Teachers and the Use of Information and Communication Technologies in Teaching Foreign Languages in English Secondary School Contexts. *Journal of In-Service Education*, 34(5) 20-33

So, J.H. and Kim, B. 2009. Learning about Problem Based Learning. Student- teacher Integrating Technology and Content Knowledge. *The Australian Journal of Research*

Sodipo O 2014. Employability of tertiary education graduates in Nigeria: Closing the skills-gap. Global Journal of Human Resource Management, 2(3): 28–36

Steketee, C. 2005. Integrating ICT as an integral teaching and learning tool into pre-service teacher training courses. Issues in Educational Research, 15. Retrieved on 26th March 2015 from http://www.iier.org.au/iier15/steketee.html

Stevenson, J. 2000. Working knowledge. *Journal of Vocational Education and Training,* 52(3)

Swain, C. 2006. Preservice teachers' self-assessment using technology: Determining what is worthwhile and looking for changes in daily teaching and learning practices. *Journal of Technology and Teacher Education,* 14(1), 29-59.

Swarts, P., and Wachira, E. M. 2010. *Tanzania: ICT in education situational analysis*. Dar es Salaam: Ministry of Education and Vocational Training.

Tasir, Z., Abour, K. M. E. A., Halim, N. D. A. and Harun, J. 2012. Relationship between Teachers' ICT Competency, Confidence Level, and Satisfaction toward ICT Training Programmes: A Case Study among Postgraduate Students. Turkish Online Journal of Educational Technology, 11(1), 138-144. ERIC Number: EJ976576

Temechegn, E 2011. ICT-enhanced Teacher Development Model. UNESCO-IICBA, AddisAbaba.http://www.eng.unesco-iicba.org/sites/default/files/ICT-enhanced%2Teacher%20Development.pdf

Temechegn, E 2012. ICT-enhanced Teacher Standards for Africa. UNESCO-IICBA, Addis Ababa. http://www.eng.unesco-iicba.org/sites/default/files/ICTeTSA.pdf

Thompson, A. D., and Mishra, P. (2007-2008). Breaking News: TPCK becomes TPACK! *Journal*

Titilayo, A.E.M. 2010. Realities of Integrating Information and Communication Technology in Nigeria Secondary Schools. (Experience from a Local Government in Osun State, Nigeria), Journal of Africa Society for Scientific Research, 1(3), 654 – 660.

Tola, K.O and Okoye K.R.C 2015. Effective Utilisation of Information Communication Technology (Ict) Tools by Vocational Technology Teachers for Efficient Instructional Delivery. PJ *Palgo Journal of Education Research*, Vol 3 Issue 1, Page 146-149 www.palgojournal.org/pjer/index.html

UNESCO. 2008. ICT Competence Standards for Teachers Implementation Guidelines. Paris; UNESCO.

UNESCO. 2011. UNESCO ICT Competency Framework for Teachers. Paris; UNESCO.

UNESCO. 2011. UNESCO ICT Competency Framework for Teachers. Paris; UNESCO

UNESCO-UIS. 2015. Information and communication technology in education in sub-Saharan Africa: A comparative analysis of of basic e-readiness in schools. Information paper No. 25. Montreal: UNESCO Institute for Statistics. Utrecht: Inspectie van het Onderwijs (in Dutch)

United Nations, 2003.Press Release PI/1548 12 December: \\"E-Schools and Communities Initiative Launched Today at Information Summit" http://www.un.org./News/Press/docs/2003/pi1548.doc.htm

Uwaifo, V.O. 2010. Technical education and its challenges in Nigeria in the 21st Century. *International NGO Journal* Vol. 5(2), pp. 040-044, February, 2015 Available online at http:// www.academicjournals.org/ingoj ISSN 1993–8225. *Academic Journals*

Wang, F., and Hannafin, M. J. 2005. Design-based research and technology-enhanced learning environments. Educational Technology Research and Development, 53(4), 5-23. doi.10.1007/BF02504682 Web based games. *Journal of Engineering Education*, 90(3), 347-355.

Wojtezak, A 2000. Glossary of Medical Education Terms. Institute for International Medical Education. http://www.ume.org/glossary.htm

World Economic Forum, 2017. The Future of Jobs and Skills in Africa Preparing the Region for the Fourth Industrial Revolution. retrieved 2020 http://www3.weforum.org/docs/WEF_EGW_FOJ_Africa.pdf. www.weforum.org

Ya'acob, A. 2010. Implementation of the Malaysian Smart School: An Investigation of Teaching-Learning Practices and Teacher-Student ICT Readiness. *Internet Journal of e-learning* 2(3), 17-26.

Yusufu, M.O. 2005. Information and Communication Technology and Education: Analyzing the Nigerian National Policy for Information Technology. International Educational Journal, 6 (3), 316 – 321

Zhang, Q. 2004. The Construction of a Model for the Development of Teachers IT Literacy. China Distance Education 4(7), 32-36: http://210.40.132.172/kns50/detail.aspx?filename=DDJY200407017&dbname=CJFD204

Zhao, Y., and Frank, K. A. 2003. Factors affecting technology uses in schools: An ecological perspective. *American Educational Research Journal*, 40(4), 807-840.

Zwaneveld, B. 2005. Mathematics and computer science: innovation and consolidation about questions in mathematics and computer science education, Heerlen Open University of the Netherlands (in Dutch)

Table 1.9 Rubric measuring skill-level of students based on the digital artefact produced

Appendix I

Skill Acquisition Rubric of each Trainee (SAR)

	Knowledge	**Standard of work**	**Autonomy**	**Coping with complexity**	**Perception of context**
1. Novice	Minimal, or 'textbook' knowledge without connecting it to practice	Unlikely to be satisfactory unless closely supervised	Needs close supervision or instruction	Little or no conception of dealing with complexity	Tends to see actions in isolation
2. Beginner	Working knowledge of key aspects of practice	Straightforward tasks likely to be completed to an acceptable standard	Able to achieve some steps using own judgment, but supervision needed for overall task	Appreciates complex situations but only able to achieve partial resolution	Sees actions as a series of steps
3. Competent	Good working and background knowledge of area of practice	Fit for purpose, though may lack refinement	Able to achieve most tasks using own judgment	Copes with complex situations through deliberate analysis and planning	Sees actions at least partly in terms of longer-term goals
4. Proficient	Depth of understanding of discipline and area of practice	Fully acceptable standard achieved routinely	Able to take full responsibility for own work (and that of others where applicable)	Deals with complex situations holistically, decision-making more confident	Sees overall 'picture' and how individual actions fit within it
5. Expert	Authoritative knowledge of discipline and deep tacit understanding across area of practice	Excellence achieved with relative ease	Able to take responsibility for going beyond existing standards and creating own interpretations	Holistic grasp of complex situations, moves between intuitive and analytical approaches with ease	Sees overall 'picture' and alternative approaches; vision of what may be possible

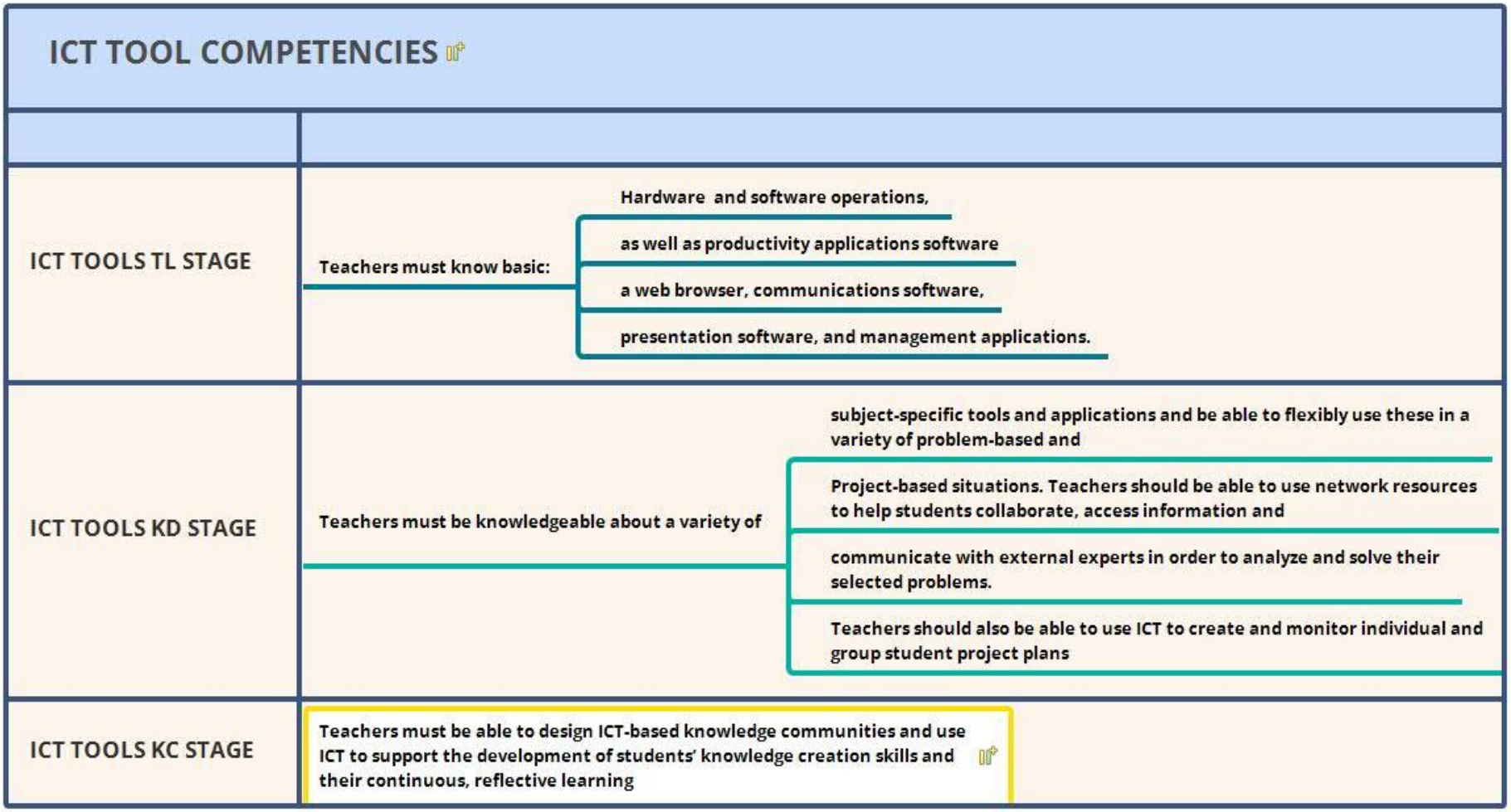
From the professional standards for conservation, Institute of Conservation (London) 2003 based on the Dreyfus model of skill acquisition.

Appendix II

Fig 1.1. Objectives of each of the ICT tools stages

ICT TOOLS	
ICT_TL STAGE	Describe and demonstrate the use of common hardware. Describe and demonstrate the basic tasks and uses of word Describe and demonstrate the purpose and basic features of presentation software and other digital resources Describe the purpose and basic function of graphics software. Describe the Internet and the World Wide Web. Use a search engine Create an email account and use it for a sustained series of email correspondence. Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects. Locate off-the-shelf educational software packages and web resources, evaluate them for their accuracy and alignment. Use networked record keeping software to take attendance, submit grades, and maintain student records. Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.
ICT_TOOLS KD STAGE	Operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references Use an authoring environment or tools to design online materials. Use a network and appropriate software to manage, monitor, and assess progress of various student projects. Use ICT to communicate and collaborate with students, peers, parents and the larger community in order to nurture student learning Use the network to support student collaboration within and beyond the classroom. Use search engines, online databases, and email to find people and resources for collaborative projects.
ICT_TOOLS KC STAGE	Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.

Appendix III Fig 1.2. Expected competencies at each ICT tools stage



Appendix IV

Creativity componenet of student's Artefact

Creativity Component Rubric for Student's Artefact

S/N	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1
Cri 1	The work is unusually creative. The ideas/materials/methods used are novel, striking, and highly effective. Important ideas/feelings are illuminated or highlighted in sophisticated ways. The creation shows great imagination, insight, style, and daring. The work has an elegant power that derives from clarity about aims and control over intended effects. The designer takes risks in form, style, and/or content.	The work is highly creative. The ideas/materials/methods used are imaginative and effective. There is attention to detail. A clear and confident voice and style are present.	The work is creative. The ideas/materials/methods used are effective. A voice and style are present.	The work is somewhat creative. The ideas/materials/methods used show signs of imagination and personal style.	The work is not very creative. The approach is trite and the ideas clichéd, leading to a flat and predictable performance. There is little sense of the creator's touch, voice, or style here.	The work is uncreative…

Cri 2	•The problem has been imaginatively re-framed to enable a compelling and powerful solution •Methods/approaches/techniques are used to great effect, without overkill •"less is more" here: there is an elegant simplicity of emphasis and coherence •Rules or conventions may have been broken to create a powerful new statement. •Common materials/ideas have been combined in revealing and clever ways •The audience is highly responsive to (perhaps disturbed by) the work •The work is vivid through careful attention to telling details and deft engaging touches •There is an exquisite blend of the explicit and implicit	•Novel approaches/moves/directions/ideas/perspectives were used to good effect •There is an effective blend of personal style and technical knowledge •Familiar materials and ideas have been combined in new and imaginative ways •The work provokes a lively audience response	•Novel approaches/moves/directions/ideas/perspectives were used to good effect •There are imaginative and personal touches scattered throughout the work •The work keeps the audience mostly engaged •There is a discernible and interesting effect/focus/message/style, with lapses in execution •The work takes some risks in methods/style/content	•Familiar approaches/routines/moves were used, but with a few new twists •There are places where ideas and techniques are borrowed whole. •Novel ideas or approaches may be present but they seem stuck on, excessive, out of place and/or not integrated effectively in the work •Time-tested recipes and clichés are used even where there is a personal voice – the work is pretty "safe" •The work is a mish-mash of interesting and familiar approaches and effects, but with no coherence OR the work is technically very competent and coherent, without much spark or insight	•The work offers little in the way of new approaches/methods/ideas •There is little sign of personal voice, touch, or style •The work suggests that the creator confuses "creative" and "risk-taking" with "shocking in a juvenile way" •There is excessive and incoherent use of different materials, techniques, ideas •The creator may have confused great care and precision with creativity – the work is more polished than imaginative or revealing	•The performance re-creates someone else's performance or relies exclusively on the models/algorithms/moves/recipes/templates/directions/materialsprovided. •The work is predictable throughout, relying almost exclusively on hackneyed approaches; there is no apparent personal touch •The work is timid and lacking in vivid feelings and ideas – so abstract that it has little to say to an audience •The work is done with care but without direction or insight

Appendix V

Student's ICT Artefact Package Rubric on Technical Drawing

(ICT-APRTD)

Date: _____

Evaluator: **Research Assistants/Researcher/Subject Experts/Instructional designers**

School/Position: _____

Package Title: _____

Subject Area: **Technical Drawing**

EVALUATION CHECKLIST

1. strongly disagree
2. disagree
3. agree
4. strongly agree

NA- Not applicable

Check the rating for each items

S/N	**ITEM**	1	2	3	4	NA
A	**CONTENT**					
1	The content is accurate					
2	The content is factual					
3	The content is educationally appropriate					
4	The content is free of errors in grammar, spelling and punctuation.					
5	The content meets learning goals and objectives					
6	Content on the screen would not confuse learners					
7	The content is age appropriate					
8	Content is prejudiced-free					
9	Content illustrates a sense of moral and ethical issues					
10	Program is an accurate depiction of the real world					
11	The content is free of stereotypes					
12	The content is cultural bias					
13	The content meets the Nigerian basic education standards					
B	**EASE OF USE**					

14	Directions are clear					
15	Students can exit the program at any time					
16	Students can restart the program where they stopped					
17	Software allows first-timer easily					
18	Software icons are accessible					
19	Software documents are printable					
20	Software is controlled by learners					
21	Further learning materials are presented					
22	Screen instructions are clear					
23	Software is easy to manipulate					
24	Software installation is easy					
25	software is compatible with system software					
26	Prompts for error committed are noticeable					
C	**DOCUMENTATION AND SUPPORT**					
27	The teacher instructor manual is clear and thorough					
28	Operational manual is easy					
29	Learning objectives and content are well stated					
30	Technical online support are provided					
31	The software has a support number					
32	Online technical support is available					
33	Software documentation is clear					
34	Helpful material are provided.					
35	Documentations for classroom application are provided					
36	Help within the program is easily accessible and understandable.					
D	**ABILITY LEVELS**					
37	The user level can be set by the teacher					
38	Software text elements are readable and simple and steps progress in logical manner					
39	Teaching strategies for classroom application can be repeated					
40	The user level automatically advances					
41	The software covers a variety of ability/skill levels					
E	**USER'S ENGAGEMENT AND INTERACTIVITY**					
42	Timely feedback is provided					
43	Mastery of content by users are provided for motivation					
44	Content layout is logically arranged and curriculum-based.					
45	Screen cues are clear.					
46	Users can control the software at will					
F	**ASSESSMENT**					
47	Software has built in assessment and reporting tools					
48	Software can track students'/user's progress					

49	Feedback reinforces content and is not abusive or insulting					
50	Assessment methods are appropriate and suited to learning objectives					
51	Software documents and records student's progress					
52	Teachers easily can assess student' progress by evaluating progress reports					
G	**TECHNICAL QUALITY**					
53	Animation and graphics are used well					
54	Quality graphics elements, audio and video clips are provided.					
55	Texts at the background are readable and simple.					
56	Media elements in the software like texts and images are not gender biased nor culturally implied.					
57	Option to save your work and progress locally without internet access is possible.					
58	To save user's activity to track the progress is possible.					
59	Printing/downloading/export/import capabilities work properly.					
60	Audio (voice input/output) is used well					
61	Feedback and prompts are appropriate					
62	Branching is possible in the software					
63	Keys work independently					
H	**FUN**					
64	Learning is meaningful and interesting					
65	Learning content is captivating					
66	Activities are randomly generated					
I	**ADAPTABILITY**					
67	Compatibility issue with system file is resolved					
68	Software works fine on all operating systems.					
69	Software is adaptable and assistive in nature..					

Appendix VI

Interview Guide for *ICT competence of Technical Drawing Students* (ICT_CTDS)

Section B: Understanding ICT in Education

- ✓ Which of the ICT facilities do you think could benefit the learning of T.E courses especially the ones you know?
- ✓ If yes, why do you think so

Section A:

- ✓ Are you aware of ICT policy that fosters the use of ICT for Technical Education courses?
  - ✓ If yes, why
  - ✓ If no, why

Section D: Pedagogy

- ✓ What are the strategies available to learn T.E courses?
- ✓ Do you think the use of ICT facilities could be used to implement and enhance such strategies?
- ✓ If yes, why
- ✓ If no, why
- ✓ If your answer is yes, do you have the skills to do that?
- ✓ If yes, can you describe it in one sentence

Section E: Information and Communication Technology (ICT)

- ✓ Can you mention any of ICT productivity tools you have used before to learn?
- ✓ How did you use any of them to learn T.E courses?

Section F: Organize and administration

- ✓ Have any of ICT facilities can be used to organize your class, students' grades/works/projects
- ✓ [illegible]
- ✓ **Section G: Teacher professional learning**

If you Do yo*u* have internet searching skills for relevant materials to learning of T.E courses especially the ones you teach

Are you aware of any community or groups on-line that deals with T.E Courses?

If yes, name them

If no, why?

How often do you participate in professional development in your course of study?

Appendix VII

Interview Guide for *ICT competence of Technical Drawing lecturers* (ICTCTDL)

Section A:

- ✓ Are you aware of ICT policy that fosters the use of ICT for Technical Education course?

If yes, what have you done with ICT facilities in the course you teach?

Section B: Understanding ICT in Education

- ✓ Which of the ICT facilities do you think could benefit the teaching and learning of T.E courses especially the ones you know?
- ✓ If yes, why do you think so

Section C: Curriculum and Assessment

- ✓ Do you think the ICT facilities you mentioned in (section B) or any ICT facilities you know could help implement the curriculum of T.E programmes and formative assessment?
- ✓ If yes, why
- ✓ If no, why

Section D: Pedagogy

- ✓ What strategies can be used teach T.D courses
- ✓ Do you think the use of ICT facilities could be used to implement and enhance such strategies?
- ✓ If yes, why
- ✓ If no, why?
- ✓ If your answer is yes, do you have the skills to do that
- ✓ If yes, can you describe it in one sentence

Section E: Information and Communication Technology (ICT)

- ✓ Can you mention any of ICT productivity tools you have used before to teach?
- ✓ How did you use any of them to teach T.E/T. D courses?

Section F: Organize and administration

- ✓ Have you used any of ICT facilities to organize your class, students' grades/works/projects?
- ✓ If yes, can you mention it
- ✓ If no, why

If your answer is yes, how did you use it or them?

Section G: Teacher professional learning

Do you have internet searching skills for relevant materials to teaching of T.E courses especially the ones you teach?

Are you aware of any community or groups on-line that deals with T.E/TD courses?

If yes, name them

If no, why

How often do you participate in professional development in your course of study?

School name:

Phone Contact:

Email Contact:

Thank you for your time.

Appendix VIII

Interview Guide for *Technical drawing* Students (IGTDS)

You have been learning ***Technical drawing*** for quite some time now, **what do you have to say about?**

- **Do you have any problem with the subject?**
- **Do you have any problem with the teacher(s)**
- **Do you have any problem with Teaching/learning materials used by teachers for Technical drawing?**
- **Do you have any problem with the way you have been taught?**
- **Would you say the subject is interesting? Yes or No**

If no, Why?

- ✓ **If yes, why?**
- ✓ **What aspect of the subject do you find difficult to learn?**
- ✓ **Why? How can we solve the difficulty?**

Appendix IX

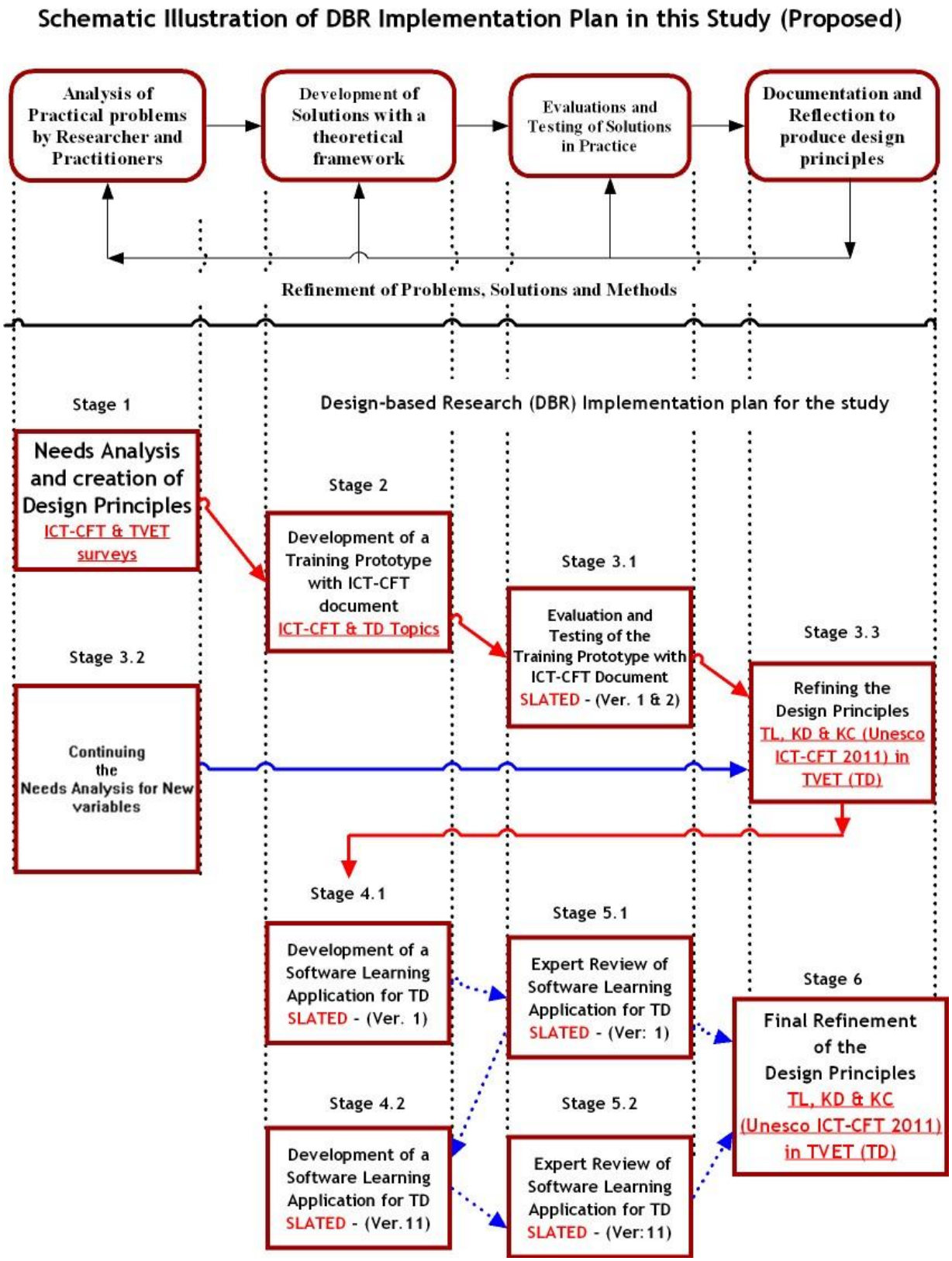
Interview Guide for *Technical drawing* Teachers (IGTDT)

- ✓ **For how long have you been teaching *Technical drawing*?**
- ✓ **What has been your experience with the subject and students in this subject across all levels?**
- ✓ **What is student's attitude toward the subject?**
- ✓ **Looking at these** Technical drawing topics such **as Lines and drawing; Principles of projection; Geometrical construction/plane Geometry; Principles of Tangency; Pictorial view; Solid Geometry; Mechanical drawing; Building drawing; Electrical drawing Etc.** What is the perception of students when you teach them? Do students really understand these topics at all?
- ✓ **Identify one or more of the topics above that you have taught before, and how you have been teaching it/them these topic(s)**
- ✓ **What do you think can help them resolve some of the perception's students have toward the subject/topics/themes?**
- ✓ **What do you think can be done to correct these students' perception about the subject/topics/themes?**
- ✓ **What do you think can solve the problem if you are asked to proffer solution to the subject?**

Thank you very much. Contact number:

School name:

Appendix X


Schematic Illustration of DBR Implementation Plan in this Study (Proposed)
Analysis of Practical problems by Researcher and Practitioners
Development of Solutions with a theoretical framework
Evaluations and Testing of Solutions in Practice
Documentation and Reflection to produce design principles
Refinement of Problems, Solutions and Methods
Design-based Research (DBR) Implementation plan for the study
Stage 1
Needs Analysis and creation of Design Principles
ICT-CFT & TVET surveys
Stage 2
Development of a Training Prototype with ICT-CFT document
ICT-CFT & TD Topics
Stage 3.1
Evaluation and Testing of the Training Prototype with ICT-CFT Document
SLATED - (Ver. 1 & 2)
Stage 3.3
Refining the Design Principles
TL, KD & KC (Unesco ICT-CFT 2011) in TVET (TD)
Stage 3.2
Continuing the Needs Analysis for New variables
Stage 4.1
Development of a Software Learning Application for TD
SLATED - (Ver. 1)
Stage 5.1
Expert Review of Software Learning Application for TD
SLATED - (Ver: 1)
Stage 6
Final Refinement of the Design Principles
TL, KD & KC (Unesco ICT-CFT 2011) in TVET (TD)
Stage 4.2
Development of a Software Learning Application for TD
SLATED - (Ver.11)
Stage 5.2
Expert Review of Software Learning Application for TD
SLATED - (Ver:11)

Appendix XI

Technology Literacy Assessment Sheet (TLAS)

Area of Specialization: _____

This Technology Literacy Report sheet has six sections, and you are expected to respond to each question as frankly as possible.

Section A: Understanding ICT in Education- Policy Awareness

1. Looking at the Nigeria ICT Policy:

S/N	Items	Yes	No	IDK
1	The implementation of ICT policy in school is describable			
2	ICT policy strengths and weaknesses are describable			
3	If the policy is put to use, it would promote the use of ICT to create student-centered learning?			
4	It can be mainly be used for efficient presentation			
5	ICT policy is beneficial to classroom			

Section B: Curriculum and Assessment-Basic Knowledge

1. Based on the knowledge of the tools at this stage, mention one topic alongside with the appropriate tool in TE that this tool can help you teach effectively.
   Topic:
   _____
   Tool:
   _____
2. Identify 3 objectives of the chosen topic that the ICT tool can teach effectively
   _____
   _____
   _____
   _____
   _____
   _____
3. Can this tool be used for assessment of the topic chosen?

If yes, how?

_____
_____

If no, why?

_____
_____

Section C: Pedagogy-Integrate Technology

1. Choose a particular tool, what teaching strategies/methods can this tool help in implementing? _____, _____, _____
2. How would you use the tool to implement the strategies/methods to teach a topic in TE (in 5 sentences)?

   _____
   _____
   _____
   _____
   _____
   _____
   _____

Section D: ICT: Basic Tools

To what extent would you use these tools to teach courses/subjects considering the knowledge you have acquired at this stage?

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Tools	1	2	3	4	5	6	7	8
1	Word Processors								
2	Presentation software								
3	Web browser								
4	Search engines								
5	E-mail addresses								
6	Courseware								
7	Open source educational tools								

Section E: Organization and Administration-Standard classroom

To what extent would you use tools at this stage to organize and manage the teaching and learning of TE courses/subjects?

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Items	1	2	3	4	5	6	7	8
1	A computer Laboratory if available								
2	ICT tools in the classroom								
3	ICT tools with your students for presentation without altering the classroom setting								
4	ICT tools for individual study								
5	ICT tools for small group activities								

Section F: Teacher Professional Learning- Digital Literacy

1. Could you list at least 3 main uses of internet?

_____
_____
_____
_____
_____
_____

2. To what extent would you use these tools for professional learning

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Items	1	2	3	4	5	6	7	8
1	Virtual learning environments								
2	ICT tools for sharing information with your colleagues								
3	ICT tools to share teaching-learning resources								
4	Access e-learning courses								
5	Link staff to experts in the field								

Date Signature

_____ _____

Appendix XII

Knowledge Deepening Assessment sheet (KDAS)

Area of Specialization: _____

Knowledge Deepening Report sheet has six sections, and you are expected to respond to each question as frankly as possible.

Section A: Understanding ICT in Education- Policy understanding

1. One of ICT policy statements in Nigeria IT policy is:
   'To empower Nigerians to participate in software and ICT development'
   What is the implication of this statement? In three (3) sentences

_____
_____
_____
_____
_____
_____

2. If there is any ICT policy use in education, to what extent do you think:

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Items	1	2	3	4	5	6	7	8
a	that ICT policy could change the face of Technical education as a course								
b	that ICT policy could change the practices of TE in the classroom								

3. In what way does the ICT policy statement above favour the implementation of subject-related tools (At least 3 ways)

_____
_____
_____
_____
_____
_____

4. In your opinion, how can these subject-related tools help in achieving deeper knowledge of student-centered learning (At least 3 points)

_____
_____
_____
_____

Section B: Curriculum and Assessment-Knowledge Application

1. Based on the knowledge of the subject related tools at this stage, mention one topic alongside with the appropriate tool in TE that this tool can help you teach deeper.
   Topic: _____
   Tool: _____
2. How can this tool help in implementing the teaching of the topic more effectively?
   _____
   _____
   _____
   _____
   _____
   _____
3. Mention one subject-related tool at this stage: _____
   How can this tool be used for assessments of students' learning activities?
   _____
   _____
   _____
   _____
   _____
   _____

Section C: Pedagogy-Complex problem solving

1. Identify a complex problem, and tool to teach, what teaching strategies/methods can this tool help implementing? _____, _____, _____
2. How would you use the tool to implement the strategies/methods to teach a topic in TE (in 5 sentences)?
   _____
   _____
   _____
   _____
   _____
   _____
   _____
3. To what extent would you use subject-related tools to:

Scale: Low Extent (1-2); Fairly Extent (3-4); Averagely Extent (5-6), and Great Extent (7-8)

S/N	Tools	1	2	3	4	5	6	7	8
1	adopt collaborative learning in classroom								
2	adopt project-based learning in classroom								
3	design on-line materials to support your students								
4	applicable to real-world problems								

Section D: ICT: Complex tools

To what extent would you use these tools to create deeper knowledge TE courses/subjects considering the knowledge you have acquired at this stage?

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Tools	1	2	3	4	5	6	7	8
1	AutoCAD								
2	Smart Draw								
3	Camtasia								
4	Google sketch-up								
5	Sweet Home								
6	Edraw								
7	Authoring software								

Section E: Organization and Administration-Collaborative groups

To what extent would you use tools at this stage to implement the following?

S/N	Items	1	2	3	4	5	6	7	8
1	Organize computers and other resources within the classroom to support collaborative work								

2	Create a learning environment to manage project-based activities								
3	Define the requirements of a classroom setting to match the needs of groups								
4	Organize the classroom to support groups working with different tools								

Section F: Teacher Professional Learning- Manage and Guide

5. How would use virtual communities for your professional learning? (at least 3)
   _____
   _____
   _____
   _____
   _____
   _____
6. Based on the training of these subject related tools:

S/N	Items	Yes	No
1	Would you share digital resources with outside experts?		
2	Would you collaborate with outside experts?		
3	Would you participate in an on-line community related to TE?		
4	Would you use make use of community of practice of these subject-related tools?		

Date **Signature**

_____ _____

Appendix XIII

Knowledge Creation Assessment Sheet (KCAS)

Area of Specialization: _____

Knowledge Creation Report sheet has six sections, and you are expected to respond to each question as frankly as possible.

Section A: Understanding ICT in Education- Policy Innovation

1. How do you think you could contribute to implement or modify an ICT policy in relation to TE programme? (At least 3 ways)
   _____
   _____
   _____
   _____
2. How would you contribute to the discussion of policy for introducing ICTs into TE programme?
   _____
   _____
   _____
   _____
3. How would change in ICT policy affect the practice of TE programme in the classroom?_____
   _____
   _____
   _____
   _____

Section B: Curriculum and Assessment-Knowledge society skills

1. Based on the knowledge at this stage, mention one topic in TE, and how would you help students use ICT skills of searching for, managing, analyzing, evaluating to create knowledge economy?
   _____
   _____
   _____
   _____
   _____
2. Create a unit of lessons and activities to help students acquire the skills of reasoning, planning, reflective learning, knowledge building, and communication using ASEI Lesson Plan?
   Topic:
   _____
   _____
   Learning objective(s)

_____
_____
_____
_____

Rationale:

_____
_____
_____
_____
_____
_____
_____

Pre-requisite previous knowledge:

_____
_____
_____

Learning Materials:

_____
_____

Introduction:

a. Teacher's activity

_____
_____
_____
_____

b. Learners' activity

_____
_____
_____
_____

c. Learning points

_____
_____
_____
_____

Development:

a. Teacher's activity

_____
_____
_____
_____

b. Learners' activity

c. Learning points

Evaluation:

a. Teacher's activity

b. Learners' activity

c. Learning points

Conclusion:

a. Teacher's activity

b. Learners' activity

c. Learning points

How would you help students to apply skills acquired to understanding key subject? (At least 3 points)

_____
_____
_____
_____
_____

Section C: Pedagogy-Self-management

1. To what extent would you perform the following:

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Items	1	2	3	4	5	6	7	8
1	create synchronous activities capable of engendering creativity								
2	use social media networks to support students' learning								
3	apply web 2.0 tools to create students' support for digital materials								
4	allow your classroom be involved in learning projects with other institutions using online communication in TE programme								
5	help students create multimedia production, web production and publishing technologies								

Section D: ICT: Pervasive Technology

To what extent would you use these tools to create software packages in TE courses/subjects considering the knowledge you have acquired at this stage?

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Tools	1	2	3	4	5	6	7	8
1	AutoCAD (KD)								
2	SmartDraw (KD)								

3	Camtasia (KD)								
4	Google sketch-up (KD)								
5	Sweet Home (KD)								
6	Edraw (KD)								
7	Authoring software (KD)								
8	Word Processors (TL)								
9	Presentation software (TL) PowerPoint (KC)								
10	Web browser (TL)								
11	Search engines (TL)								
12	E-mail addresses (TL)								
13	Courseware (TL) Opus pro Creator (KC)								
14	Open source educational tools (TL)								
15	Articulate storyline (KC)								

Section E: Organization and Administration-Learning organizations

To what extent would you use the knowledge at this stage to implement the following?

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Items	1	2	3	4	5	6	7	8
1	Organize the classroom as a learning community								
2	Create a learning environment to support collaborative projects with other institutions								
3	Create online and offline learning communities								
4	Use planning and thinking tools to support students' creation and planning their own learning activities for reflective thinking								

Section F: Teacher Professional Learning- Teacher as a model learner

1. How would use virtual communities for your professional learning? (at least 3)
   _____
   _____
   _____
   _____
   _____
   _____
2. To what extent would you use the knowledge at this stage to implement the following?

Scale: Low Extent (1-2); Fair Extent (3-4); Average Extent (5-6), and Great Extent (7-8)

S/N	Items	1	2	3	4	5	6	7	8
1	Play a key role in introducing ICTs into TE programme								
2	Play key roles to craft a vision for TE programme that incorporate ICT usage in classroom								
3	Evaluate and reflect continuously on professional practice to promote innovation and improvement								
4	Teach in-service teachers in ICT related course								
5	Replicate the ICT competency-based training to your colleagues in TE and other fields								

Date **Signature**

_____ _____