An Exploration of how Early Childhood Education Lecturers Train Pre-Service Teachers to Use Technologies at a Nigerian University

by

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A thesis submitted in fulfilment of the academic requirements for the degree of Doctor of Philosophy, School of Education, University of Kwa Zulu-Natal

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April 2021

DECLARATION

(i) I, Blessing Chinonyerem Chiedozie (218085236) declare that: The research reported in this thesis, except where otherwise indicated, is my original work.

(ii) This thesis has not been submitted for any degree or examination at any university.

(iii) This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

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a) The words have been re-written but the general information attributed to the author(s) has been acknowledged; and

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(v) The work described in this thesis was carried out in the School of Education, University of KwaZulu-Natal, from September 2018 to April 2021 under the supervision of Dr Asheena Singh-Pillay (Supervisor).

(vi) Ethical clearance was granted prior to undertaking the fieldwork.

Signed:  Date: 19/05/21

As the candidate's supervisor I, Dr Asheena Singh-Pillay, agree to the submission of this thesis.

Signed: A. Singh-Pillay_____ Date: 20 May 2021

DEDICATION

This project is dedicated to my Lord and Master, Jesus Christ, for His wisdom, knowledge and understanding which he bestowed on me throughout my study. Also, to my beloved children, husband and my siblings, who through one way or the other spurred me on to endure the PhD journey.

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My profound and everlasting gratitude goes to my beloved Lord and Master, Jesus Christ, for sufficient grace he granted me to attain this level of academic excellence. His faithfulness endures forever! I love you Lord.

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ABSTRACT

The Nigerian government initiated the introduction of educational policies for technology integration in Early Childhood Education due to its relevance in the cognitive and social learning of pre-schoolers (Obiweluzor, 2015). Unfortunately, the teachers in both private and public Early Childhood Education (ECE) centres were not competent to handle the technologies provided; which is of great concern to both the federal government and other stakeholders. Calls were made by the Nigerian government to enhance the technological competence of pre-service teacher training as Early Childhood Education teachers. Thus, ECE lecturers are seen as key role players in the development of technological knowledge and skills of the ECE preservice teachers. In response to the lacunae identified between policy intention for the integration of technologies in ECE centres and the poor integration of technologies in the ECE centres, this study explored how ECE lecturers train ECE pre-service teachers in the use of technology at a University in Nigeria. This qualitative case study was located within the interpretative paradigm. Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) model underpinned the study. It posed three research questions, namely: What technologies do ECE lecturers use to train ECE pre-service teachers? How do ECE lecturers train ECE pre-service teachers in the use of these technologies in terms of content and pedagogy? Why do ECE lecturers train ECE pre-service teachers to use these technologies the way they do? Sampling was purposive. All the eight ECE lecturers with over five years teaching experience at ECE department of the university were requested to participate in this study. Data were generated through individual interviews, lesson observation, document analysis, focus group interviews, collages and concept maps. Content analysis was used to analyse the data. The findings indicated that there was a mismatch between Nigerian national policy for integration of technology and the enactment of policy for integration of technologies at CB University. Moreover, the ECE lecturers lacked the Technological Knowledge (TK) and Technological Pedagogical Knowledge (TPK) required for effective integration of technology in their lessons, which lead to inefficient training of the ECE preservice teachers in the use of technology. Insufficient technologies, insufficient integration of technology in the ECE curriculum and insufficient technological knowledge (TK) and technological pedagogical knowledge (TPK) were factors that constrained the effective training of ECE preservice teachers in the use of technologies. The findings of this study highlight the need for the socio-cultural factors to be the centerpoint on which the intersection of the various components of the TPACK model hinges. Hence, the study makes a recommendation for a modification to the

TPACK framework which has until now fore-grounded only technological content knowledge, to a new model to make room for the explanation of teachers' socio-cultural backgrounds (context) when investigating pedagogical practices.

Keywords: Curriculum, Early Childhood Education, Early Childhood Education lecturers, Early Childhood Education centres, re-service teachers, technologies.

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CHAPTER ONE

INTRODUCTION

The purpose of this study was to explore how Early Childhood Education (ECE) lecturers train pre-service ECE teachers to use technologies at a Nigerian university. This introductory chapter describes the background of the study, its purpose, the specific objectives, the research questions, the rationale of the study, and its significance, and provides a clarification of key terms used in the study. The chapter concludes with a brief review of the approach adopted by the researcher and outlines the contents of the chapters that follow.

1.1 Background of the Study

The importance of technology in the teaching and learning process cannot be overemphasised. Researchers have emphasised the importance of using technology in the classroom to facilitate learning (Good & Lavigne. 2017). Aladé et al. (2016), Clark and Mayer (2016), Johnson et al. (2016), Kukulska-Hulme and Viberg (2018) in their studies affirmed that technology increased learning, particularly in young children as technologies have rapidly become an essential part of their daily life. The influence of technology in the improvement of young learners' learning was expansively acknowledged in literature (Imazeki, 2014; Livingstone et al., 2014).

Children as young as 12 months old were assimilating information (about the world) through devices such as television, cellular phones, handheld gaming devices, electronic tablets and laptops (Imazeki, 2014; Livingstone et al., 2014). Neumann and Neumann (2017) contend that when children use or play with electronic devices, they are faced with complex tasks such as analysing, synthesising and problem solving. Rogowsky et al. (2018) also contend that when children used or played with electronic devices, their literacy and numeracy skills were enhanced. The movement of the mouse on the screen and computer engaged children in the aforementioned skills (ibid). With regard to the preceding point, it is worth noting that Willmann (2017) found that in ECE, the use of technologies can contribute to three main areas of learning, namely: social and emotional development; language, problem solving, reasoning, and creative development; and operational and motor skills. The purposeful use of technologies in the cognitive and social growth of young children is well documented (Neumann, 2018).

In recognition of the value of using technology during teaching, the federal government of Nigeria made computer education and computer literacy compulsory for all levels of the nation's educational system (Eze & Akubugwo, 2016). The Federal Republic of Nigeria also

recognises the role that technologies play in the cognitive and social learning of young children attending childcare centres. Hence, these centres have been equipped with technologies by the Federal Ministry of Education (MoE) (Sifuna, 2018). This means that the Federal Republic of Nigeria underscores the role that Early Childhood Education **(**ECE) teachers play in the teaching and learning of various forms of literacy among young learners via the use of technologies (ibid).

The Nigerian government also placed an educational policy for technology integration in Early Childhood Education on the National Policy on Education, which calls for schools, including ECE centres, to be equipped with technologies (Federal Republic of Nigeria, 2013). Content analysis of the policy reveals the technologies that ought to be used in teaching ECE learners. These technologies were reflected in Table 1.1 below:

Table 1.1: Technologies to be Used as per the Nigerian National Policy on Education for ECE

Technologies to be used to develop	National ECE Curriculum
Cognitive skills	Television, Tape recorder, digital video, Radio, Digital Toys, computer- desktop, laptop, E- books, MP3player, iPods, Whiteboard.
Affective skills	Digital Toys, Radio, Television, Electronic Musical Instruments, Digital Video, Tape recorder, Cassettes, Computer.
Psychomotor skills	Television, Digital video player, Electronic Musical instrument, computer-desktop/laptop.

Source: Document on National Early Childhood Curriculum for Ages 0-5 Years by Nigerian Educational Research and Development Council (NERDC)

However, the National Policy on Education's call for the integration of technologies has not been adhered to in the ECE sector, due to teachers' incompetence to use the available technology (Akinrotimi & Olowe, 2016). Along similar lines, Kara and Cagiltay (2017)

emphasised that technologies were not properly integrated in the ECE classrooms to enhance children's knowledge, academic skills in mathematics, reading, writing and social development, because most ECE teachers lacked competence in the use of technologies. The aforementioned points reveal that in the absence of proper training, increasing access to technologies and having policies for the integration of technologies in teaching do not lead to effective use of technologies in education. In other words, the disjuncture between policy goals and practice has been elucidated by both the Nigerian government as well as private owners of schools (Newman & Obed, 2015). Tondeur et al. (2016) asserted that for teachers to be equipped with the changing skills required to teach with technologies, the education system must ensure that they (teachers) acquire the skills needed to practice as required. Research has shown that new teachers do not feel sufficiently prepared to use technologies in their classrooms (Yildiz, 2019). There may be many factors that have contributed to new teachers' lack of confidence in their use and their practice. However, studies by Kukulska-Hulme and Viberg (2018) revealed that the quality of pre-service teachers' exposure to the use of technologies for learning affects the ways they view and use technology once they become practising teachers. Therefore, institutions of education must train pre-service teachers to use the relevant technologies and prepare them to teach with those technologies.

This study responds to the aforementioned lacunae noted in the literature as well as the outcry by the Nigerian government and ECE public school authorities and ECE private school owners on ECE teachers' incompetence in the use of technologies, and seeks to explore how ECE lecturers prepare ECE pre-service teachers in the use of technologies at a Nigerian university.

1.2 Purpose and Focus of this Study

The purpose of this study was to explore how ECE lecturers train pre-service teachers to use technologies at a Nigerian university.

1.3 Research Objectives

The study was underpinned by the following three objectives:

1.3.1 Establish what technologies ECE lecturers use to train of ECE pre-service teachers.

1.3.2 Explore how ECE lecturers use these technologies to train ECE pre-service teachers, in terms of content and pedagogy.

1.3.3 Ascertain why these technologies are used the way they are.

1.4 Research Questions

The research questions that guided this study were:

1. What technologies do ECE lecturers use to train ECE pre-service teachers?
2. How do ECE lecturers train ECE pre-service teachers in the use of these technologies in terms of content and pedagogy?
3. Why do ECE lecturers train ECE pre-service teachers to use these technologies the way they do?

1.5 Rationale for the Study

In spite of the fact that the Nigerian Ministry of Education (MoE) envisaged the role of ECE teachers to promote learning via technologies, the Nigerian Ministry of Education has expressed concern over the poor quality of ECE education, incompetent ECE teachers, lack of integration of technologies and lack of creative learning activities (Newman & Obed, 2015; Oluwafemi et al., 2014). Studies conducted by Kara and Cagiltay (2017) revealed that technologies were not properly integrated in the ECE classrooms to enhance children's knowledge, academic skills in mathematics, reading, writing and social development, because most ECE teachers lack competence and confidence in the use of technologies. With regard to the above-mentioned studies, it is worth noting that Liu and Bang (2015) and Tondeur et al. (2016) contend that in the absence of proper training, increasing access to technologies do not lead to effective use of technologies in education. Put simply, this means to successfully embed and fully optimise technologies, teachers need to be trained with reliable instruction and learning activities grounded in sound pedagogy.

Within the Nigerian context, studies on ECE have been conducted on the implementation of ECE curriculum in schools (Obiweluozor, 2015; Okewole, Abuovbo & Abosede, 2015; Oluwafemi et al., 2014; Sooter, 2013), there is a lack of empirical studies on how ECE pre-service teachers are trained to use technologies during their programme of study in tertiary institutions. This study hopes to add to this gap identified in the literature by shedding more light on how ECE lecturers train ECE pre-service teachers to use varied forms of technologies in their training programmes. Knowing about ECE lecturers' training of pre-service ECE teachers on how to use technologies has implications for both teaching and learning.

1.6 Significance of the Study

In previous studies that used TPACK as a framework, observation on planning lessons have not been significantly employed. As part of the methodology, this study deployed the use of observations of instructional planning of ECE lecturers to train pre-service teachers on the use of technologies. Instructional planning refers to creating, arranging and organising instructional

events to enable students to learn effectively, and is considered a key aspect of a teacher's routine work, both in order to provide their students with the most useful and meaningful learning experiences and to lead to effective teaching. Obtaining insights into how ECE lecturers use technologies to train pre-service teachers to use technologies might assist educational technologists and programme developers to plan for ECE education. This study might also inform the training of ECE lecturers and assist them in merging effective pedagogical strategies for pre-service teachers to engage with the curriculum in a more active manner.

The findings could be beneficial to lecturers, policy makers and pre-service Early Childhood Education teachers, and might introduce the integration of technologies in more modules with the ECE programme at CB University. Also, curriculum developers, textbook authors/publishers writing about Early Childhood Education pedagogy and curriculum could benefit as the links between early childhood education content, teaching strategies and the use of appropriate technologies would become explicit.

1.7 Research Design

This qualitative case study explored how ECE lecturers train ECE pre-service teachers to use technologies in their teaching. Yin (2017) defined case study research as an empirical study that explores a contemporary phenomenon within its real-life context in which various sources of data are used. In this study, the case explored was ECE lecturers' use of technologies and the context was bounded to an ECE pre-service teacher training programme at a Nigerian university (CB University) (Pseudonym). Purposive sampling was used to select the participants for accurate data. Purposive sampling, according to Etikan, Musa and Alkassim (2016) and Maniram and Maistry (2018), is a deliberate act of choosing a participant based on the attributes he/she possesses. It was not done randomly; I selected the Early Childhood Education lecturers who could give relevant information needed for the study based on their years of experience and knowledge.

Furthermore, the study embraced the interpretive paradigms. According to Cohen, Manion and Morrison (2017), the interpretive paradigm seeks to understand the subjective world of human experience, to derive meaning from shared experience. In this case, the intention was to gain a deep insight on how early childhood education lecturers trained pre-service early childhood education teachers to use technologies.

1.8 Research Findings

Research Question 1 on what technologies were used by ECE lecturers to train ECE pre-service teachers revealed the following:

- It was established in this study that ECE lecturers used technologies in the training of pre-service teachers for the development of the three domains of learning, namely, psychomotor, affective and cognitive domains.
- There appeared to be an almost one-on-one alignment between the technologies that the ECE lecturers were expected to use when they train ECE pre-service teachers (as stipulated by the CB University curriculum), and the technologies lecturers claimed to use when they train ECE pre-service teachers.
- The ECE curriculum of CB University did not embrace the latest technologies available to promote the skills required for the Fourth Industrial Revolution (4IR).
- Some of the technologies contained in the ECE curriculum of CB University and those ECE lecturers claim to use were very old and dated.

Research Question 2 on how ECE lecturers train pre-service teachers in the use of technology in terms of content and pedagogy revealed that:

- There is insufficient integration of technology courses/modules in the CB University ECE curriculum and the national ECE curriculum at large.
- There was a lack of technologies for pre-service teachers (PST) to engage in hands-on practice needed to acquire the desired technological skills for future use in their profession.
- There was insufficient time in the timetable for the few courses/modules on technology, to enable the PST attain the desired outcome within the lesson period.
- The ECE lecturers were very efficient in Content Knowledge (CK) but lacked sufficient Pedagogical Knowledge (CK) and Technological Pedagogical Knowledge (TPK) needed for effective technology integration.
- There was insufficient Continuous Professional Development (CPD) given to the ECE lecturers at CB University to equip them technologically.
- The CB University ECE lecturers trained the PST in the use of technology effectively in terms of content but ineffectively in terms of pedagogy.

Research Question 3 on why ECE lecturers train ECE pre-service teachers to use these technologies the way they do revealed that:

ECE lecturers train the pre-service teachers the way they do because of the immense relevance of technology in this 21st century, although the training was not efficient and effective due to some intrinsic and extrinsic factors: ECE lecturers lack continuous professional development needed to be proficient in the use of technology; as such, they still struggle with the use of technology which hampers the effective training of pre-service teachers in the use of technology. In addition, there were insufficient technologies for effective training of ECE pre-service teachers in the use of technology, also poor integration of technology in the curriculum.

1.9 Overview of Chapters

Chapter One provides the background to the study, the rationale, its purpose and objectives, the research questions guiding the study and the significance of the study. It also provides a brief synopsis of the research design and research findings.

Chapter Two presents a review of related literature locally and internationally that are concerned with use of technology in teaching and learning in ECE.

Chapter Three highlights the theoretical framework underpinning this study, which consists of Technological Pedagogical Content Knowledge (TPACK) and its suitability to the study.

In Chapter Four, the research methodology is discussed. Attention was paid to the research paradigm, research design, justification for a case study approach, location of the study and sampling. Data generation processes and instruments were described. These were individual interviews, focus group interviews, lesson observation and document analysis used to explore how ECE lecturers trained ECE pre-service teachers in the use of technology. The chapter concludes with data analysis strategies that would be used.

Chapter Five focuses on analysis of technologies used by ECE lecturers to train ECE pre-service teachers.

In Chapter Six, the study focuses on analysis of how ECE lecturers trained ECE pre-service teachers in the use of technologies in terms of content and pedagogy. The analysis was guided by the theoretical framework of TPACK.

The emerging themes related to Research Question 3 are presented in Chapter Seven.

The thesis ends with Chapter Eight, which provides a summary of findings from the study and highlights recommendations emanating from the findings.

1.10 Concept Clarification

For the purpose of this study the following concepts are examined:

1.10.1 *Early Childhood Education*

Early childhood education is a branch of education theory that relates to the teaching of young children from birth up to eight years. It developed as a field of study during the enlightenment, particularly in European countries with high literacy rates. Early childhood education consists of activities and experiences that are intended to effect developmental changes in children prior to their entry into primary school (Follari, 2015, Oluwafemi et al., 2014).

1.10.2 *Pre-service Teachers*

Pre-service teachers are students that enrol in a teacher preparation programme, who must successfully complete the degree requirements, including course work and teaching practices before they will be awarded a teaching certificate (Zacharis, 2020)

1.10.3 *Technologies*

Technologies are the tools, and machines/devices that help to solve problems, facilitate learning or do new things. It is a means of using resources to solve a problem such as knowledge, skills, processes, techniques, tools and raw materials (Curry & Whitney-Emberton (2016).

1.10.4 *ECE Curriculum*

The Early Childhood Education curriculum is a document that contains all the learning goals at different levels that outline the intended early childhood education content and process goals at particular points in time throughout the ECE programme. The ECE curriculum contains materials, resources, and processes for evaluating the attainment of ECE objectives.

1.10.5 *Early Childhood Education Centre*

The Early Childhood Education Centre are the premises used for the education and care of children below school age.

1.10.6 *Technological Pedagogical Content Knowledge (TPACK)*

TPACK is a term that describes what a teacher must know to integrate technology effectively into the curriculum or teacher practices, and represents the combination of teacher content knowledge, pedagogical knowledge and technological knowledge, which are interrelated. TPACK allows educators to consider what knowledge is required to integrate technology into teaching and how they might develop that knowledge within themselves (Koehler, Mishra & Cain, 2013).

1.11 Summary of Chapter One

In this chapter I introduced the study, which explored how early childhood education lecturers train pre-service teachers to use technologies at a Nigerian university. The chapter provided the background to the study, the rationale behind it, the purpose, objectives and research questions guiding the study and its significance. In addition, a brief synopsis of the research design, research findings and an overview of subsequent chapters were provided. The next chapter focuses on the literature review.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The previous chapter gave an introductory background to the study. This chapter presents a review of related literature relevant to the study. A review of a body of literature is important as it creates an understanding of the topic under exploration in order to know what has already been researched, and understands what key issues need to be addressed.

A review of literature is organised under the following six subheadings:

- Early Childhood Education in Nigeria.
- The Use of Technologies in Education.
- ECE teachers' perception and attitudes towards the use of technology.
- Teacher training institutions and the use of technologies.
- Training pre-service teachers to use technology factors that influence the use of technology in teaching and learning.

2.2 Early Childhood Education in Nigeria

In this section, the following four aspects are discussed:

- Conceptualisation of early childhood education.
- A brief history of early childhood education in Nigeria.
- Basic curriculum provision of national policy on ECE in Nigeria and its objectives.
- Challenges of early childhood education in Nigeria.

2.2.1 *Conceptualisation of Early Childhood Education*

Early childhood education (ECE) is the system of education and care offered to young children, from birth through to eight years of age, in settings outside of the child's home by non-family members (Follari, 2015). Furthermore, Oluwafemi et al. (2014) described early childhood education as the education given to young children prior to entering the primary school in an educational institution. According to Ige (2011), ECE is concerned with building the child's physical, cognitive and emotional maturity before entering into primary school. This idea is based on the fact that exposing children to ECE enhances their cognitive and mental development to enable their understanding of basic concepts when they enter primary school. This understanding of ECE enhances the idea of it being an essential basic need, like food,

warmth, health, safety, affection, communication and motivation for social, emotional, psychological, physical and cognitive development. These basic needs are very important for survival, development and later education (Obadiah, Ibrahim & Hussaini 2017).

Moreover, the Nigeria National Policy on Education 2013, defined early childhood education as education given to children aged three to five years in preparation for their entry into primary school. It includes crèche, nursery and kindergarten. The crèche or day care centre is meant for children between the ages of 0 and 1-year. The kindergarten is meant for children between the ages 1 to 2 years, while the nursery is meant for children between ages 3 to 5 years (Federal Ministry of Education, 2013).

The Nigerian government recognises early childhood education as a foundational and essential programme that Nigerian children should experience before entering their primary school (Federal Ministry of Education, 2013). This is because the early childhood years are generally accepted as the most essential period during which children develop cognitive skills, language, perceptual, socio-emotional and motor domains are introduced into their social lives, and are taught how to build good character and moral discipline which they need for achievements and social functioning in future schooling and life itself (Obiweluozor, 2015). This informed the reason why the Nigerian government gave notable attention to early childhood education through various interventions such as the formulation of policy documents and a network of relationships among diverse sectors (Akinrotimi & Olowe, 2016).

In ECE, young children were taught music through lullabies and literature through folktales, fables, myths and legends of gods and heroes by their mothers or nannies. In the same vein, Nwanekezi and Onyekuru (2014) reported that in Nigeria, most parents, both literate and illiterate, endeavour to use nursery school provisions to complement home care for their young children. If they could not afford the nursery school bills, they left their children with house-helps, nannies or neighbours, who were less busy. However, some enlightened parents, with the realisation of the immense importance of early education, sent their children to nursery schools to inculcate the right values in them before they entered primary school.

Generally, early childhood education was targeted at enhancing the holistic development of children from birth to eight years of age (Oluwafemi et al., 2014).

2.2.2 *A Brief History of Early Childhood Education in Nigeria*

According to Sooter (2013), the missionaries introduced the concept of infant schools in Nigeria in the early 20th century. Such schools were set up in the Western and Eastern regions of Nigeria. These infant classes consisted of groups of children considered not yet ready for primary education. As grouping for instruction in infant schools was not age-based during that period, some children aged six or even more, could be found in some of the infant classes. With the phasing out of infant classes, some parents began to feel the need for nursery schools. During the period, of Nigeria's pre-independence all efforts for provision of early childhood education were confined to the voluntary sector and received little or no support from the Nigeria government (Sooter, 2013). It was in 1977 with the introduction of the National Policy on Education by the military government of Nigeria, that for the first time, there was an official recognition of the importance and need for early childhood education (ECE) in Nigeria, and ECE was linked with the child's educational performance in primary school. Progressively, early childhood institutions developed, and by 1985, Nigeria had about 4200 of these institutions. In 1992, the numerical strength of early childhood centres in Nigeria increased to about 8,300 (Federal Ministry of Education, 2013).

Currently, there are over 10000 ECE centres in many locations in Nigeria: in church premises, business organisations, residential buildings with extraordinary expansion due to increased demand for ECE by Nigerian parents (Obadiah et al., 2017). This shows the importance attached to early childhood education by parents.

2.2.3 *Basic Curriculum Provision of National Policy on ECE in Nigeria and the Objectives*

The immense importance of ECE is generally acclaimed in numerous international documents and developmental goals such as UN Convention on the Right of the Child, African Charter on the Rights and Welfare of the Child, Millennium Development Goals (MDGs) and Education for All (EFA) goals, among others (Akinrotimi & Olowe, 2016; Obadiah et al., 2017). The government of Nigeria is among the member states that endorsed these documents and goals, thus Nigeria has several interventions geared towards providing quality ECE for Nigerian children (Sooter, 2013).

As part of the interventions of the Federal Government of Nigeria on ECE, there was enactment of Universal Basic Education (UBE) Act of 2004, which had an expanded scope that included programmes and initiatives for early childhood education and development (Kozma & Isaacs 2011). Provision was made in the UBE programme for every public primary school in Nigeria

to have a pre-primary school (ECE centre) to cater for young children. As a result, there was an increased government ownership and participation in ECE (Kozma & Isaacs 2011).

1) In 2007 there was development of a policy referred to as National Policy for Integrated Early Childhood Development to promote an integrated holistic approach to the development of the child ((Federal Ministry of Education, 2013).
2) Furthermore, there was an amalgamated early childhood education curriculum which was all incorporating and shared into two sections to cater for age 0-3 and age 3-5 years respectively.
3) In addition, the Federal Government of Nigeria included ECE programmes in curriculum of colleges of education and tertiary institutions in Nigeria (Akinrotimi & Olowe, 2016).
4) Recently, the National Policy on Education categorised the programme of ECE into two sections, namely, Early Childhood Care, Development and Education (ECCDE) and Kindergarten Education (Federal Ministry of Education, 2013).

The objectives of early childhood education, according to the Federal Republic of Nigeria (2013) were:

- effect a smooth transition from home to school;
- prepare the child for the primary level of education;
- provide adequate care and supervision for the children while their parents are at work (on the farm, in the market, or offices);
- inculcate social norms;
- inculcate in the child the spirit of inquiry and creativity through the exploration of nature, the environment, art, music and playing with toys, electronic devices and so on;
- develop a sense of cooperation and team spirit;
- learn good habits, especially good health habits; and
- teach the rudiments of numbers, letters, colours, shapes, forms and so on through play, the use of technologies (Obiweluozor, 2015).

As stated in the National Policy of Education, the implementation guidelines stated by the government in order to achieve these objectives were as follows:

- To establish pre-primary sections in existing public schools and encourage both community and private efforts in the provision of pre-primary education.
- To make provision in teacher education programmes for specialisation in early childhood pre-primary education.

- To ensure that the medium of instruction is principally the mother tongue or the language of the immediate community; and to this end will develop the orthography of many more Nigerian languages and produce textbooks in Nigerian languages.
- To ensure that the main method of teaching at this level shall be through play and that the curriculum of teacher education is oriented to achieve this, regulate and control the operation of pre-primary education. To this end the teacher - pupil ratio shall be 1:25.
- Set and monitor minimum standard for early childhood centres in the country; and
- Ensure full participation of government communities and teacher associations in the running and maintenance of early childhood education facilities (Obiweluozor, 2015).

2.2.4 *Challenges of Early Childhood Education in Nigeria*

Early Childhood Education in Nigeria is faced with some challenges despite the efforts of the government, private institutions and all stakeholders (Oluwafemi et al., 2014). According to Akinrotimi and Olowe (2016), the main challenges of implementation of ECE in Nigeria are:

1) Lack of qualified and competent teachers: There is the issue of lack of competence on the part of ECE teachers, which is a deterrent in the delivery of the holistic education to these young ones (Adeosun, 2014). Some of the teachers in ECE centres are not qualified to teach these children and also lack competence in the use of the technologies (Akinrotimi & Olowe, 2016).
2) Inappropriate curriculum: A major challenge facing ECE in Nigeria is that the curriculum used in the teacher training institutions is not modern and updated to suit current educational trends (Adeosun, 2014).
3) Funding problems: There is also the challenge of funding for maintenance, provision and upgrade of ECE facilities (Ibhaze, 2016; Oluwafemi et al., 2014).

These studies emphasised that teachers hold the key to effective implementation of any educational initiative. That is the reason the federal government of Nigeria stated that no education system can rise above the quality of its teachers (Federal Republic of Nigeria (FRN), 2013). This is to say that whatever technologies that are provided in ECE centres, will be of little or no effect if the teachers are not skilled or are incompetent in the use of those technologies to facilitate learning. In same vein, Ogunyemi and Ragpot (2015) asserted that the key challenges in ECE in Nigeria revolves around the curriculum, quality of teachers and funding. Commenting on the challenges of ECE in Nigeria, Ige (2011) also stated the need to revisit the curriculum of pre-service teachers to make sure it is directed towards achieving the

ECE goals of developing the affective, cognitive and psychomotor domains of these young children by proper integration of technology in both content and pedagogy.

From the afore-mentioned points, the importance of ECE is recognised in Nigeria. government institutions, private institutions and individual families acknowledge the inevitable need for children to develop basic skills right from their young age. As a result, all stakeholders are interested in quality childhood education. Unfortunately, there has been an outcry by all stakeholders over the performance so far as the optimum experiences expected in ECE centres is not being achieved. There is lack of technological integration in ECE in Nigeria.

The next section unravels the use of technologies in education.

2.3 The Use of Technologies in Education

Curry and Whitney-Emberton (2016). asserted that technology comprises tools, techniques and our own creative efforts to solve problems in our environment, while Govender and Khoza (2017) categorised technology as a study that deals with the application of both technology in education (TIE) and technology of education (TOE), with the main purpose of enhancing the teaching and learning process. Govender and Khoza (2017), further explained TIE and TOE as follows:

Technology In Education (TIE) are those tangible teaching and learning resources one can see or touch, which are basically categorised as software (SW) and hardware (HW) examples, such as overhead projectors, video cassette players, radio cassette players, desktop computers, laptops, smartboards and mobile phones and more for hardware, while software are those materials used to display information through the hardware, such as computer software application, overhead projector transparencies, YouTube, blogs, Facebook, Skype and others.

Technology of Education (TOE) involves teaching and learning techniques, theories, research findings, lecturers' competencies, everyday knowledge and others that cannot be seen or touched.

The current fifth generation of computers has witnessed great advancement in technologies, ranging from Robotics, Neutral networks. Game Playing, Desktop, Laptop, NoteBook, UtraBook, the development of true artificial intelligence associated with early childhood, and more (Jain et al., (2018,).

Golonka et al. (2014) differentiated among the different types of modern technologies used in education as follows:

Communication technologies – used to transfer information through technology tools like phones, computers, emails, or fax.
Information technologies: a set of hardware and software tools used to store, transfer and process information like Television and radio.
Educational technologies, which aims at improving learning through creativity and various technologies like electronic whiteboards, flipped learning, desktops and laptops, projectors, video conferencing, video tapes, mobile learning, digital cameras, computers, computer games, iPods/ MP3 players, IPod touch devices, e-readers, tablet computers and toys (Voogt & McKenney, 2017).

2.3.1 *Role of Technology in Education*

In recent times, educational stakeholders have recommended the significance of integrating technology in education (Thomas, 2016). Technology has already changed the world, including the way we learn and teach. The effects of technology in education have been studied since the beginning of the 1970s when educators were becoming convinced that computer technology could support students in formal education (Drigas & Kokkalia, 2014). Technologies are also increasing in importance as these tools have entered many aspects of our lives, including education (Steffens et al., 2015). Omwenga, Nyabero, and Okioma (2015) categorically stated that technology is a basic driver of economic development and social transformation globally. It is promptly and constantly changing the way people interrelate in their daily activities.

Nowadays, technology has successfully penetrated virtually all human endeavours, including the field of education (Burbules & Callister, 2018). In fact, several studies have been carried out on the integration of ICT (Information and Communications Technology) into classroom teaching with a view to complementing and modifying the pedagogical practice of teachers (Afunde, 2015; Thomas & Oladejo, 2017).

However, schools have taken on the responsibility of preparing students to become digitally literate (Rahmah, 2015). Queensberry, Mustian and Clark-Bischke (2016) further state that technology-based learning and assessment programmes would be pivotal in improving student learning and generating data. Therefore, Queensberry et al. (2015) emphasised the importance

of schools and teachers to focus on the ways to support student learning through the use of technology-enhanced instructional tools. After conducting a study on how teachers

can integrate technology at the early childhood level, the researchers concluded that social skills can be developed through three steps, which include planning and technology selection, introducing the technology, and evaluating the effectiveness of the technology. The teachers from the study used tools such as the interactive white board, computers and tablets.

In addition, Hennessy, Haßler and Hofmann (2015) asserted that to enhance and improve the quality of education in the Sub-Sahara Africa region, it is pivotal to develop technology use for twenty-first century teaching and learning. King (2017), from the U.S. Department of Education in 2017, as secretary of the office of Educational Technology, asserted that technology can be a potent tool for transforming learning. It can help support and advance interactions between teachers and students, reinvent their methodologies to learning and collaboration, shrink established parity and accessibility gaps, and adapt learning experiences to meet the needs of all learners. Hannaway and Steyn (2016) found that South African foundation phase teachers integrate technologies in their teaching to help simplify complex /abstract ideas that young children might struggle to learn, as well as initiate in learners the attributes of problem solving, creativity, visualisation and manipulation of objects. Similarly, Fagan (2018) asserts that integrating technologies into the classroom helps prepare students for the elaborate and technologically-connected world they will face daily.

Falk-Ross and Linder (2018) conducted a study focusing on teachers' use of technology during reading instruction. The researchers found that many teachers used the technology instructional tools to display multimedia content, produce collaborative learning activities, focus student attention, display texts for shared reading, and personalise learning activities. The researchers found that the technology instructional tools offered teachers many resources and allowed for lessons to run smoothly.

2.3.2 *Use of Technology Globally and in Nigerian Schools*

The relevance of technology in teaching and learning is no doubt recognised in Nigerian education for its free flow of information and dissemination of knowledge (FRN 2013 p. 5). The Nigerian Federal Ministry of Education (MoE) in 2015 acknowledged the use and integration of Information and Communication Technology (ICT) into education as one of the five distinct development areas. Also, technology has become a vital tool in teaching and

learning in embracing learner-centeredness (Afunde, 2015). Information and Communication Technology (ICT), particularly computer education, was introduced in Nigeria around mid-1960s, when IBM (International Business Machines) that set up computer centres at the Universities of Ibadan, Ibadan; University of Lagos, Akoka; Obafemi Awolowo University, Ile-Ife; University of Nigeria, Nsukka; and Ahmadu Bello University, Zaria University (Thomas & Oladejo, 2017). Presently in Nigeria, most private and government sectors have equipped their classrooms with modern technologies like video, television and computers, although a major challenge is lack of skilled teachers to use the technologies effectively in teaching (Siddiquah & Salim, 2017). Although Nigerian teachers have access to ICTs in their schools, there is lack of expertise on the use of technology, which is a major barrier to effective integration of technology in teaching and learning (Ibrahim, Talba, & Danjuma, 2018).

According to Tayo, Thompson and Thompson (2016), technology has great impact in the everyday life of Nigerians in all facets. It has changed the learning system as students and teachers have access to relevant teaching materials from developed countries which can be adopted and adapted to suit the Nigerian context. Also, learning is not confined to the classroom; learners can access learning anytime and anywhere. Most schools in Nigeria, are now fully equipped to give children a solid head start in the use and application of A to Z software and apps to enhance their education and explore the limitless wonders that technology has to offer.

In addition, Ejike (2017) affirmed that technology use has become common in rural communities in Nigeria and among war-displaced children. Some children in the northern parts of Nigeria who were displaced by Boko Haram from attending the normal school system were able to communicate via technology using laptops embedded with online educational apps for learning. Similarly, in the South Eastern Nigeria, technology is used in learning across schools, even in the rural areas through the use of their mobile phones connected to Wi-Fi.

Although the use of technology in Nigeria is increasing, teachers' lack of expertise on the use of technology is a major barrier to effective integration of technology (Ifinedo, Rikala & Hämäläinen, 2020). Hence, there is a need to improve teachers TPACK, contents of pre-service teachers' programmes in higher education in Nigeria for effective integration of technology in Nigerian schools at all levels. This study seeks to explore how ECE lecturers train ECE pre-service teachers in the use of technology. The uses of technology in early childhood education specifically in some countries and in Nigeria is discussed below:

Turkey. According to a study on in-service preschool teachers' thoughts about technology and use of technology in early educational settings by Kara and Cagiltay (2017), they discovered that the computer, projector, overhead projector and TV were the technologies that teachers used in preschool settings, thus they preferred to use various technologies rather than using computers only. The teachers also recognised the visual, audial, concrete, affective, quick and repetitive characteristics of technology. It can be inferred from this finding that teachers are aware of the power of technology having multiple characteristics. On the purpose of using technology, they found that teachers preferred to use technology in storytelling activities, native language activities, math activities, cognitive activities, music activities, science and nature activities, concept teaching, showing cartoons and animations, and art activities and documentaries. On the learning activities, the teachers mostly used technology for supporting teaching and learning activities through searching for educational software or programmes suitable for children; using technology based on their choice; using it to support teaching concepts or objectives; guiding children to use computers at school; preparing pre-lessons using electronic materials; presenting stories or several topics on power point; using their own personal computers at school and for guidance. Based on these findings, teachers mostly use technology for supporting teaching and learning activities.

United States of America. Aladé et al. (2016) revealed that children in early childhood education centres who either played an interactive tablet-based game or watched a non-interactive video demonstrated superior transfer of knowledge than those in a control group. This study thus shows the positive effect of technology in learning in early childhood education. According to Steinhoff (2016), a new survey of early childhood on how teachers use technology in their classrooms revealed that 90% of teachers have access to technology at school and use it always; 88% use technical devices once a week; 80% confirmed they include iPads or tablets for their own use in the classroom; 45% to 51% affirmed they have integrated computers and interactive whiteboards, while the greater number of teachers integrated the use of tablets, desktops or interactive whiteboards to enrich the teaching and learning environment and establish stronger relationships with children on subjects taught in class.

Blackwell et al.'s (2013) study on adoption and use of technology in early education with a sample of 1329 early childhood educators from 48 states using an online survey, discovered that two types of technologies were used. Those that were universally available, like TV/DVDS, laptops, desktops computers, and digital cameras have a higher percentage usage, ranging from 79% to 92%. Secondly, newer technologies like non-video ipods/MP3, ipod touch

devices, e-reader and tablet computers had a lower percentage usage, from 15% to 28%. They concluded that for proper integration of technology in ECE there is a need to increase teachers' technological skills.

Moreover, Bers, Seddighin and Sullivan (2013) in a study carried out in Tufts University, United States, on "Teachers as designers: integrating robotics in early childhood education," presented a constructionist approach to introducing technology, in particular robotics in the early childhood classroom. The authors emphasised that the use of robotics (technology) was well suited since the four basic tenets of constructionism have a long-standing tradition in early childhood education, namely: (a) learning by designing meaningful projects to share in the community; (b) using concrete objects to build and explore the world; (c) identifying powerful ideas that are both personally and epistemologically significant, and (d) instilling the importance of self-reflection as part of the learning process. The article introduced a methodology for teaching pre-service teachers to integrate technology in the classroom. In the same vein, Sullivan and Bers (2016) in their study on robotics in the early childhood classroom discovered that it offered a playful and tangible way for children to engage with both technology and educational concepts during their foundational early childhood years. The results showed that beginning in pre-kindergarten, children were able to master basic robotics and programming skills, while the older children were able to master increasingly complex concepts using the same robotics kit in the same amount of time.

Sweden. Hallström, Elvstrand, and Hellberg (2015) in their study on gender and technology in free play in Swedish early childhood education, discovered that technology education was emphasised in the new Swedish curriculum for pre-school as an important pedagogical area to work with. The observed situation indicated that children use technology in their daily lives in the pre-school, both in circumstances which are arranged as technology exercises by the preschool educators and in their free play (Milne, 2013). In the two pre-schools studied, the children have access to traditional material, for example, Lego and wooden railroads as indoor games, while outdoor games were ropes, jars and pipes. The teachers likewise effectively assembled diverse natural construction materials not initially intended for children's play, for example, sticks and cones aimed at empowering development play. Irrespective of the age of the children, they were allowed to choose the type of material they needed to play with. The younger children normally had a few confinements for security reasons, for instance, they were not permitted to play with small pieces of Lego. The sand-box was the central place for relating to technology when the children played outdoors (Sundqvist & Nilsson, 2018). Children

moulded sand cakes, built roads for transporting different types of things roads. Preschool children of all ages are naturally attracted to sand box. In their indoor games both boys and girls engaged in numerous types of construction play. Many factors determine how children handle technology in their indoor games, such as their age, the type of game they like playing and the acceptable games in the preschool policy, and the available space and time in the school for play. For instance, in the municipal pre-schools, children are allowed to play around classrooms and even carry indoor toys outside, although in private schools they are restricted to playing in an organised way and only on certain designated areas. Some schools provide children with various kinds of materials in boxes to arouse children's interest in changing roles in their play: one box can contain barbing tools, another box a small car and so on. These create ample opportunities to support children's' developmental characteristics.

Conclusively, in many countries technology has been emphasised as an important aspect of early childhood curricula, in recent years although most of the teachers in ECE centres lack expertise in technology (Sundqvist & Nilsson, 2018). According to Kerckaert, Vanderlinde, and Van Braak (2015), more authors these days were convinced that technology provides multiple possibilities for young children in early childhood education. They point to the growing evidence that technology presents new space for exploration, discovery, challenging exercises to young children that respond to their curiosity. Moreover, Toh et al. (2016) stated in their paper that educational robots influence children's development skills in four different ways, namely: cognitive, conceptual, language and social collaborative skills. Gormley and McDermott (2015) conducted a study focusing on teachers' use of technology during reading instruction. The researchers found that many teachers used the technology instructional tools to "…display multimedia content, generate interactive learning activities, focus student attention, display texts for shared reading, and individualized learning activities" (Gromley & McDermott 2015, p. 121). The researchers found that the technology instructional tools offered teachers many resources and allowed for lessons to run smoothly; however, the researchers felt that there was room for higher-level and more creative thinking activities that were not present during the observations conducted.

2.3.3 *Use of Technology in Early Childhood Education*

Technology plays a pivotal role in children's development and learning (Willmann, 2017). Through the use of technology, teachers have access to more innovative and improved teaching methods that allow them to promote learning and create an active learning environment for

children (Alakärppä et al., 2017). In addition, Willmann (2017) described interactive technology in the classroom as a means to avoid distraction. These tools can be used to help children concentrate on activities. Child-computer interaction is a learner centred approach where children can take the initiative to explore and learn a multitude of information in many subject areas. These multimedia tools equipped with animation, digital photography, and videos have proven to improve motivation and interests of students at the early childhood education level (Willmann, 2017). Moreover, Yilmaz (2016) asserted that the early childhood education curriculum incorporates play time for children, which help child development. He commented on the impact of technology such as digital toys, which have done good work in shaping preschool children's experiences, enhancing their hand-eye coordination, cognition, imagination, effort and remoulding their behaviours.

Furthermore, Brunsek et al. (2020) in their study of in-service teachers discovered that the quality of learning correlates with the teachers' expertise to use technologies. Burnett (2010) in his research review on technology and literacy in early childhood educational settings discovered that there have been developments in research into literacy and technology for young children; however, there is a need for more research to investigate children's use of a wider range of technologies.

Kermani and Aldemir (2015) in their study affirmed the need for proper integration of technology in early childhood education for the following reasons:

- Children who were exposed to technology in their early life education have a solid foundation for their future learning.
- Children from low-income families, who were not exposed to quality early childhood education, perform at lower levels in language, technology, mathematics and engineering (STEM) subjects.
- Children have better opportunities to utilise their natural curiosity and excel in every area of their development when they are exposed to high quality child care with proper technology integration.

According to Sultanee (2017), integrating technology reinforces key technical skills that children need to thrive in the 21st century such as reading ability, math fluency in manipulation of figures, digital story creativity and accountability. It is essential to provide early leaners with enough time to play, create and utilise their imaginative abilities. However, teachers should ensure that students learn how to use modern technologies in this constantly advancing world.

Integrating technology properly and adequately, has not only reinforced key technical skills children needed to develop in the 21st century, but also increased students' commitment and improved learning. Listed below are ten technological devices that early childhood teachers can use to accomplish better results in the classroom.

1) Interactive websites: There are a lot of engaging sites for early learners that reinforce key educational concepts. Starfall is a phonics-based site for kids' pre-K through first grade that intends to create and fortify reading abilities. ABC Ya Cookie and Fuel the Brain feature age-appropriate educational games and activities covering all subject areas. Math Magician and XtraMath help kids improve their math fluency with addition, subtraction, multiplication and division. Suessville, named for Dr. Suess, include children-friendly activities as well as information about the author's books and motivating characters. These self-directed sites require little or no teacher assistance and will keep children actively engaged both at school and at home (Reinen, 2013).
2) Enriching apps**:** School iPad carts are available for teachers to use in the classroom, although some schools have Bring Your Own Device (BYOD) policy. All the same, bringing iPads into the classroom is an excellent way to generate excitement about learning. iPads enhances learning for children; for example, 'Best Apps For Kids' features some of the best apps by age, grade level and subject matter. Also, "Top 10 Educational Apps for pre-schoolers" features reviews by a former teacher and mother, highlighting both paid and free apps for preschool children (Reinen, 2013).
3) Educational video sites: With the availability of current educational videos via the click of a mouse, teachers no longer needed to search their school library's archaic VHS OR DVD collections. Educational videos like BrainPOP Jr and Discovery Education feature academic videos designed for learning objectives and particular age groups. Also, TeacherTube, a media site similar to YouTube, helps teachers to share instructional materials such as videos, audio recordings and photographs and SafeShareTV is a student-friendly filter that takes away the unpleasant elements sometimes surrounding YouTube clips (Reinen, 2013).
4) Online Organisation: This format like Symbaloo solves the problem of lost papers, as it helped teachers to gather and organise the most commonly used websites on their computer desktops as graphical tiles. It can also help teachers manage their excellent resources and significantly improve the ability of readers who are struggling to navigate the desktops on students' computers. In addition, LiveBinders is a visual binder for the

web, useful for collecting resources and making them available for both students and parents (Yen et al., 2019).

5) Interactive whiteboards: Electronic touch boards such as the Promethean board and SMART board allows teachers and students to manipulate items on a large screen using electronic pens, bringing a new level of interactivity to classroom instruction. Promethean Planet offers over 60,000 free teaching resources for the Promethean board, while SMART Exchange shared a myriad of activities for the SMART board. Teachers also created their own lessons and broadcast media from the Internet, including academic videos or energising clips that promote movement like those featured in 20 Brain Break Clips: Fight the Fidgeting. The possibilities are endless (Akar, 2020).
6) Digital storytelling: Several websites encourage children to tap into their creative imaginations to produce digital stories online. Story Bird support children in creating visual stories with artwork; Little Bird Tales provides a medium for students to design and narrate their personal work; and Zimmer Twins carry it further by helping kids produce their own animated tales. Digital storytelling has not only kept children engaged, it also encourages higher-level thinking (Kuonanoja & Oinas-Kukkonen, 2018; Yilmaz, 2016).
7) Collaborative resources: Another source of memorable learning experiences for children is communicating with classes in other schools, districts, states and countries. Using Skype, children can hold video chats with other students over the Internet. The social platform Edmodo has connected classes so they share materials and access information easily and safely. ePals Global Community connected over half a million classrooms around the world. While students can still benefit from writing to traditional pen pals, these sites may offer a level of cultural contact deeper than what the written word can convey (Austin, Hampel & Kukulska-Hulme, 2017).
8) EBooks: In addition to the high-interest texts that classrooms provide, teachers could take advantage of the many sites featuring popular kids' books online, such as Disney Digital Books, TumbleBooks, and We Give Books. Storyline Online, a special site run by the Screen Actors' Guild Foundation, shares videos of famous actors and actresses reading well-known children's books (Meyers, Nathan & Stepaniuk, 2017).
9) Virtual timers: Timers can help set a tone of accountability and assist students in self-regulation and completing their work. Online Stopwatch offers a range of teacher timers, clocks, and countdowns for display on the computer screen and/or interactive

whiteboard. Tick Tock Timer, Egg Timer, and Timerland are other options for tracking time (Reinen, 2013).

10) Online Behaviour Systems: Behaviour management software can help teachers manage their classrooms online. An example is Class Dojo, which allows teachers to award points to students for participating, helping others, exercising creativity, showing great insight, working hard, and making a good presentation. The software could be accessed from a tablet or smart phone in addition to the teacher's school computer. Class Dojo is especially helpful for teachers who manage more than one group of children (Dillon et al., 2019).

11) To get the most from the new technology and hold the very short attention spans of little ones, it is important to avoid technical difficulties and to have a solid understanding of the functions and features of new technology before making use of it. Teachers should think deeply about how each tool may enhance their students' abilities to reach their personal goals. Approached properly, technology need not be intimidating; rather, it can catapult its users to new heights. As teachers, we must embrace the technology that shapes our world. To develop life-long learners in our classrooms, we must be life-long learners ourselves (Manolev, Sullivan & Slee, 2019).

In recent years, research in science and technology are incorporating studies in early childhood education. Researchers have observed the lack of technologies in early childhood activities. Hallström, Elvstrand and Helberg (2015) emphasised the need for early introduction of technology in preschool children to arouse their natural interest and self-confidence in technology usage.

2.3.4 *Advantages of Technology*

There are advantages and disadvantages of the use of technology in education and early childhood education in particular. With children becoming familiar with technology at increasingly early ages, it is imperative that researchers uncover the effects that these tools have on emergent literacy development. On the advantages of technology, it is advantageous as it can be used anywhere at all times and has the potential for children's learning and development (Lauricella, Blackwell & Wartella, 2017). In addition, Yilmaz (2016) affirmed that technology, like educational magic toys, is of great importance as it helps shape the experiences of children, enhances their imagination and affects their behaviour positively. Also, digital toys are advantageous as they integrate multimedia materials in traditional toys.

Takacs, Swart and Bus (2015), in their meta-analysis, compared technology-enhanced stories on young childrens' literacy development to listening to stories in traditional settings like storybook reading. They affirmed that the use of technology-enhanced stories improved their understanding more than mere reading of story books.

Furthermore, Zomer (2014) studied the use of technology in early childhood education with children aged 3-6years and discovered a positive effect of technology on learning, literacy development, social interactions, mathematics skills, sequencing, visual perception, creative thinking and fine motor capability in young children. This is in line with Sharkins et al. (2016), who also discovered that technology-enhanced learning of children on his study on young children and technology. Similarly, it was observed that children who received media -rich literacy supplements using television clips had greater performance on letter recognition, phonics, print and story concepts (Penuel et al., 2012). Moreover, Kara and Cagiltay (2017) in their research found that the advantages of using technology in young children were:

- improved attention span of children;
- improved cognitive skills;
- catered for different learning styles;
- improved psychomotor skills;
- improved motivation;
- allowed for hands-on learning;
- allowed for rehearsal learning; and
- helped children transfer their knowledge to real life; and
- improved creativity.

It can be inferred that by considering these advantages, teachers believe the support and contribution of technology to children in many areas.

2.4 Teachers' Perceptions and Attitudes towards the Use of Technologies

Teachers' perceptions about the role of technology in education are essential for teachers' pedagogical reasoning. As such, it is obvious that unless teachers perceive the importance of technologies, they will be reluctant to use them meaningfully (Nikolopoulou & Gialamas 2015; Tondeur et al., 2017). Whether technology will be integrated in the classroom or not depends on the teachers' views and intentions, while effective integration of technology is dependent on teachers' training and competence (Nikolopoulou & Gialamas, 2015).

The study conducted by Park et al. (2017) uncovered teachers' mixed feelings when exploring their knowledge, beliefs, and practices in using technology with young children. Park et al. (2017) indicated that teachers believed in the importance of integrating technology in their daily lessons. However, findings also indicated that they have the feeling of inadequacy in their preparations to incorporate these technologies in a successful and meaningful manner. With these mixed feelings being manifest in the research, they had a negative attitude towards the use of technology.

Nikolopoulou and Gialamas (2015) in their study on teachers' perceptions of barriers to the use of technology in early childhood settings, discovered lack of funding, lack of technical and administrative support, as well as inadequate training opportunities as major barriers in the use of technologies. In contrast to the above findings, Aldhafeeri, Palaiologou and Folorunsho (2016) in their study of teachers' views, attitudes and aptitudes of technology integration into play-based pedagogy in early childhood education in Kuwaiti, discovered that although the teachers were competent in the use of technology, and there were sufficient technological resources in ECE centres, the teachers were reluctant to integrate technology in their teaching because they believed that technologies do not belong in a play-based pedagogy. In line with this, Mertala (2019) observed in his analysis of pre-service teachers' perceptions of the use of technologies in early childhood education, that the pre-service teachers could accept or reject the use of technology in the classroom based on their beliefs in its importance for that particular lesson. According to Jeong and Kim's (2017) investigation into the teachers' perception of the use of technology in kindergarten schools in South Korea, they found that teachers are more likely to use technologies in their lessons when they feel that the technologies are easy to use and are useful to enhance the lesson.

Moreover, Liu and Pange (2015) deduced from their study that teachers perceived that the barriers to their use of technologies were lack of hardware (for example, laptops, computers), lack of teaching content and materials, lack of pedagogical models, and lack of the teachers' interest and support. However, Baydas and Goktas, (2016) in their study, found that teachers have a positive attitude towards the use of technology because of its perceived importance, including: it saves time, contributes to the concretisation and visualisation of lessons, increases students' interests, and makes lessons more entertaining.

Hsu et al. (2017), carried out a survey on in-service teachers' beliefs about game-based learning and perceptions of technological pedagogical and content knowledge of games. It was

revealed that younger teachers have a more positive attitude towards the use of technology than the older teachers. As such, younger teachers integrate technology more in their lessons.

In a recent study to investigate pre-service teachers' perceptions on the use of technology in teaching mathematics after they attended training programme that combined technology, pedagogy and content knowledge, it was observed that there was a significant difference in their perceptions towards the use of technology. As a result, it was concluded that training that incorporates technological, pedagogical and content knowledge during pre-service training develops pre-service teachers' perceptions on the use of technology in mathematics teaching (Akkaya, 2016).

In same vein, an investigation of the attitudes of pre-service teachers towards technology based on various variables showed that pre-service teachers' attitudes towards the use of technology were positive, and their attitudes showed significant differences based on various demographic variables (Birkollu et al., 2017).

Thomas and Oladejo's (2017) research on teacher-trainees' perceptions of ICT integration in Nigeria's teacher education programme revealed that teachers believe that teaching requires modern technologies to provide more flexible and effective ways of improving teacher education. Also, that integration of technology into teachers' education is the key to equipping and producing professional teachers as well as improving pedagogy. This was in agreement with Mertala's (2019) research on teachers' beliefs and technology integration practices. He synthesised 35 qualitative empirical research studies via the method of meta-ethnography, and found that teachers believe that technology complements and enriches the curriculum, and transforms teaching and learning to reinforce skills; however, the major barrier to proper integration of technology was teachers' lack of sufficient knowledge and skills. There is a need, therefore to provide ubiquitous technology access to teachers and their students, and that professional developers should focus first on increasing knowledge and skills of the pre-service teachers.

The findings from a study in Nigeria on perceived importance of ICT in preparing early childhood education teachers for the new generation children by Olowe and Kutelu (2014), revealed that ECE lecturers and pre-service teachers are of the view that preparing teachers to use technologies help them facilitate the cognitive, physical and social-emotional development of children. In addition, children can be motivated and their interest in the lessons sustained in the learning activities by the use of technologies.

Ndibalema's (2014) study on teachers' attitudes towards the use of information communication technology as a pedagogical tool in secondary schools in Tanzania, revealed that the teachers believe that ICT could be used as a pedagogical tool to enhance their teaching when there are sufficient resources and infrastructures. As such, the teachers had a more positive attitude towards the use of technology.

Kara and Cagiltay (2017) asserted that in-service teachers recognise the advantage of using technologies as it makes the teacher's job easier, allows the teacher to use different materials, accelerates teaching, helps the teacher in classroom management and saves time. However, these scholars also noted that the lack of high-quality resources and crowded classrooms impinged the use of technologies in their classrooms. Moreover, teachers were having difficulties as they were uncertain how, when and where technologies could be incorporated into the content to be taught, and how to link technologies to their existing pedagogy.

If in-service teachers are encountering uncertainties with when and how to use technologies in their teaching, it is quintessential to gain a deeper insight into how ECE lecturers train the ECE pre-service teachers in their use as well as their level of integration into the pre-service ECE teachers' curriculum. The next section unveils how technologies are used in teacher training institutions.

2.5 Teacher Training Institutions and the Use of Technologies

Teacher education refers to the educational programme basically designed with a view to equipping the would-be teachers with the attitudes, skills, and knowledge required of them to perform their tasks effectively in the classroom, school, and wider community (Zeichner, 2017; Thomas & Oladejo, 2017). In many educational systems, teacher education programmes are the main environments in which pre-service teachers learn how to teach and prepare to enter the profession (Osler & Starkey, 2017). Thus, they need to observe, interpret and analyse teaching during the initial teacher education period.

Teacher training programmes underscore three dynamic fundamentals, which prepare would-be teachers to possess and establish the knowledge, skills and personalities required to be an operational teacher (Creasy 2015).

Nelson, Voithofer, and Cheng (2019) emphasised that teacher education programmes need to provide pre-service teachers with additional and alternative technology training programmes,

which will help pre-service teachers learn how to use technologies as instructional tools to enhance their teaching and students' learning.

The use of technology in teaching and learning in teacher education promotes reflection, and is helpful in learning effective classroom practices. The analysis of videos of teaching, for instance, can enhance the development of prospective teachers' professional vision, which, in turn, improves instruction (Osmanoglu, 2016). The use of technology is increasing in significance in educational programmes, not only to support teaching and learning but also as a subject of its own. In this perspective, it is strongly believed that to effect a real change in the classroom and produce competent and effective teachers, teacher training institutions must modify their devices, techniques and methodologies by integrating modern technologies (Tondeur et al., 2017).

According to Thomas and Oladejo (2017), there is need for modern technologies in teaching to provide more dynamic ways of improving teacher education and connecting teachers to a global network. Integrating technology into teacher training is a way for preparing and developing competent teachers as well as improving pedagogy.

2.6 Training Pre-service Teachers to Use Technology

Pre-service teacher education is the education and training provided to student teachers before they can engage in any teaching. The need to teach pre-service teachers in an early childhood education department and other departments in teacher training institutions, and how to use technologies has been the concern of most researchers in many parts of the world (Brun & Hinostroza, 2014; Tondeur et al. 2016; Nelson, Voithofer & Cheng 2019). Regrettably, the study by Voogt and McKenney (2017) in the Netherlands, on how five teacher training institutes are helping students to develop the TPACK needed to effectively integrate technology in early childhood education, revealed that currently, little attention is given to inculcating technological knowledge that is needed by pre-service teachers to integrate technology in early literacy. This is due to some factors such as: lack of modern technologies in teacher training institutions; lecturers still struggling with the use of technology; and despite the availability of technological and early literacy specialists, there is a distinct lack of technology use in their institutions.

In a qualitative study, carried out to find the impact of technology on pre-service teachers, it was discovered that its use helped pre-service teachers to internalise their lessons and built

confidence in them as they prepared to teach children with the same tools (McGee & Welsch 2020). If teachers are competent and technology-literate, they would be more willing to use efficient and appropriate technologies to enhance their teaching and learning (Onyema, Ogechukwu & Anthonia 2019).

Andyani et al. (2020) discovered in their research that when pre-service teachers were taught to use technologies, they changed their views of its infusion into their teaching, from thinking that they would teach and learn about technologies to thinking they could use technologies to support student learning. Bruno, Scott, and Willis (2018) also confirmed greater performance by pre-service teachers who were taught using technological tools than traditional lecture methods.

However, it is not sufficient for pre-service teachers to learn about different applications of technology, as they should be able to interpret these applications and apply them correctly when required in a specific educational context (Tondeur et al., 2017). Pre-service teachers should be able to collaboratively observe, discuss and reflect on successful uses of technology, which can help them realise the usefulness, significance and possibility of preferring to use one type of technology for a particular lesson to ensure proper integration. In order words, pre-service teachers must be knowledgeable in content, pedagogy and technology in order to decide the appropriate and effective technology to be used for a particular lesson or subject matter, based on its content and pedagogy (Tondeur et al., 2020).

Akinwale et al. (2017) asserted that since teacher education is designed specifically for getting the teachers ready for future classroom lessons, and after graduation; therefore, lecturers who are preparing these pre-service teachers for the workforce must be acquainted with the modern technological drive in the 21st century and transform their old conceptions and methodology to suit the need of the learners. Otherwise, teachers and teaching would be become out-dated, which would have a devastating and deteriorating effect on the quality and standard of teacher education. Pre-service teachers from the start of their vocation, therefore, need to develop a vision for using computers in their classrooms. As such, they should be taught technological operations to an appreciable degree that would enable them to develop a vision for the significance and use of technology in education (Thomas & Oladejo 2017).

Furthermore, it was observed that the new teachers' adoption of technology is greatly influenced by the quality and quantity of their pre-service technology experiences. To put it plainly, new teachers with more encounters utilising innovation in bona fide encouraging

settings during their educator training programmes seem bound to overcome obstructions commonly experienced in their first teaching experiences. It is very important, therefore, that pre-service teachers have intensive and thorough training on how to use technology during their teacher training programme for better performance in the workforce (Ottenbreit-Leftwich et al., 2018). Hence, different educational organisations and governments in Africa are putting emphasis on teachers' development as the key to technology implementation to improve the standards of education. They are expected to integrate and use technology adequately in their classrooms and thus implement the required pedagogical changes (Hennessy et al., 2015). Olowe and Kutelu (2014) also asserted that for the immense benefit of technology in the development of children's cognitive, social and emotional domains to be achieved, their teachers must have the professional skills and experiences needed. This was the reason, why the NAEYC and Fred Rogers Center for Early Learning and Children's Media in their joint position statement, emphasised that teachers must be knowledgeable and prepared to make informed decisions about how and when to appropriately select, use, integrate and evaluate technology and media to meet the cognitive, physical, emotional, social and linguistic needs of young children.

It presumes, therefore, that training pre-service teachers to use technology requires urgent attention. This might be the reason behind the introduction of ICT Competency Standards for Teachers (ICT-CST) by the UNESCO (United Nations Educational, Scientific, and Cultural Organisation) in January 2008, published by UNESCO (Kozma & Isaacs 2011). However, there are some factors which could deter the use of technology in training the pre-service teachers.

Summary of Chapter Two

This chapter presented a review of literature relevant to the study. A review of a body of literature was important as it creates an understanding of the topic under investigation, the relevant concepts and variables in the study, and the understanding of how it has been researched, or grasped. The focus in the literature review was given to literature that bears on themes related to the research study's sub-research questions. This was done in order to ensure critical and extensive engagement with the literature relevant and appropriate to the study. The literature review was thematically informed; six themes that were developed theoretically were critically examined. The review of empirical studies drew on the West, other African countries and finally in Nigeria, as discussed above.

CHAPTER THREE

THEORETICAL FRAMEWORK

3.1 Introduction

This chapter dealt with the theoretical framework underpinning this study. A theoretical framework is any theory of social and/or psychological processes that can be applied to the understanding of phenomena (Anfara Jr & Mertz, 2014). It allows the researcher to view what seems to be ordinary and familiar in new and different ways. A theoretical framework presents and portrays the theory that clarifies the existence of the research problem under study (Swanson & Chermack, 2013). Mishra and Koehler (2006) stated that Technological Pedagogical Content Knowledge (TPACK) is a form of knowledge that is different from the knowledge of a technology expert and also from the general pedagogical knowledge of a teacher. Rather, it is knowledge that helps teachers to understand how to teach a particular topic using a particular type of technology. Thus, this study which sought to explore how early childhood education lecturers train pre-service teachers to use technologies at a Nigerian university is framed by Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK, hereafter) framework.

This chapter provides an overview of TPACK framework, elaborates the rationale for the use of TPACK and its application to this study, and discusses how this framework informed the data analysis process with a view to explaining the findings of the study.

3.2 An Overview of TPACK

Technological Pedagogical Content Knowledge (TPACK) is a theoretical framework that explains the interaction and integration of technology, pedagogy, and content knowledge needed to successfully integrate technology use into teaching (Niess, 2016). According to Koehler et al. (2014), this framework highlights some vital qualities of teacher knowledge needed for integration of technology in teaching, as well as handling the complex, multifaceted and situated nature of knowledge. Koehler et al. (2014) further asserted that to use technology meaningfully in a pedagogical context, there is a need for a development of a complex, positioned form of knowledge such as Technological, Pedagogical, and Content Knowledge (TPACK). The TPACK framework has been used widely in many studies; for example:

Muir, Callingham, and Beswick (2016) conducted a study on using the Interactive White Board (IWB) in an early years' mathematics classroom. The framework of TPACK was used

to evaluate the teacher's use of the IWB to teach mathematical concepts in children's early years.

Knolton (2014) in an exploratory study of adjunct faculty technology proficiency at Kansas State University, Manhattan, US, applied TPACK in a quantitative research to investigate whether a relationship existed between technological pedagogical content knowledge (TPACK), pedagogical training and personal technology.

Salavati (2016), in another study conducted in Sweden, employed TPACK framework to illuminate and advance the understanding of the complexity of compulsory school teachers' everyday work practices using technologies.

Mouza et al. (2014) conducted research in the United States in which TPACK was employed to analyse the pre-service teacher knowledge (TK, CK, TCK, PK, PCK, TPK and TPACK).

Voogt and McKenney's (2017) research conducted in the Netherlands explored how pre-service teachers were being prepared to effectively use technology for fostering early literacy. TPACK was also employed to describe the knowledge base required for effective use of technology in teaching and learning.

Blackwell, Lauricella and Wartella (2016), in their study in the United States, employed TPACK to access factors that influence early childhood educators' tablet computer use.

Altun (2019), in his study in Turkey, employed TPACK to investigate pre-service early childhood education teachers' competencies regarding digital literacy skills and their technology attitudes and usage.

Park and Hargis (2018) in their study, employed TPACK to investigate the affordances of iPad transpired within four early childhood educators with varying Technological Knowledge (TK) at a low-income preschool.

In this study, TPACK is described as the kind of knowledge pre-service teachers should acquire to integrate technology into pedagogy and content knowledge for effective and efficient teaching and learning. It represents the combination of content knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK) (Koehler, et al. 2014, Niess 2016).

This framework was built on Lee Shulman's (1986, 1987) construct of pedagogical content knowledge (PCK) (Koehler, Mishra & Cain, 2013). Shulman (1986) first claimed that teachers

needed content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK). The PCK describes how and why teachers' knowledge of content and pedagogy cannot be considered as separate entities. Rather, the teacher needs to have a mastery of the relationship between content and pedagogy in order to plan methods that will facilitate students understanding of the content (Koehler et al., 2013). Mishra and Koehler (2006) extended Shulman's (1986) work by adding technological knowledge (TK) and used the term TPACK. Therefore, including technology as basic knowledge must be acquired by the teacher for effective instruction, as good teaching requires an understanding of how technology (like chalkboards, digital computers, television, overhead projectors) relates to the pedagogy (the process and practice or methods of teaching and learning) and content (the actual subject matter that is to be learned or taught) (Koehler, et al. 2013). The collaboration of these bodies of knowledge, both in theory and in practice, produces the kinds of flexible knowledge required to effectively incorporate technology use into education (ibid). The TPACK framework consists of seven domains: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK) (Mishra & Koehler, 2006). Basically, there are three major knowledge components that form the foundation of the TPACK framework which are: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK).

The TPACK framework suggests that teachers should have a deep understanding of each of the above components of knowledge in order to orchestrate and coordinate technology, pedagogy, and content into teaching. Most importantly, TPACK is an emergent form of knowledge that goes beyond knowledge of content, pedagogy, and technology taken individually but rather exists in a dynamic transactional relationship (Koh, Chai, Benjamin, & Hong, 2015; Niess, 2016, 2018) between the three components (Koh et al., 2015). Although the TPACK model diagram (Figure 3.1) situated the interconnecting rings/circles in an area marked "context", the model did not specify or define this context. Hence, I argue, that TPACK's theorisation does not include room for explaining teachers' socio-cultural backgrounds when investigating pedagogical practices (the argument is expanded in Chapter Eight).

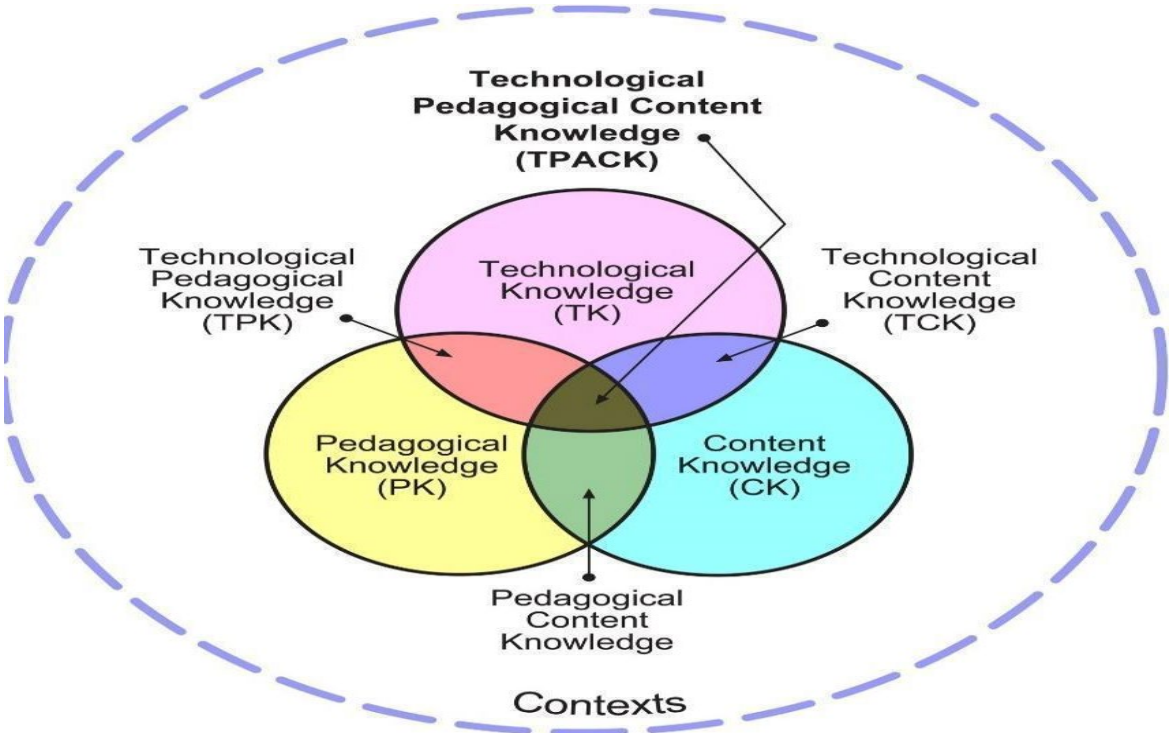

Figure 3.1: The TPACK Framework and its Knowledge Components

Source: Herring, Koehler and Mishra (2016): Handbook of technological pedagogical content knowledge (TPACK) for educators.

A review of the seven components that constitute this framework is presented in detail below:

Content Knowledge (CK). Content knowledge is knowledge of the actual subject matter that is to be learned or taught as postulated by Shulman (1986). The content to be covered in early literacy is not the same content that will be covered in early numeracy. It is vital that ECE teachers must know and understand the subjects that they teach, including knowledge of central facts, concepts, theories, and procedures within a given field; knowledge of explanatory frameworks that organise and connect ideas; and knowledge of the rules of evidence and proof (Koehler, Mishra & Cain, 2013). ECE teachers must also understand the nature of knowledge and inquiry in different fields. For example, how is a proof in numeracy different from story telling or a literary interpretation? ECE teachers who do not have these understandings can misrepresent those subjects to their pre-schoolers (Koehler, et al. 2014, Herring, Koehler, and Mishra 2016). However, Shulman (1986) asserted that teaching starts with the teacher's comprehension of what must be learned (CK) and how it must be taught, and as such, introduce the idea of pedagogical knowledge (PK).

Pedagogical Knowledge (PK). Pedagogical knowledge (PK) is an in-depth knowledge of the processes and practices or methods of teaching and learning and how it envelops, among other things, overall educational purposes, values, and aims (Koehler et al., 2014). This is a generic form of knowledge that involves all issues of student/pre-schooler learning, classroom management, lesson plan development and implementation, and student evaluation. It includes knowledge about techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating learners' understanding. A teacher with deep pedagogical knowledge understands how children/students construct knowledge, acquire skills, and develop habits of mind and positive dispositions toward learning. As such, pedagogical knowledge requires an understanding of cognitive, social, and developmental theories of learning and how they apply to pre-schoolers/students in their classroom (Koehler et al., 2014; Herring et al., 2016). Furthermore, Shulman (1986) introduced the idea of a correlation between CK and PK which is represented by two circles intersecting each other as shown in (Figure 2), which is the genesis of Pedagogical Content Knowledge (PCK).

Pedagogical Content Knowledge.

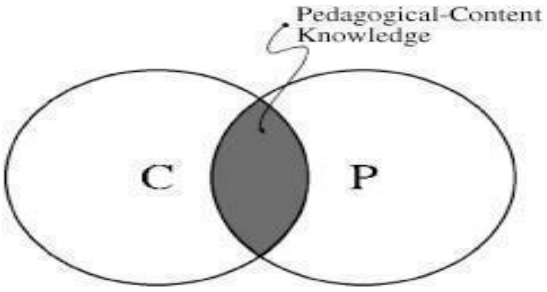

Figure 3.2: The Two Circles of Pedagogical Knowledge and Content Knowledge now Joined by Pedagogical Content Knowledge

Source: Mishra and Koehler (2006, p.6). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers' College Record*, *108*(6), 1017-1054.

The idea of pedagogical content knowledge (PCK) is consistent with and similar to Shulman's idea of knowledge of pedagogy that is applicable to the teaching of specific content. This knowledge includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching. This knowledge is different from the knowledge of a disciplinary expert and also from the general pedagogical knowledge shared by teachers across disciplines (Koehler et al., 2013). PCK is concerned with the representation and formulation of concepts, pedagogical techniques, and knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories

of epistemology. It also involves knowledge of teaching strategies that incorporate appropriate conceptual representations in order to address learner difficulties and misconceptions and foster meaningful understanding. It includes knowledge of what the students bring to the learning situation, knowledge that might be either facilitative or dysfunctional for the particular learning task at hand. This knowledge of students includes their strategies, prior conceptions, misconceptions that they are likely to have about a particular domain, and potential misapplications of prior knowledge (Koehler et al., 2014, Herring et al., 2016). Based on Shulman's (1986) statement regarding pedagogical content knowledge (PCK), Koehler and Mishra (2006) introduced the conceptual framework of integrating educational technology into pedagogy and content, bringing to light TK, TCK, TPK and TPACK discussed below.

Technology Knowledge (TK) Technology knowledge (TK) is knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies, such as the Internet and digital video. This involves the skills required to operate particular technologies (Koehler et al., 2014). In the case of technologies, this includes knowledge of operating systems and computer hardware, and the ability to use general technology/computer software such as iPhones, iPods, iPads, digital media, interactive app and mobile devices. TK entails having a diverse set of technology skills and knowledge such as knowledge of using technology and digital media to plan activities with young children. Most standard technology workshops and tutorials tend to focus on the acquisition of such skills (Herring et al., 2016). Since technology is continually changing, the nature of TK needs to shift with time as well. For instance, many of the examples given above (iPad app, iPods, iPhones etc.) may change, and may even disappear in the years to come. The ability to learn and adapt to new technologies (irrespective of what the specific technologies are) will still be important (Koehler et al., 2014; Herring et al., 2016).

Technological Content Knowledge (TCK). Technological Content Knowledge (TCK) is knowledge about the manner in which technology and content are reciprocally related. Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology. For example, consider iPad apps, iPad photos and videos as a tool for teaching pre-schoolers numeracy and literacy. It enhances learning about butterflies, numbers, shapes, vocabulary building, language development and letter formation. By allowing pre-schoolers to 'play' with

the iPad app, changes the nature of learning. Children see learning as fun, as they use the iPad app to practise their math skills, vocabulary skills, shapes, numbers and more; which was not available prior to this technology (Park & Hargis, 2018). Similar arguments can be made for a range of other software products (Koehler et al., 2014, Herring et al., 2016).

Technological Pedagogical Knowledge (TPK). Technological pedagogical knowledge (TPK) is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies. This might include an understanding that a range of tools exists for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. This includes knowledge of tools for maintaining assessment, class records, attendance, and grading, and knowledge of generic technology-based ideas such as a mobile app, interactive white boards, and iPods (Koehler et al., 2014; Herring et al., 2016).

For example, using appropriate technology and methods that are appropriate for the particular developmental level of the child because, for instance, some story telling app like the "Toontastic" and Educreations app for practising writing and presentation of YouTube videos to children requires adjustments depending on the developmental level of the children in the class to avoid complication (Park & Hargis, 2018).

Technological Pedagogical Content Knowledge (TPCK). Technological pedagogical content knowledge (TPACK) is an emergent form of knowledge that goes beyond all three components (content, pedagogy, and technology). This knowledge is different from knowledge of a disciplinary or technology expert and also from the general pedagogical knowledge shared by teachers across disciplines (Koehler et al., 2014). TPACK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that learners face; knowledge of learners' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones (Koehler et al., 2014, Herring et al., 2016).

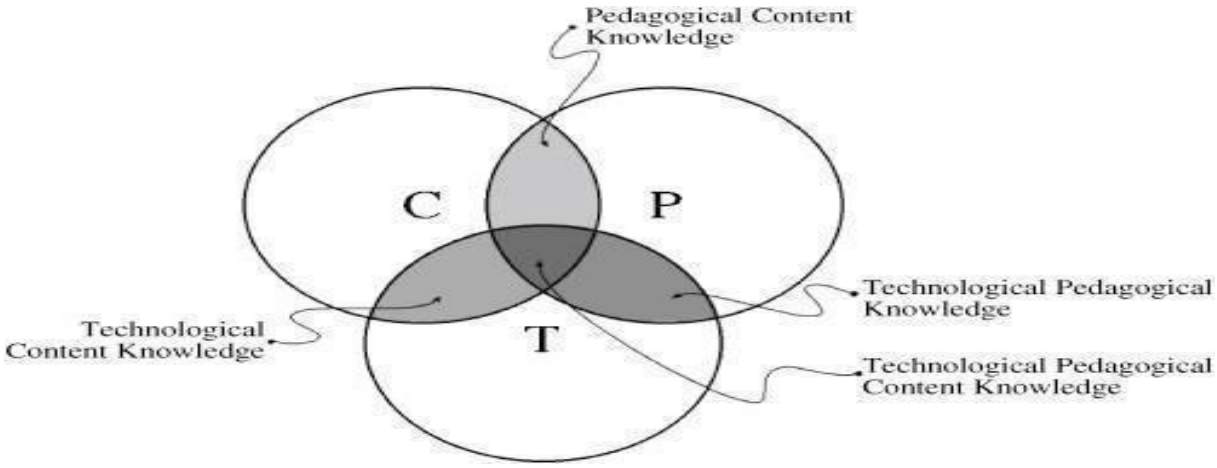

Figure 3.3: Pedagogical Technological Content Knowledge. The Three Circles, Content, Pedagogy and Technology, Overlap to Lead to Four More Kinds of Interrelated Knowledge.

Source: Mishra and Koehler (2006, p.9). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers' College Record*, *108*(6), 1017-1054.

Based on the three main knowledge categories for teachers (i. e., content, pedagogy, and technology), TPACK emphasises the dynamic interaction and integration of knowledge with the use of technology. It describes its use of to support specific pedagogies within a particular content area. Additionally, TPACK describes the use of technology as an instructional technique. Finally, it describes its use to help teachers improve student learning (Koehler et al., 2014, Herring et al., 2016; Govender & Khoza 2017). According to Gur (2015), for proper and effective integration of technology in education, teachers/lecturers and pre-service teachers should imbibe the seven constructs of TPACK, which is the rationale for choosing this framework for my study, as shown below.

3.3 Rationale for the Use of TPACK as the Framework in the Study

The TPACK framework explains various categories of knowledge that should be acquired by the teachers in order to teach with technology and how these bodies of knowledge interact with one another. Hence, teachers must understand the interrelationship of technology, pedagogy and content in order to reproduce the kind of knowledge that goes beyond the three separate knowledge bases (Govender & Khoza, 2017; Herring et al., 2016; Koehler et al., 2014).

Teaching with technology requires an adaptable framework that explains how emerging technologies can be effectively integrated into the pedagogical approaches and content areas (ibid). According to Özgür (2020), the TPACK framework is concerned with knowledge of technology and integration of technology holistically in the teaching and learning process.

Since this study seeks to explore how ECE lecturers train ECE pre-service teachers to use technology, it is suggested that they (teachers) have a holistic knowledge of the content, pedagogy and technology for effective teaching and learning which is in line with TPACK framework.

The relevance of technology integration into content and pedagogy of ECE cannot be overlooked, as it is the cornerstone for successful teaching and learning in an early childhood education programme. The study therefore advocates for the integration of technology into the content and pedagogy of teaching and learning in early childhood education. The understanding that teaching is a complex activity is the basis of my theoretical framework.

According to Gur (2015), pedagogical content knowledge has been considered as a pivotal support for professional development of teachers in teacher education. Teachers should increase in new knowledge and skill acquisition to keep pace with increasing educational demands in this 21st century. Furthermore, Gur (2015), asserted that technological pedagogical knowledge clarifies how technology can be used to shape the teaching methodologies. Many researchers have adopted TPACK theoretical framework in various educational areas and it has shown promising results in the integration of technology in teachers' practices.

In this study, knowledge about content (C), pedagogy (P), and technology (T) is central for developing good teaching and that good teaching requires an understanding of how technology relates to the pedagogy and content (Niess, 2018). This implies proper interaction and integration of the bodies of knowledge in each lesson plan and practice.

According to Andyani et al. (2020), TPACK has a positive influence on teachers and pre-service teachers' intention to use technology in a technology-integrated learning and teaching setting. In addition, Kent and Giles (2017) also asserted that teachers who developed TPACK will be more confident to select and use technology in an appropriate way in their instruction.

Koh et al. (2015) affirmed that teachers should be knowledgeable in the application of TPACK in the classroom to develop in their students the required 21st century competencies.

Moreover it is assumed that pre-service teachers' traits such as technological pedagogical content knowledge (TPACK) go together with the impact of their teacher training (Tondeur et al., 2017). TPACK is therefore relevant for this study to ascertain the extent to which this vital characteristic is inculcated into the pre-service teachers during their teacher training programme.

Many researchers have recently realised the need to better align pre-service teachers' preparation in the integration of technology with pedagogical issues and curriculum integration (Tondeur et al., 2017). According to Tondeur et al. (2017), this resulted in teacher training institutions employing certain techniques to develop pre-service teachers' TPACK such as using teacher educators as role models, learning technology by design, scaffolding authentic technology experiences. Students' interest in the subject increases when teachers integrate technology into the instruction. Hence, teachers should have a deeper knowledge in identifying the subject matter to be taught with appropriate technologies and suitable teaching strategies, thus applying TPACK in the classroom.

3.4 Application of TPACK to the Study

The data generated in this study was analysed by applying content analysis, bearing in mind the seven constructs of my theoretical framework, namely: Content Knowledge (CK) , Pedagogical Knowledge, (PK) Technological Knowledge (TK), Pedagogical Content Knowledge (PCK) , Technological Content Knowledge (TCK) , Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK). Each construct represents a foundational knowledge type for teachers. According to Mishra and Koehler (2006), teachers who apply technology into teaching should not only have the foundational knowledge types, but also use them either in a pair or triadic fashion by understanding the dynamic interaction and relationship of each of the three knowledge types (Technological Content Knowledge: TCK, Technological Pedagogical Knowledge: TPK, and Technological Pedagogical Content Knowledge: TPACK).

3.5 Summary of Chapter Three

This chapter dealt with the theoretical framework underpinning this study, that is, the Technological Pedagogical Content Knowledge (TPACK) of the lecturers. TPACK was revealed in this study as an essential attribute which lecturers and pre-service teachers must possess for an effective and efficient teaching and learning process. It discussed the formation of TPACK from PCK, which was initially postulated by Shulman (1986) because there cannot be an all-round development of the educational domains of learning without the integration of technology. A review of the seven components that constitute this framework was also presented in detail. Moreover, the rationale for the theory to the study, its application to other studies and how this framework informed the data analysis process with a view to explaining the findings of this study were highlighted.

The next chapter, elaborates, explains and justifies the methodological approaches that were used to explore how early childhood education lecturers train ECE pre-service teachers to use technologies at a Nigerian university.

CHAPTER FOUR

RESEARCH METHODOLODY

4.1 Introduction

This chapter elaborates, explains and justifies the methodological approaches that were used to explore how early childhood education lecturers train ECE pre-service teachers to use technologies at a Nigerian university. According to Flick (2015), research methodology unveils the different stages of a study from data generation to analysis. The chapter considers the following aspects of methodology: structure of the study, paradigm, approach, the design, location of the study, sampling, data generation techniques, triangulation, ethical considerations, validity and reliability, limitations of the study and ends with a summary of the chapter.

4.2 Structure of the Methodology

The methodological structure of the study, its location, approach, nature of study and methods of data generation were depicted in Figure 4.1 below. Thereafter, each methodological choice is explained.

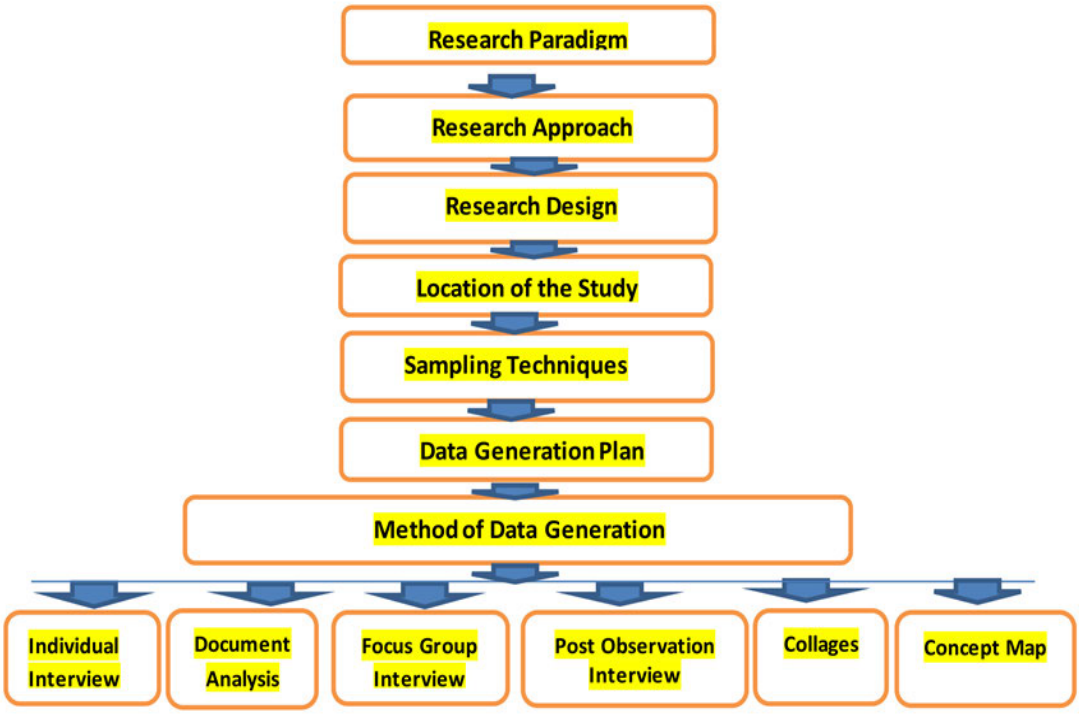

Figure 4.1: The Methodological Structure of the Study

4.3 Research Paradigm:

A paradigm deals with one's perception or understanding of reality (Kitchin, 2014). Cohen, Manion and Morrison (2017) asserted that a research paradigm defines and influences the research process and outcomes in several ways, such as decisions to be made regarding the nature of the phenomenon explored, theoretical framing, literature, methods or research design.

Thus, a paradigm deals with a researcher's consideration of how to explore the problem identified so that the results are credible (Creswell & Creswell, 2017). This study sought to explore how early childhood education (ECE) lecturers trained ECE pre-service teachers to use technologies and lay within the interpretive paradigm. My paradigmatic choice was influenced by three factors, as depicted in Figure 4.2 below.

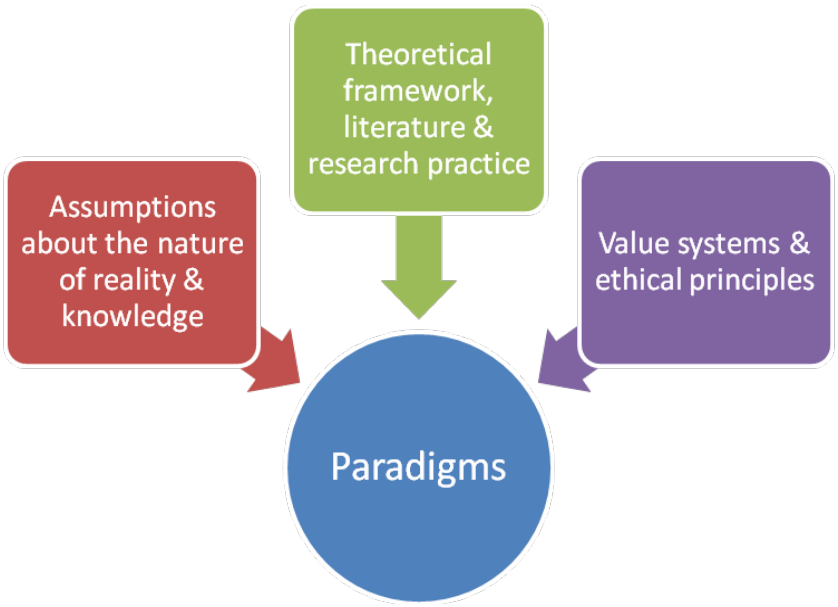

Figure 4.2: Factors Influencing the Choice of a Paradigm

Source: Chilisa and Kawulich (2012). Selecting a research approach: Paradigm, methodology and methods. *Doing Social Research: A Global Context*, *5*(1), 51-61.

A key tenth of the interpretive paradigm is that it seeks to understand the subjective world of human experience and derives meaning from that shared experience (Cohen et al., 2017). Likewise, Bertram and Christiansen (2014) contended that the purpose of an interpretive paradigm is to develop a better understanding of how people make sense of contexts in which they live, work and learn. This means that researchers employing an interpretive paradigm aim to describe and make sense of social phenomena, such as people's opinion and experiences from the perspective of the participants. Therefore, the interpretive researcher, interacts with participants to derive meanings from their lived experiences. Additionally, Rahi (2017) emphasised that the interpretive researcher uses open-ended research questions, focuses more on qualitative data to derive meanings, uses a small sample to get a rich in-depth understanding of the participants experiences, does not generalise the findings but seeks to explore the meaning which participants attach on the social situation being explored. Thus, in this research, the interpretive paradigm enabled me to gain a deep insight on how ECE lecturers train pre-service ECE teachers to use technologies.

I believe that the reality to be studied consists of people's subjective experiences of the external world, therefore this study focused on their experiences using an ontological stance towards reality, and relied on methodologies such as in-depth individual interviews, focus groups and document analysis. Furthermore, aligned with the interpretive paradigm, qualitative methods were used to understand and interpret meanings, actions and situations. Conclusively, the choice of a paradigm is based on one's perception of reality, what you know and how you know it, in line with the theoretical perspective(s) of the study, the literature that exists on the subject, and one's value system (Chilisa & Kawulich, 2012).

4.4 Research Approach

This study employed a qualitative research approach. Qualitative research approach allows for smaller-scale studies using a small sample with an aim to do an in-depth study of a phenomenon (Flick, 2018). In my choice of research approach, I was guided by the ontological position of the interpretive paradigm. Ontology is the idea about how we interpret our physical world and ourselves as human beings (Yom, 2015). The qualitative approach embraced the notion of multiple social realities which aligns with the interpretive paradigm. Qualitative research offers suitable approaches when seeking to know or interpret in-depth understanding of a real-life phenomenon, such as human subjective experiences, contexts or conditions of living, social behaviours, understanding or conceptions, views and perspectives on social issues (Flick, 2018). Creswell (2014) agreed that qualitative research is concerned with understanding participants' views, experiences, beliefs, ideals, thoughts and actions of social or human problems.

This study adopted a qualitative research approach in order to gain deeper insights into what technologies ECE lecturers use to train ECE pre-service teachers, how and why these technologies are used the way they are.

Justification for a qualitative research approach for the study. The essential features of qualitative research makes it relevant for this study as enumerated below by Flick (2018):

- correct choice of appropriate methods and theories;
- recognition and analysis of different perspectives;
- researchers' reflections on their research as part of the process of knowledge production; and

- variety of approaches and methods.

Qualitative research in its descriptive nature gives room for an in-depth understanding of the experiences of the participants, which will either support or confront the theoretical assumptions on which the study is based.

Qualitative research was deemed suitable for this research project as the purpose of this study was to explore how ECE lecturers train ECE pre-service teachers to use technology. The aim was to explore a particular experience without presenting the findings as the absolute truth but as one way in which ECE lecturers train pre-service teachers in the use of technology.

4.5 Research Design:

The research design embraced in this study was a case study. Yin (2017, p. 25) defined case study research as an "empirical inquiry that investigates a contemporary phenomenon within its real life context in which multiple sources of evidence are used". Case study focuses its findings on a single entity, which can be a person, group/s or organisation, event, action, or situation. According to Creswell (2014), a qualitative case study explores a bounded case or a case through in-depth data collection over time, which involved various sources of information, each with its own sampling, data collection and analysis strategies.

In this study, the case explored is how ECE lecturers train ECE pre-service teachers to use technologies in their teaching. The context is bounded to the ECE pre-service teacher training programme at a Nigerian university (CB university), (Pseudonym).

Hancock and Algozzine (2017) explained that a case study entails a narrative report and comprises of rich thick descriptions of experiences. This was relevant to this study because the researcher was able to describe the experiences and activities of the participants and as such create awareness of the context and factors that enable and inhibit their use of technologies in the training of ECE pre-service teachers.

4.6 Location of the Study.

The study was based at CB University (pseudonym) in Lagos State Nigeria, in the South Western geo-political zone of the country. The institution has six faculties, namely, faculties of Agriculture, Arts, Education, Law, Science and Social Sciences. This study was conducted in Faculty of Education, specifically in the Department of Early Childhood Education. The university offers full-time and part-time studies to both the undergraduate and post graduate

students in all the faculties. The student population of the university is about 100,000. The duration of the ECE teacher-training programme is four years. Approximately one hundred students enrol for this programme yearly from all over Nigeria but the majority of ECE pre-service teachers are females.

Figure 4.3: Map of Lagos State Showing Main Urban Areas

Source: Lagos-state-map onelagosfiesta.ng

There are eight lecturers in the ECE department who were the primary data source in this study.

4.7 Sampling Technique:

Yin (2014) defined sampling as a selection of participants to address the research purposes. In agreement with Yin (2014), Gentles et al. (2015) defined sampling in qualitative research as gathering of information from a selected group of participants to gauge answers in response to the research questions posed. Similarly, Bertram and Christiansen (2014) asserted that sampling involves making proper decisions about which people, settings, events or behaviour to be included in a research study for data collection.

There are different types of sampling techniques, but this study employed purposive sampling to select the participants to generate relevant data to respond to the research questions. Purposive sampling, according to Maniram and Maistry (2018), as well as Etikan, Musa, and Alkassim (2016), is a deliberate act of choosing a participant based on the attributes he/ she possesses. It is not done randomly; the researcher finds the people who can give relevant information needed for the study based on their experiences or knowledge. The selection criterion for the participants in this study was that they had to be ECE lecturers at CB University. The purposive sampling technique was a deliberate attempt to choose a particular set of participants considered to possess the entire required attribute to elicit the information needed. Simply put, the researcher determined what needed to be known and identified the

right people qualified to give the required information voluntarily, based on their knowledge or experience (Etikan et al., 2016).

This study sought to explore how ECE lecturers train pre-service ECE teachers to use technologies; thus, the following data sources were purposively selected: ECE curriculum / course pack for an early childhood teacher education programme at a CB university; and the eight ECE lecturers at CB university who lecture from year one to four of the ECE teacher training programme (there are only eight ECE lecturers at CB university). Fraenkel, Wallen, and Hyun (1993) asserted that qualitative researchers prefer using purposive sampling since they are able to select the participants they deem fit to provide the information they need. The eight lecturers by virtue of their years of experience were purposively chosen as they would be able to answer the question on the how and why they train pre-service teachers in the use technology during their teacher training programme in the university.

4.8 Data Generation Plan

Lewis (2015) defined data generation as an exercise of gathering a set of interrelated information in order to answer the research questions posed. Thus the importance of data generation cannot be overemphasised as it is meant to contribute to a better comprehension of a theoretical framework (Bernard, 2017). It is therefore important that decisions on how the data will be obtained and from whom the data will be obtained, and be reasonably and carefully done as no amount of analysis complements inaccurate collection of data (Etikan et al., 2016). This simply means that for the researcher to get the right information concerning a study, the right participants/data sources and instruments must be selected. In this study, an interview schedule, observation schedule (for lesson planning and the delivery of the lesson), post-observation interview, document analysis, collages, concept maps and focus group interviews were used as instruments for data generation, while the data source comprises the ECE lecturers and the ECE lecturers' teaching portfolio.

To answer the research questions posed, data was generated in three phases as reflected in Table 4.1.

Table 4.1: Data Generation Plan

Research question	Phase	Data source	Data generation method	Data analysis
1) What technologies are used by ECE lecturers to train ECE pre-service teachers?	1	ECE Lecturers ECE Curriculum	Individual interview Document analysis	Content analysis
2) How do ECE lecturers use these technologies to train pre-service teachers in terms of content and pedagogy?	2	ECE Lecturers ECE lecturers teaching portfolios	Observation Individual interview Document analysis	TPACK Constructs & Content Analysis
3) Why do ECE lecturers use these technologies the way they do to train pre-service teachers?	3	ECE Lecturers	Collage Concept map and focus group interview	Content Analysis & TPACK Constructs

The above table shows the research questions, the data source, data generation instrument and method of data analysis employed.

4.9 Data Generation Methods

The following data generations methods were used in this study.

4.9.1 *Interviews*

Cohen et al. (2017, p.349) defined an interview as an "interchange of views between people on topics of mutual interest that may assist in answering the research questions". The most commonly selected method of data collection for qualitative research is interviewing (Adhabi & Anozie, 2017). According to Flick (2018), a well-planned interview creates an accepting environment that puts participants at ease, allowing them to thoughtfully answer questions in their own words and add meaning to their answers. This study adopted a qualitative approach, and individual face-to-face interviews were conducted with eight ECE lecturers from CB University. Face-to-face interviews are useful because they allow opportunities for the researcher to probe participants' responses and for the researcher to note non-verbal cues which accompany the verbal responses (Sullivan, 2012).

Creswell and Creswell (2017) explained that there are three types of interviews, namely, structured, semi-structured and unstructured. Creswell and Creswell elaborated further on these three types:

- Structured interview – this type of interview is controlled by the interviewer and contains predetermined questions that have fixed wording in a specific order.
- Semi-structured interview – the interviewer utilises an interview schedule that guides the interview. The addition of unplanned follow-up questions (probes) is allowed. This type of interview is less controlled by the interviewer.
- Unstructured interview – this type of interview in very flexible and informal in nature with the interviewer having a general area of interest, but allows the conversation to develop.

For my study, I chose to use semi-structured face-to-face interviews which were audio-recorded. I chose this type of interview because it afforded adequate flexibility to probe responses. In this way I was able to gain a rich and in-depth understanding of how ECE lecturers train pre-service teachers to use technologies in terms of pedagogy and content within the ECE programme at CB University. Semi-structured interviews allowed me to probe more deeply and to seek clarity on certain issues (Iyamu, 2018). This resonates with Alshenqeeti's (2014) view that through interviews, detailed information about a phenomenon can be elicited.

Furthermore, individual face to face interviews would enable the researcher to elicit information from those participants who may feel shy speaking out in groups. A semi-structured interview schedule (see Appendix 5) was used to guide the interview process.

The ECE lecturers were used as a primary data source to ascertain what technologies were used by ECE lecturers to train ECE pre-service teachers. These ECE lecturers have over ten years of lecturing experience to ECE pre-service teachers from year one to four and as such could give responses to the research question on what technologies were used by the ECE lecturers to train ECE pre-service teachers in CB University.

Wyse (2014) expands on the advantages and disadvantages of interviews. The following are some of the advantages of interviews:

- It gives the researcher the freedom to add follow-up questions during the interview.
- The researcher is able to 'hear' more than just the 'response' from the participant. The researcher has the opportunity to observe the participant's body language.
- An interview can be an outlet for participants to give their views or vent their feelings and emotions.
- More often than not, interviews provide the researcher with useful, rich data for analysis.

The following are some of the disadvantages of interviews:

- An interview can be seen as time-consuming, as time should also be allocated for transcription of the interview.
- Analysing data can prove to be problematic.
- If an interview is not strictly controlled, there may deviate away from the point of focus.

In my study, I was able to overcome the aforementioned disadvantages by allocating sufficient time for the interviews, transcription and analysis of data. The use of a carefully designed semi-structured interview schedule ensured the interviews did not deviate too much from the central focus of the study. I generated the data personally, and I was always mindful of the critical questions which framed the study. The main intentions of conducting the individual semi-structured interviews were to triangulate data, and to elucidate and elaborate on lessons observed.

4.9.2 *Document Analysis*

Bowen (2009) mentioned that document analysis involves a careful study of documents in order to understand tin depth the meaning conveyed by the content. In addition, Yin (2014) asserts that documents can provide information which supports details from other sources.

According to Cohen et al. (2017), primary documents and secondary documents are the two types of documents used in documentary study. Primary documents refer to eye-witness accounts produced by people who experience the particular event or behaviour we want to study, while secondary documents are those whose authors are not eye witnesses but people who compile the information in the document from interviewing eye witnesses or reading primary documents.

In this study, both primary and secondary documents were analysed. CB University ECE curriculum, ECE lecturers teaching portfolios of CB University were used to gain insight into what technologies ECE lecturers use to train pre-service teachers in terms of pedagogy and content knowledge. The ECE Curriculum was examined to note the technology that lecturers were expected to use to train pre-service teachers. I also noted goals of these in terms of the use of technologies in the training of pre-service teachers.

Additionally, analysis of ECE lecturers' teaching portfolios was conducted. Some of the aspects included in the document analysis schedule (see Appendix 16) were:

- Do the module outlines/ curriculum/teaching portfolio incorporate the use of technologies in terms of pedagogy and content knowledge?
- How and when in terms of context and content?

The lesson plans of ECE lecturers were also analysed. Some of the aspects included in the document analysis schedule, relating to the lesson plans were recorded (see Appendix 15 to 17):

- Does the lesson plan incorporate the use of technologies?

Zina (2021) enumerated two techniques that should be adopted during document analysis with the intent of data generation:

- Interview technique: here the researcher tries to derive answers to his questions from the documents by highlighting the answers within the texts.
- Content analysis or noting occurrences by quantifying the use of particular words, phrases and concepts.

Document analysis has both advantages and limitations as described by Bowen (2009, p.31). Document analysis has the following advantages:

- Document analysis is less time-consuming and therefore more efficient than other research methods. It requires data selection, instead of data collection.
- Document analysis is cost-effective. The data (contained in documents) have already been gathered, what remains are for the content and quality of the documents to be evaluated.
- The researcher's presence does not alter what is being studied when analysing documents. Thus documents are said to have "stability".

Bowen (2009) suggests that document analysis as a method is limited by the lack of detail in documents to enable deep responses to research questions. However, Bowen argues that insufficient detail is a minor limitation which is outweighed by advantages of document analysis, the latter which include the fact that this method is not prohibitively expensive, and is highly effective. In this study multiple methods of data generation were used to answer the research questions. Documents were not used in isolation, which facilitated the attainment of sufficient in-depth data for a detailed response to each research question.

4.9.3 *Observation.*

Observations entail being present in a situation and recording impressions of what takes place, then interpreting the meaning of the observed behaviour (Cohen et al., 2017). Observations take place in real-world settings, where programmes are subject to change and redirection. With fieldwork observations, researchers are in direct contact with the setting and the people they are observing. This direct observation gives researchers first-hand experience and thus enables them to generate detailed descriptions of the setting, the activities, interactions and participants' experiences. Observation also allows the researcher to compare what is written in official programmes to what actually takes place. First-hand experience on site is also important in providing insights that might be missed if the researcher relied only on other people's descriptions of the setting (Creswell & Creswell, 2017). Good inquiry through observation thus documents what is actually happening. Through direct observation, a researcher sets out to document, accept and understand the complexities of a changing situation, including what may be unanticipated but emerges as important in understanding the participants' experiences.

Observations are considered a direct method for understanding the natural processes of teachers' planning and teaching (Cohen et al., 2017). Cohen et al., (2017, p. 396), emphasised

that observation "offers a researcher the opportunity to gather 'live' data from naturally occurring social situations", specifically by looking directly at what is happening, instead of relying on second-hand accounts. Cohen et al. (2017) point out that observation potentially produces more valid or authentic data than that obtained through reading a second-hand account. Likewise, the strength of observations is that it gives direct access to social interaction.

In light of the aforementioned ideas, an observation schedule was designed with the assistance of university researchers to focus on how ECE lecturers plan their lesson and how they teach them (see Appendix 6 for observation schedule).

The purpose of lesson observations was to gain insight into the ECE lecturers' practice with regard to the use of technologies when training pre-service teachers and to capture any possible disjuncture between the curriculum and their practice in terms of training the latter to use technologies in their teaching. The semi-structured observation schedule enabled the researcher to gather data on the programme settings. The programme setting involves the curriculum and pedagogical style. The interactional setting involves formal and informal, planned and unplanned verbal and non-verbal interactions that take place during observation (Cohen et al., 2017). It focuses on how the lesson was introduced, methods used in teaching, how pre-service teachers' needs are catered for, as well as the kinds of activities in which they engage. Observation of the 'think aloud' planning of lessons was to gain insights into the rationale behind their decisions made in the planning of the lesson in terms of the use of technology and pedagogy.

Observation is advantageous in that it can help the observer take cognisance of things that have become routine to the participants themselves, which may lead to understanding the context. It is useful in discovering some facts which the interviewees may not willingly release. Observations are also conducted to triangulate emerging findings; that is, they are used in conjunction with interviewing and document analysis to substantiate the findings (Merriam & Tisdell, 2015).

4.9.4 *Collage*

A collage is a piece of art made by sticking various photographs and other materials on a poster or similar backing, which represents feelings and experiences about the situation depicted (Summers, 2016). The use of art as a data generation method is a technique on the rise in qualitative research (Mayaba & Wood, 2015). Using art as a research method provides

researchers with an insight into the lived experiences of the participant and a means to understand how they make meaning of these experiences; they also provide a powerful intervention to engage participants in the construction of alternative realities (Mayaba & Wood, 2015). Collages, or rather the images in the collage, allow for access to different levels of consciousness, many conversations with self and others, thereby communicating a holistic picture of "what is", or the reality of an experience (Khanare & De Lange, 2017). A wide variety of magazines were provided to the ECE lecturers from which to source pictures for their collages.

To create the collages, ECE lecturers sat in groups of four (two groups were formed) and collectively looked through magazines, newspapers, catalogues for pictures and words (Khanare & De Lange, 2017). The intention of this exercise was to choose pictures or images that best capture their experiences of using technologies to train ECE pre-service teachers. They also cut out words and sentences that add to what they aim to articulate through their collages. As a group they looked at images compiled by each member of the group and collectively made choices based on what best expressed their experiences of using technologies to train ECE pre-service teachers. They collectively created the collage as they negotiated and debated over its construction of the collage. If pictures could not be found in the magazines to express their experiences pertaining to the use of technologies, then they were asked to draw a picture/ representation of their experiences. Two collages were produced. Each group of lecturers transcribed meanings from their collages into concept maps.

4.9.5 *Concept Maps*

Concept maps are described by Trochim (2017) as graphical tools for organising and representing knowledge. O'Sullivan and Dallas (2017) describe concept mapping as a technique that can demonstrate how people visualise relationships between various concepts, and therefore provide a visual representation of dynamic schemes of understanding within the human mind. According to Yelich Biniecki and Conceição (2016), concept maps have been used by educators and students to acquire new knowledge. Beckers et al. (2018) affirmed that concept mapping avails the researchers the opportunity to efficiently analyse, arrange and synthesise knowledge on the problem under investigation. In agreement with this, Waltz et al. (2015) stated that concept mapping is designed to analyse complex problems by integrating qualitative inputs from various sources to clarify such qualitative data or problems. In addition Conceição, Samuel, and Yelich Biniecki (2017), stated that concept map can be used as a

framework to conduct research as it helps to clarify relationships and as such gives a desired result via a standardised data-set according to the issue being addressed.

Each group of lecturers transcribed meanings from their collages into concept maps. The main images from the collages were numbered consecutively and thereafter, the sets of related concepts will be grouped together. This allowed ECE lecturers to represent an understanding of relationships between important sets of concepts pertaining to their use of technologies in the training of pre-service teachers.

Thereafter, information from the collage and concept maps were used to build questions for focus group discussion.

4.9.6 *Focus group interviews*

I opted to use a focus group interview as it allowed the researcher to further probe and gain insight into the participants' collage and concept map with regard to why they train pre-service teachers to use technologies in the way they do. Furthermore, the focus group interview generated debates amongst the ECE lecturers when they presented their practice on the use of technologies within the ECE teacher training programme. The focus group interviews were video recorded to capture both verbal and non-verbal information. Newcomer, Hatry and Wholey (2015) explains that interviewing is about talking and listening. It is about paying attention. It is about being open to hear what people have to say. It is about being non-judgmental. It is about creating a comfortable environment for people to share. In other words, the researcher had to be careful and systematic with the information in peoples' responses. Consequently, a semi-structured interview format was decided upon, which is also referred to as an informal, conversational or soft interview. The focus group interview was used to probe and provide further information about the how ECE lecturers train pre service teachers to use technologies in their teaching.

In this study, the focus group questions were dependent on the collage and concept map produced by the ECE lecturers. The purpose of a focus group interview as a follow up to the expressions on the collages and concept marks by the ECE lecturers on why they use these technologies the way they do to train pre-service teachers. With the help of a focus group interview, the researcher was able to clarify their expressions and any vague expressions will be thrown back to respondents for clarity.

Advantages of focus group interviews. It's easier to get quick information in a focus group interview as only one interview will be scheduled for a group, instead of one for each individual**.** Flick (2018**)** asserted that the main benefit of focus group interview is that they are less expensive yet rich in data as they stimulate the participants and support them in recalling events, which can lead beyond the answers of an individual interviewee.

Focus group discussion is advantageous in generating discussions or debate about a research topic that requires collective perspectives and the meanings that lie behind views discussed, including their experiences and beliefs (Harisha & Padmavathy, 2013; Mfune, 2014). Furthermore, a focus group interview can be used by researchers to explore a research topic and obtain information for use in the later stages of the research (Zander, Stolz & Hamm, 2013). Focus group interviews also helps to clarify findings and produce feedback to research participants (Harrison et al., 2015).

However, Harrison et al. (2015) asserted that focus group discussion is not suitable in cases where group bias is anticipated and where the respondents are uneasy with each other or if they are in danger of social stigmatisation. In such circumstances, participants will not freely air their opinions and some may be unwilling to participate in the study.

4.10 Triangulation of Data

Triangulation of data is a technique of gathering information on the same topic by using more than one method of data generation in order to ensure the validity of the research (Fusch, Fusch & Ness, 2018). Heale and Forbes (2013) stated that the purpose of triangulation of data in research is to establish the confidence in the findings by conforming to the proposition of using two or more methods. Creswell and Creswell (2017) mentioned that by triangulating among various data sources, the accuracy of information can be heightened. What this implies is that all the data are mapped at different perspectives and will converge and be analysed to construct a text. Mandal (2018) supports the use of triangulation by arguing that triangulation by using multiple methods enhances rigour of a study. Moreover, "triangulation is seen as a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study" (Creswell & Creswell, 2017, p. 126). This case study made use of multiple data generating methods that served to triangulate the data, thereby answering the research questions, which enhanced the trustworthiness of my study. Triangulation of data will help to validate the findings of this study by triple-checking the findings from the interviews and the observation with the findings from the documents (ECE

lecturers teaching portfolio and ECE module outline/curriculum). The results from these sources will give more confidence on the validity of the research by drawing an incisive conclusion.

4.11 Data Analysis

Data analysis refers to the meaning-making from data sets (Merriam, 2015). Cohen et al. (2018, p. 83) define data analysis as "reviewing each unit of analysis and categorising it according to the predefined categories". In preparation for data analysis, all audio recordings of interviews, observation of lessons, construction of collages and concept maps as well as focus group interviews were transcribed verbatim.

I engaged in qualitative data analysis. Qualitative data analysis is not a linear process; it is iterative, recursive and progressive. In my study, as I analysed data from the interviews with ECE lecturers I began to notice new trends and patterns that appeared in the observations, collages and concept maps, making the process iterative and progressive. When I had analysed the concept maps, I reverted to what participants had said in the interviews, and I was able to find a convergence between the two. In this way, my analysis was recursive.

The data generated in this study was subjected to content analysis. Content analysis involves the organisation of the data into categories. In my study, coding was used to categorise the data that was generated. Coding is the process of identifying themes or concepts that are in the data. The seven constructs of my theoretical framework, viz Content Knowledge (CK) , Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK) were used to code the data.

I used open, axial and selective coding during content analysis defined below:

- Open coding: the process of breaking down, examining, comparing, conceptualising and characterising data.
- Axial coding: a set of procedures whereby data are put back together in new ways after open coding, by making connections between categories, utilising a code paradigm involving conditions, context, action or interactional strategies and consequences.
- Selective coding: the process of selecting the core category, and systematically relating it to other categories, validating those relationships and filling in categories that need further refinement and development.

These three types of coding were used in my study, in order to look at the dynamic transactional relationship amongst these seven types of knowledge when ECE lecturers use technologies in their training of ECE pre-service teachers. To map the transactional interplay amongst the seven components during data analysis I traced trends and patterns that appeared in the focus group interviews, individual interviews, observations, collages, concept maps and noted them. I observed consistencies and codes that emerged inductively from the data. I searched for those codes that have "internal convergence and external divergence," thus each code was consistent but distinct from one another. I engaged in rigorous, repetitive reading and coding of transcripts to develop key themes. Transcripts were read "horizontally, which involves grouping segments of text by theme" (Flick, 2018). Thus, major themes would be condensed into sub-themes so that they would be convenient to analyse. The data would be engaged with critically, and links within the data would be established.

4.12 Research Rigour

Rigor entails all the steps taken in the study to ensure thoroughness and consistency (Cypress, 2017). If rigour is not ensured, a study is flawed. A step undertaken to ensure rigour in this study was to share the study at a postgraduate supervision cohort session, post graduate student conferences so that it could be critiqued and evaluated by many readers, not just by my supervisor.

Furthermore, to ensure research rigour, data was generated in multiple ways. Other measures taken in this study included member checking used during the data generation stage and data transcription processes respectively. Smith and McGannon (2018) asserted that one of the most used strategies to ensure rigour in qualitative research is member checking, which was popularised by Lincoln and Guba in 1985 within the qualitative research literature. Also, audio data generated in the interviews were transcribed verbatim to ensure accuracy of participants' responses before developing themes. Trustworthiness is discussed next.

4.12.1 *Trustworthiness.*

Trustworthiness is a measure of whether the findings of a research study can be relied on by readers. It speaks to the processes followed in gathering data or information (Daniel, 2018). Bertram and Christiansen (2014) suggested that trustworthiness in qualitative research can be ensured if appropriate research methodology is applied. As this study is a qualitative one, I considered the entire research design to ensure fitness of purpose. In the interviews/ focus

group interviews, my participants were given a chance to restate what they said to be sure that they had meant what they said. The interview questions were open- ended in order not to impose opinions on the participants.

One of the key steps that was taken to ensure trustworthiness is known as 'member checking' (Birt et al., 2016). Birt et al. (2016) suggest that member checking is related to participant reflection, and consists of taking data and interpretations back to the participants in the study so that they can confirm the credibility of the information and narrative account. A popular strategy is to convene a focus group of participants to review the findings, or have the participants view the raw data and comment on their accuracy. For this study, member checking was applied during data generation. The essence of member checking is to make sure that participants can express their views accurately on the phenomenon being explored, and to avoid misinterpretation by the researcher. Interview transcripts were also subjected to member checking. For interviews, member checking is really important because of the possibility of mishearing what was said and to ensure that their views are accurately captured. To ensure member checking, the recorded audio and video were transcribed and the participants were allowed to read the transcription of their interviews and video records to confirm the authenticity and accuracy.

Sutton and Austin (2015) maintained there are no statistical tools for measuring the validity and reliability of data analysis in qualitative research as there are in quantitative research. However, there are other ways of establishing confidence in the findings of qualitative research, which is termed "trustworthiness" of the research. There are four criteria of trustworthiness, namely: credibility, transferability, dependability and confirmability. According to Belotto (2018), credibility deals with how to align the findings of a study with reality. To ensure the credibility of the findings of this study I used multiple data generation methods, engaged in member checking of interview transcripts, and triangulated data obtained. Cohen et al. (2018) add that a study incorporating two or more methods of data collection displays triangulation. To further enhance the credibility of this study I had regular meetings with my supervisor, especially during data analysis to seek consensus and clarify misconceptions. I also shared my analysis during Ph.D. cohort sessions to obtain critique and comments from a wider inter-university academic community.

Kivunja and Kuyini (2017) describe transferability as the extent to which the findings of one study can be applied to other situations (contexts). This study as a case study did not aim to

generalise the findings. Cohen et al (2018) argued that readers must determine for themselves the degree to which the results and conclusions of a qualitative study apply to their current context. Creswell (2014) asserts that transferability is achieved by providing a detailed, rich description of the settings studied to provide the reader with sufficient information to be able to judge the applicability of the findings to other settings that they know. I provided rich descriptions of the context and research design to enhance transferability of this study.

Cohen et al. (2018) stated that dependability deals with the way in which a study is conducted and it should be consistent across time, the researchers and analysis techniques. Dependability is achieved when the researcher details the research design and process so that the study can be replicated in another setting. The detailed research design and the triangulation of data further enhanced the dependability of this study.

Conformability is concerned with establishing that data and interpretations of the findings are not figments of the inquirer's imagination, but is clearly derived from the data. El Hussein, Jakubec and Osuji (2016) highlighted the use of an audit trail to enhance the confirmability of a study. I presented my findings to my supervisor and to critical academic audiences to ensure rigour of interpretation of data. The triangulation of data, according to Johnson et al. (2017), contributes to the confirmability of a study.

4.12.2 *Ensuring Validity of the Research*

Validity in qualitative research refers to the overall authenticity of the research. Unlike rigour, validity speaks to the entire research report rather than merely the process of gathering information in the research. FitzPatrick (2019) proposed that one of the measures of ensuring validity is to include thick or rich descriptions.

Thick description, as described by FitzPatrick (2019), is a procedure used to describe the setting, the participants and the themes in a qualitative research. Furthermore, Lew, Yang, and Harklau (2018) stated that thick descriptions are deep, dense, detailed accounts which helps x-ray the credibility of the research. FitzPatrick (2019) further added that thick description speaks to the confidence with which the readers feel as if they had experienced, or could experience, the events being described in a study. thus bringing the story alive to the reader. The process of writing using thick description is to provide as much detail as possible. In other words, thick description is the ability of the research to connect with every reader of the research report in

the simplest and most comprehensible language. This procedure would influence my study at every step.

4.13 Ethics:

Ethics refers to the system of moral principles by which individuals can judge their actions as right or wrong, bad or good. Social researchers are expected to conduct their research in an ethical manner because research of any kind takes place within a social context (Creswell & Creswell, 2017). This justifies the need to introduce a moral perspective to the way the study was designed and conducted, taking into account the moral, legal context and boundaries placed on topics of investigation (Cohen et al., 2018). In this section, the study addressed ethical considerations as follows:

Gatekeeper permission

The study sought permission from CB University via the dean of the Faculty of Education on behalf of the academic registrar because the target sample was from the School of Education at CB University (See Appendix 2). Ethical clearance from University of KwaZulu-Natal was also obtained (See appendix 1). This meant, therefore, that the data generation process was guided by ethical standards.

Informed Consent

Informed consent was obtained from each ECE lecturer at CB University in writing, with a clear indication that they could at any stage request termination or withdrawal from the research (Descombe, 2014). Participants were informed at the outset that participation in this study was voluntary (see Appendix 3 and 4 for informed consent letter). The principles and rules developed by the Professional Association of German Sociologists and the American Sociological Association for ethics guided this study. These principles include, among others, the following: (1) avoid harm to participants/damage avoidance; (2) avoid misrepresentation, deception/ fidelity/ breach of confidentiality; (3) respect of privacy of participants; (4) avoid stress and discomfort; (5) avoid undue intrusion; (6) have confidentiality of data. The principle of informed consent means that research participants were provided with sufficient and accessible information about the study so that they could make informed decisions as to whether to become involved or decline their participation (Creswell &Creswell, 2017).

Confidentiality and Anonymity

Cohen et al (2018) mention that participants should be assured that they would be protected from physical or psychological harm by the use of pseudonyms. Pseudonyms ensure anonymity and confidentiality of participants, and were used in writing up of this study, for both the institution where the study was conducted and the participants. All responses were treated in a confidential manner. Ensuring that the ethical considerations mentioned above were adhered to, gave the participant the confidence to share their views and experiences of training pre-service ECE teachers to use technologies in their teaching without fear of exposure. Moreover, this assurance contributed to a trustworthy environment, which allowed high levels of participation and openness during the focus group interviews. As a result, participants were quite willing to be involved in the study and saw it as an opportunity to share their experiences of training pre service ECE teachers to use technologies in their teaching.

Data use, storage and disposal

The data would be stored for a minimum of five years in a secure location agreed to by my research supervisor. All transcripts, collages and concept maps would be shredded using a shredding machine after five years. Audio recordings would be incinerated after five years. This written commitment was made to gatekeepers and participants.

4.14 Limitations of the Study

This study involved a case study of CB University so the data cannot be generalised. To overcome this limitation, rich, thick descriptions were provided in terms of the data generated so that the findings could be applicable to a similar setting in Nigeria.

4.15 Summary of the Chapter

This chapter elaborated, explained and justified the methodological approaches that were used to explore how early childhood education lecturers train pre-service teachers to use technologies at a Nigerian university. The following aspects of methodology were explicated: the study employed a qualitative research approach, as this research offers suitable approaches when seeking to know or interpret in-depth understanding of a real-life phenomenon; the research paradigm that guided the study was interpretive, as I aim to describe and make sense of ECE lecturers' opinions and experiences on how they train pre-service teachers on the use of technology from their own perspectives.

A case study research design was employed, and the study was based at a university in Lagos State, Nigeria, in the South Western geo-political zone of the country. A purposive sampling

technique was employed to select participants to generate relevant data that would respond to the research questions.

Data generation techniques that were employed in order for the researcher to get the right information were: an interview schedule, observation schedule; post observation interview; document analysis; collages and concept maps. These were used as instruments for data generation, while the data source comprised the ECE lecturers and the ECE lecturers' teaching portfolio. Ethical considerations, triangulation, validity, reliability, limitations of the study and phases of data analysis were presented.

In the next chapter, the data, analysis and interpretation for research question one are presented.

CHAPTER FIVE

PRESENTATION OF DATA AND DISCUSSION OF FINDINGS: RESEARCH QUESTION ONE

5.1 Introduction

In Chapter Two, I elucidated the numerous studies which emphasised that ECE teachers remain reluctant to use technologies in preschool settings, and researchers have attributed this to insufficient training (Dong, 2018; Weng & Li, 2018). This chapter presents an analysis of data in response to research question one: "What technologies are used by ECE lecturers to train ECE pre-service teachers?" As was mentioned previously in Chapter Four, to answer research question one, data was generated through document analysis of the ECE curriculum of CB University, and interviews with eight ECE lecturers from CB University in Nigeria. The analysis is presented from content analysis of the ECE curriculum at CB University and interviews with ECE Lecturers. The chapter ends with a conclusion of the findings for Research Question One.

5.2 Presentation of Data from CB University ECE Curriculum, Interviews with ECE Lecturers and ECE Lecturers' Lesson Plans.

Content analysis of the ECE curriculum of CB University for the technologies ECE lecturers ought to use to train ECE pre-service teachers was reflected in Table 5.1. below.

Table 5.1:

Technologies to be Used to Train ECE Pre-Service Teachers at CB University

Technologies to be used to train and develop skills in pre-service teachers	CB University ECE Curriculum
Cognitive skills	Television, Audio player, DVD player, Digital Toys, overhead projector, desktop, laptops, E- books, Power Point, internet resources, mobile phone
Affective skills	Television, DVD player, computer- desktop and laptops, overhead projector, Audio player, Digital Toys. Electronic musical instruments, mobile telephone/ cell phones, the internet

Technologies to be used to train and develop skills in pre-service teachers	CB University ECE Curriculum
Psychomotor skills	Television, DVD player, computer- laptop/desktop, overhead projector, electronic musical instrument, internet resources

From Table 5.1. it is visible that the ECE curriculum at CB University stipulates that the following technologies, namely, digital toys, radio, television, tape recorder, electronic musical equipment, computer - desktop/laptop, be used to train and develop ECE pre-service teachers' high level of competence to stimulate cognitive, affective and psychomotor skills in learners they will teach in future.

The expectation is thus for ECE lecturers to train pre-service teachers to be conversant with the use of these technologies during their training. Also, since the ECE curriculum stipulates the technologies to be used when training ECE pre-service teachers, it is expected that these technologies would be available to ECE lecturers for training.

Furthermore, it was observed from Table 5.1. that the ECE curriculum put in the spot-light the same technologies that pre-service teachers were required to use to promote the development of cognitive, affective and psychomotor skills. This finding raises the question on whether the same technologies could be used to develop very diverse skills' sets.

The data collected from the interview is presented in Table 5.2., which highlights the technologies ECE lecturers claim they used in the training of the pre-service teachers.

Table 5.2: Technologies ECE Lecturers Claim to Use to Train ECE Pre-Service Teachers

Technologies Used to Develop	Cognitive Skill	Affective Skill	Psycho-motor Skill
P1	Digital Toys, television/DVD player, desktop/ laptop, Power points, and internet resources and sometimes overhead projector, iPods,	Digital Toys, computer- desktop and laptops overhead projector, Electronic musical instrument.	Laptop, electronic musical instrument
P2	Digital Toys, Television, DVD player and the internet.	Digital toys, Television, DVD player, mobile telephones, laptops	Laptop, the internet, mobile phone
P3	Audio player, Digital toys and Overhead project White board	Digital Toys, Laptops, electronic musical instrument	Computer, Television, DVD player,
P4	Television and DVD player, Computer- desktop/ laptop, the internet and my mobile phone	Digital Toys, mobile telephones, Video, Television, Laptops, the internet	Laptop, television and DVD player, mobile phones, the internet
P5	laptop, mobile phone, the internet	Digital Toys, mobile telephones, Video/ Television, Laptops, the internet	mobile telephones, Video/ Television, Laptops, the internet

Technologies Used to Develop	Cognitive Skill	Affective Skill	Psycho-motor Skill
P6	laptop, television and DVD player, cell phone	Digital Toys, mobile telephones, Video/ Television, Laptops, the internet	Laptop, the internet, mobile phone, overhead projector
P7	laptop, Overhead projector, Television/DVD player, Digital toys.	Digital Toys, mobile telephones, Video/ Television, Laptops, the internet	Laptop, television, DVD player, mobile phones, the internet, overhead projector
P8	laptop and Television/ DVD player, the internet, mobile phone, MP3 player	Digital Toys, mobile telephones, Video/ Television, Laptops, the internet	Mobile phone, the internet, laptop, overhead projector

From Table 5.2. it can be gathered that ECE lecturers at CB university claimed to use the technologies stipulated by the ECE curriculum at CB university. The inference is that these lecturers are acquainted with the requirements of the ECE curriculum for CB University and have the required TPACK to integrate the different technologies in their teaching. It is worth noting that P1, P3 and P8 claimed to use the following technologies respectively: iPod, MP3 player and white board, which are not stipulated in the ECE curriculum at CB University. It means that these three participants were also cognisant of the requirements of the national policy in terms of technologies that should be used to train these teachers (see Chapter One, section 1.1. for content analysis of the Nigerian National ECE policy with regard to technologies to be used to train ECE pre-service teachers). The above finding contributes to an

understanding of how Nigerian national policy on technologies for ECE is interpreted and enacted by ECE lecturers of CB University.

5.3 Findings and Discussion

When the data from the ECE curriculum at CB University was juxtaposed with data from the interviews conducted with ECE lecturers, there appears to be an almost one on one alignment between the technologies ECE lecturers are expected to use when they train ECE pre-service teachers (as stipulated by the CB University curriculum) and the technologies lecturers claimed to use when they train ECE pre-service teachers. This means that the Nigerian national policy goals for ECE learners and ECE pre-service teachers, to participate in and contribute to a highly digitalised society is being met, as there is congruence between the ECE curriculum of CB University and the technologies ECE lecturers claim they use to train ECE pre-service teachers to be digitally literate. The above finding resonates with that of Olofsson, Fransson and Lindberg (2020), who conducted their study in Sweden and found educational policies often emphasise the potential of technology to reform or even transform teaching and learning practices in school and university contexts.

Closer examination of Tables 5.1. and 5.2. highlighted that some of the technologies contained in the ECE curriculum of CB University and those ECE lecturers claim to use were very old and dated. In other words, the ECE curriculum of CB University did not embrace the latest technologies available to promote the skills required for the Fourth Industrial Revolution and raises questions about whether these technologies can be used to train pre-service teachers to teach learners who have access to more advanced technologies (namely, 4IR) than those stipulated in the ECE curriculum at CB University.

In this Fourth Industrial revolution (4IR), technologies have rapidly become an essential part of the daily life of many children. Children as young as 12 months old are assimilating information (about the world) through devices such as television, cellular phones, handheld gaming devices, electronic tablets and laptops (Imazeki, 2014; Livingstone et al., 2014). Technologies have become part of young children's daily life. Therefore, it is quintessential that the pre-service teachers be trained with the latest technologies, so they can then teach the young children effectively with technologies that are part of their lives. It is necessary therefore to teach pre-service teachers in the university with assorted and up-to-date technologies they will use in the classroom in the early childhood centres as the Federal Republic of Nigeria underscores the role that Early Childhood Education **(**ECE) teachers play in the teaching and

learning of various forms of literacy among “learners using technologies” (Sifuna, 2018). The ECE lecturers have an important role to play in the technological competence of the pre-service teachers.

5.4 Summary of Chapter Five

Chapter Five focused on research question 1: “What technologies are used by ECE lecturers to train ECE pre-service teachers?” It was established in this study that ECE lecturers used the following technologies in the training of pre-service teachers, namely: television, DVD player, overhead projector, computer- laptops and desktop, Power Point, internet, mobile phone/ cell phones, electronic musical instrument, digital toys, E-books, iPod, MP3 player and white board. The content analysis of the ECE curriculum revealed similarities in the basic technologies ECE lecturers claimed they used to train pre-service teachers.

Based on the findings, there is a need to integrate more up-to-date technology hardware and software in the ECE curriculum of CB University so that the pre-service teachers can have ample technologies for their training to equip them effectively in their profession.

The next chapter presents the analysis of research question 2: “How do ECE lecturers use these technologies to train pre-service teachers in terms of content and pedagogy”.

CHAPTER SIX

PRESENTATION OF FINDINGS AND DISCUSSION: RESEARCH QUESTION TWO

6.1 Introduction

Nowadays, technological knowledge is no longer seen as a tool used to facilitate teaching and learning processes; it is an important competency required of lecturers (Mishra & Koehler, 2006). Scholars have increasingly shown interest in reviewing how teachers integrate technology in their teaching. According to Mpungose (2020), pre-service teachers' use of technologies in terms of content and pedagogy has become a contested phenomenon in the era of the Fourth Industrial Revolution (4IR). Recent studies have shown the importance of teachers' technological knowledge in order to effectively incorporate technology with pedagogy and content knowledge (Lau, 2018). Moreover, to capacitate pre-service teachers to meet the twenty-first century's educational demands, it is important to equip pre-service teachers with technological skills needed to teach in the Fourth Industrial Revolution (Batane & Ngwako 2017). This is in line with the theoretical framework that underpins this study, as was enumerated by Kohler and Mishra (2006) as follows.

Content Knowledge (CK): This is the actual subject matter that is to be taught and learned (Mishra & Koehler, 2006). It includes the understanding of subjects taught: knowledge of central facts, concepts, theories, and procedures within a given field; knowledge of explanatory frameworks that organise and connect ideas; and knowledge of the rules of evidence and proof (Shulman, 1986; Mishra & Koehler, 2006).

Pedagogical Knowledge (PK): This is deep knowledge about the processes and practices or methods of teaching and learning and how they encompass, among other things, overall educational purposes, values, and aims (Mishra & Koehler, 2006). PK is also a generic form of knowledge that is involved in all issues of student learning, classroom management, lesson plan development and implementation, and student evaluation (Mishra & Koehler, 2006). PK includes knowledge about techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating student understanding, which requires an understanding of cognitive, social and developmental theories of learning, and how it is applied to learners (Mishra & Koeler, 2006).

Technology Knowledge (TK): This is knowledge of operating systems and computer hardware, and the ability to use standard sets of software tools such as word processors, spreadsheets,

browsers, and e-mail (Mishra & Koehler, 2006). TK also includes knowledge of how to install and remove peripheral devices, install and remove software programmes, and create and archive documents (Mishra & Koehler, 2006).

Pedagogical Content Knowledge (PCK): This is different for various content areas. PCK blends both content and pedagogy with the goal of being developed to promote better teaching practices, and overall, it addresses the teaching process (Shulman, 1986).

Technological Content Knowledge (TCK): This is knowledge of how technology can create new representations for specific content. It includes how to characterise, investigate and create the content with technology without consideration of teaching (Valtonen et al., 2019).

Technological pedagogical knowledge (TPK): This refers to how various technologies can be used in teaching, and to understand that using technology might change the way instructors teach. (Valtonen et al., 2019).

Technological pedagogical content knowledge (TPCK): According to Valtonen et al. (2019), TPCK can be defined as the knowledge required by instructors for integrating technology into their teaching in any content area. Instructors have an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK) by teaching content using appropriate pedagogical methods and technologies.

This chapter attempts to answer the second research question: How do ECE lecturers use these technologies to train pre-service teachers in terms of content and pedagogy? In order to answer research question two, data was generated from observation of ECE lecturers' lessons (planning of lessons and teaching of lessons), post-observation interviews with ECE lecturers and document analysis of ECE lecturers teaching a portfolio and ECE programme outline. In the analysis that follows, the biographical data of the lecturers was presented first, followed by individual cases of the three ECE lecturers who agreed to be part of the phase two data generation.

See Appendices 12 to 14 for the complete profile of the factors observed in teaching pre-service teachers how to use technologies by the three lecturers.

Table 6.1: Biographical Data of the Three Lecturers.

	Lily (THA224)	Jay (EST 224)	Zee (EST 417)
Age	45	50	52
Gender	female	male	male
Training Qualification	M.Ed. in Early Childhood Education	M.Ed. in Early Childhood Education	PhD in Early Childhood Education
Years of lecturing	10 years	15 years	20 years
Position	Lecturer	Senior Lecturer	Academic Leader
Special training to use technologies	Once off In-service training in software technologies like Microsoft Word, Microsoft Excel and Microsoft PowerPoint and hardware technology like computer and overhead projector operations	Once off In-service training software technologies like Microsoft Word, Microsoft Excel and Microsoft PowerPoint and hardware like computers and overhead projector operations	Once off In-service Training and personal training in software technologies like Microsoft Word, Microsoft Excel and Microsoft PowerPoint and hardware like computers and overhead projector operations
Technology competence	Not very competent	Not very competent	Competent but not competent in computer robotics

* The names reflected in Table 6.1. are pseudonyms

6.2 Document Analysis of CB University Programme and Module Outline

The documents analysed were the module template for ECE lecturers' lesson plans. The programme template of a qualification reflects all the modules offered within a programme and the module template indicates the module outcomes, content to be covered as well as how technologies are to be used to train ECE pre-service teachers. The module outline is derived from the ECE curriculum for CB University. In Chapter Five the congruent alignment between the ECE curriculum for CB University and ECE lecturers' claims of the technologies they use to train ECE pre-service teachers was noted.

Content analysis of the module templates of the CB University showed that out of the seventy-two (72) modules offered in the ECE programme over four years, only three modules focus on training ECE pre-service teachers in the use of technologies, namely:

- EST 224- Production and Utilisation of Instructional Materials (offered in the second year);
- THA 224- Creative and Cultural Arts II (offered in the second year); and
- EST 417 Application of Computer in Education (offered in the fourth year).

This means that the majority of modules (69) within the ECE programme do not foreground the training of ECE pre-service teachers in the use of technologies to develop cognitive, affective and psychomotor skills, and therefore lack the integration of technologies into the module content. Furthermore, there is a disjuncture between the ECE curriculum of CB University (see Chapter Five for document analysis of the ECE curriculum for CB University) and the module template for the ECE programme offered at CB University. This disjuncture has implications for how ECE lecturers train ECE pre-service teachers to use technologies in their teaching, which would consequently impact ECE pre-service teachers' TPACK. The above identified disjuncture between the curriculum and module templates brings to mind Cirillo et al.'s (2018) studies in five major European countries (Germany, France, Spain, Italy and United Kingdom) in which they asserted that for teachers to be equipped to teach with technologies , the education system must ensure that they acquire the skills needed to teach with them, and that students can only acquire these skills in the use of technologies if they are integrated into the ECE lecturers' teaching. Furthermore, research conducted at an Australian University by Bibi and Khan (2017) identified the lack of integration of technologies into the curriculum as the reason new teachers do not feel sufficiently prepared to use technologies in their classrooms. Also, studies by Kukulska-Hulme and Viberg (2018) in the United Kingdom

highlighted that the quality of pre-service teachers' exposure to the use of technologies for learning sculpts the way they view and use technology once they become practising teachers.

6.3 Cases of each Lecturer on how they Used Technologies to Train Pre-Service Teachers in Terms of Content and Pedagogy

As mentioned previously in Chapter Four (section 4.9.3.), data for observations were acquired via observation of lesson planning and observation of lesson taught. The findings arising from three ECE lecturers' (pseudonyms Lily, Jay, and Zee) data from their post- observation interview and document analysis of their teaching portfolio. Individual cases are presented on how they used the available technologies to train pre-service teachers in terms of content and pedagogy.

6.3.1 *Lily's Case: Creative and Cultural Arts II (THA 224)*

Lesson topic: Creation of poster of a cartoon character

The context: I engaged in direct observation of the planning of lesson on how to create a poster of a cartoon character and the teaching of the lesson. The observation of the planning occurred in Lily's office. Lily's office is neat; there was a table at which she planned her lesson.

The observation of the lesson taught occurred in the ECE laboratory. The lesson observation lasted for ninety minutes. The laboratory walls were very colourful, there were charts and posters hanging on the walls; there were non-digital toys, models of human bodies, a baby cot near the wall; a television and DVD player were placed at one end of the whiteboard in front on an elevated platform, an overhead projector was hanging from the ceiling of the laboratory and a desktop computer on a desk in front of the laboratory. The ECE laboratory was overcrowded, there were 50 ECE pre-service teachers seated in the laboratory built to accommodate 20 students only. Initially, the ECE pre-service teachers were rowdy but became quiet immediately the lesson began.

Planning stage. The objective of Lily's lesson was to create a poster of a cartoon character using Microsoft Power Point via computers. In terms of technological knowledge (TK) Lily was aware of the technologies available to use in the creation of the poster on a cartoon character and showed an understanding of the features of these technologies and how they would be used to create the poster.

With regard to content knowledge (CK) and subject matter that is to be taught and learned. Lily's understanding of the use of technologies in creating familiar art to teach children social skills and moral values was visible. She elaborated "…*it is important for our pre-service teachers to use the different technologies in their teaching to teach children stories about ethic, values, morals, what's right and wrong and to teach them about the Nigerian culture*" (Post observation interview).

In the observation of the planning, Lily alluded to use demonstration as pedagogy to show pre-service teachers how to create the poster; however, she did not indicate how she would manage the time for the activity (in terms of the various stages of the poster creation), for example, *the layout, the background colour, drawing tools, font colour and font size.*

She planned to use technologies such as internet resources, laptop, overhead projector and Microsoft PowerPoint to demonstrate to the pre-service teachers, the creation of a Poster on a Cartoon Character. Lily introduced the lesson by asking the students to mention different cartoon characters they know and their relevance to moral and social lives of people. The pre-service teachers were motivated by the questions and they raised their hands and answered individually with much excitement. The introduction stage of the lesson lasted for approximately ten minutes.

Observation of teaching portfolio. An analysis of Lily's teaching Portfolio[1], revealed that out of the 72 modules offered in early childhood education from year one to year four, she taught 10 modules to year one and two ECE pre-service teachers with Creative and Cultural Arts II (THA 224) being one of the modules at year two. In the creative and cultural arts module, Lily only engaged ECE pre-service teachers in the use of technologies in one activity.

Pre-service teachers being exposed to one lecture or activity in the use of technology limits their opportunity to be trained in the use of technologies. This finding illuminated that the call of the Nigerian policy for the integration of technologies in the training of pre-service teachers was ignored. The above finding is supported by Kukulska-Hulme and Viberg's (2018) study, which highlighted that the quality of pre-service teachers' exposure to the use of technologies

[1] Teaching portfolio: contains all the materials that the lecturer used in her teaching including lesson plans, scheme of work, teaching resources, samples of her students' work, grade from previous assessors, documentation of her teaching, activities to improve instruction, the student evaluations of teaching, and the syllabus.

during their training sculpts the way they view and use technology once they become practising teachers.

Lesson: *Introduction stage*. Lily introduced the lesson by asking the students to mention different cartoon characters they know and the moral, cultural and social values these characters convey to children and their warning. ("*What can children learn from the character you just mentioned?*").

The introduction stage of the lesson lasted for approximately ten minutes.

Lesson: *Presentation Stage*: Lily then followed with the main lesson for the day. The following aspects were discussed in the presentation stage: content knowledge, pedagogical knowledge, technological knowledge, technological pedagogical knowledge and technological pedagogical content knowledge.

Content Knowledge (CK). Lily's expertise with regard to content knowledge pertaining to creative and cultural arts basic concepts, theories and procedures is evident in the excerpts below from the various data sources. Data from lesson plan, observation of lessons and post observation interviews were juxtaposed to highlight Lily's content knowledge.

Cartoons are essential part of every childhood, and in teaching and learning process, with the help of cartoons kids can learn about the world around them, life issues, and moral values like being proactive, patience is a virtue, being polite. With the help of cartoons kids can learn about the world around them, about new emotions, life issues and other important things. Teaching subjects with cartoons will prevent the pre-schoolers from getting bored and will make them focus on lesson for a long time Also cartoon captures the interest of pre-schoolers as they identify with the cartoon characters. (Lesson observation).

The steps involved in making poster on cartoon character are: layout, the background colour, drawing tools, font colour and font size using Microsoft PowerPoint (Lesson plan-teaching portfolio*).*

*"All of the content is not a problem for me at all, I learnt about creative and cultural arts during my degree programme course of study although we were not taught with technologies but the content is the same. Moreover, I have improved in knowledge of the subject matter over nine years of teaching this course, my teaching is guided by the curriculum". (*Post- observation interview).

From the foregoing excerpts, it is visible that Lily did not struggle with the delivery of the content matter of the lesson. She was confident about the content knowledge of the lesson she taught and was able to provide conceptual explanations for the lesson observed. In other words, she knew what to teach. It is evident that Lily was familiar with the ECE curriculum of CB university and derived the module content from the curriculum (*my teaching is guided by the curriculum*). She gave a detailed account on the uses of cartoon posters in teaching young children and moral lessons that could be learnt via the use of cartoon characters from Mickey Mouse, for example, "*being proactive, patience is a virtue, being polite ….*" Her ability to teach the concepts of cartoon characters was influenced by her own understanding of the basic concepts of creative and cultural arts. Furthermore, Lily's biographical data with regard to her qualification (Master's degree in Early Childhood Education) alludes to her vast content knowledge.

Also, ten years of teaching experience as was revealed in her biographical data that could have contributed to her efficiency in Content Knowledge. As alluded to by Armstrong (2015), a teacher's content knowledge affects his or her teaching efficiency. From the foregoing, it can be inferred that Lily has sufficient content knowledge required to train pre-service teachers. Herring, Koehler and Mishra (2016) asserted that having a good command of content knowledge is key to avoid misrepresenting the content to the students.

Pedagogical Knowledge (PK). Analysis of the lesson plans, lesson observation and post observation interview revealed that Lily preferred to use two instructional techniques, namely: Question and answer, and Demonstration. The excerpts below highlight the use of two teaching strategies and their impact on classroom management.

"When I want to teach with technology, the methods I only think of using is demonstration method at least to show the students what they need to know about the lesson. Besides I don't know much about other instructional strategies suitable for training student to use technologies in their teaching. I think demonstration is okay."

"Ah, are there types of demonstration method, I'm not aware of that… Because of my teaching methods students often don't pay attention during the lecture". (Post-observation interview).

"Mention types of cartoon character you know and their moral values… Today's lesson is a practical demonstration of how to create a poster on cartoon character…" (Lesson observation).

List types of cartoon character you know. List the moral values that can be learnt from the cartoon character you mentioned. (Lesson plan).

The question and answer strategy was only used to induce the interest of the PST in the lesson topic and was not maintained throughout the lesson. In an effort to achieve the objective of the lesson, Lily attempted to demonstrate how to create a poster of a cartoon character, for example, Mickey Mouse using Microsoft PowerPoint software through a computer and overhead projector. Lily admitted that she did not exhibit in-depth knowledge of different teaching and learning methods.

Lily was not familiar with relevant pedagogy that could be used to train pre-service teachers to use and integrate technologies in their teaching such as collaborative learning, guided discovery and hands on activities. Her lecture was more theoretical rather than practical as pre-service teachers did not get the opportunity to use the technologies mentioned during Lily's demonstration and lesson plan. With regard to the preceding point, it is worth noting Maeko (2020), who asserted that theoretical lessons cannot be used to train students to use technologies, and emphasised that they require practical hands-on activities to be trained to use them. Lily didn't include the suitable activities for development of the knowledge and skills about use of Microsoft PowerPoint in creation of a poster of a cartoon character. However, she claimed to have used the demonstration method although admitted that she lacked the knowledge of types of demonstration methods (*Ah, are there types of demonstration method, I'm not aware of that)* that could be used to demonstrate how to use the various technologies in her lesson in order to achieve the lesson's objective.

Consequently, her lack of knowledge on types of demonstration technique affected her choice of demonstration technique; as a result, she used teach-demonstration technique, which did not enhance skill acquisition needed for technological training. The above finding resonates with that of Oviawe, Uwameiye and Uddin (2017), whose study emphasised that using varied pedagogy is essential when training students to use technologies. From the excerpt above, it is evident that Lily's limited pedagogical knowledge resulted in her favouring the completion of her lecture and its accompanying assessment task which also impacts on her classroom management and lesson plan development (*It's not easy implementing technology lessons as planned because it requires a lot of planning and time consuming).*

Technological Pedagogical Knowledge (TPK). Data from the lesson plan, observation of lesson and post observation interview were juxtaposed to illuminate Lily's technological pedagogical knowledge:

"I used Microsoft PowerPoint because I don't know of any other software application like Photoshop you talked of, also we don't have enough technologies for training PST. We have only one desktop in the department which can be used but how can fifty students use one desktop to practice, so I chose to demonstrate with my laptop while they watch. This is a major hindrance of technological training of PST in our department besides we are not giving time to practice along with the resource personnel to master the technology training, this impacts one negatively and also affects my training the PST in the use of technology since I cannot go beyond what I know." (Post observation interview).

"*It is not easy having full control of the class while demonstrating the lesson. As you observed, I struggled to set up the overhead projector, so I had to focus more on getting it done than having the students to pay attention. Beside I am not very efficient in using technology. So I had to focus on getting the lesson done, so I get this assessment task over."* (Post observation interview).

To have the knowledge and skills about use of Microsoft PowerPoint in creation of a poster on cartoon character (Lesson plan teaching portfolio).

The above excerpts illuminate the challenges Lily encountered when she trained pre-service teachers to use technologies to create a poster of a cartoon character. Lily's lack of technological knowledge impacted her choice of technologies that could be used to create the poster of a cartoon character and her pedagogy. Her choice of Microsoft PowerPoint was not suitable for the creation of posters as PowerPoint cannot create a large poster. Lily did not extensively use different kinds of technologies to demonstrate how to create a poster of a cartoon character, like Publisher, Adobe Spark, Adobe Illustrator, and Photoshop; this confirms her lack of technological knowledge needed to train pre-service teachers in the use of technology. The above finding resonates with that of Qasem and Viswanathappa's (2016) study, which highlighted that teachers need to be extremely clued up with knowledge of technologies in order to effectively integrate technologies in their teaching and to capacitate students in the use of technologies.

Also, the number of hardware technologies available for the students to engage in hands-on activities made it impossible for 50 students to work with one desktop in the laboratory. Furthermore, in her lesson plan Lily indicated to use resources like computers, internet resources and overhead projector for demonstration, but none of these resources were available for students to use during the lecture. Lily's biography revealed she was not trained on the use of technology during her degree programme but learnt how to use it on the job through continuous professional development.

Technological Pedagogical Knowledge (TPK): Lily did not exhibit effective demonstration techniques that are required to teach and develop technological skills in pre-service teachers. In her lesson pre- service teachers only listened, watched and took notes, but did not get the opportunity to use the technologies. This lack of engagement with technologies depicts Lily's lack of Technological Pedagogical Knowledge, which is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as a result of using particular technologies (Koehler et al., 2014). Learning with technology was not done and only partial teaching with technology occurred. Koehler et al. (2014) reiterated that it is not sufficient to choose any teaching method, but rather it is the ability to choose the most suitable strategy which would be suitable to achieve the lesson's objectives.

Technological skills cannot be developed without engaging the students in hands-on practice as Maeko (2020) rightly asserted that if technological hands-on skills are not transferred to the PST in Universities, the gap in technological skills will increase. In addition, Lily lacked the required knowledge about how to conduct demonstrations using a technology tool in ways that minimize classroom management issues.

6.3.2 *Presentation of Lesson Observation/Analysis of Jay (Production and Utilisation of Instructional Materials/ Technology (EST 224)*

Lesson topic: production and uses of flannel board stories in teaching

The context. Jay did not consent to me observing the planning stage of the lesson, but he consented to me observing the presentation of the lesson. His lesson occurred in a lecture theatre which could accommodate 60 students. The lecture theatre was equipped with a data projector, the furniture in it was very old and much of it was damaged. Thirty female students attended the lecture.

Observation of teaching portfolio. The main objective of the lesson was to have the knowledge and skills on how to construct flannel[2] board stories of their choice, for example: "The Tortoise and the Hare". The objectives were clear and achievable. The assessment and student activities were aligned to the objectives.

The lesson objectives were:

1) To have the knowledge and skills on how to make flannel board stories.
2) To make a flannel board story of their choice.

Student activities: demonstrate use of technologies and construct a flannel board.

The Lesson: ***Introduction stage.*** Jay used Microsoft PowerPoint to project a video clip on flannel board *story of the Tortoise and the Hare* to the PST. He introduced the lesson by telling the students the topic of the lesson, which is making *a flannel board on a story of the Tortoise and the Hare*, and the purpose of the lesson was to have the knowledge and skills on how to make flannel board on storytelling. Jay enunciated the value of using flannel boards for story telling in teaching preschool children. There was no engagement of PST during the introduction of the lesson. The introduction stage of the lesson lasted for approximately seven minutes.

The Lesson: ***Presentation stage.*** Jay then continued with the lesson in detail.

Content Knowledge (CK). Jay was very knowledgeable in production and utilization of instructional materials/ technology basic concepts, theories and procedures which he has taught for over ten years, as was revealed in his biographical data. He gave a detailed explanation of the uses, advantages of flannel board stories in teaching preschool children as is evident in the excerpts below from the various data sources.

The most common use of flannel board is for retelling simple stories from a book, or making up stories of our own, fairy tales and more. A flannel board helps a child explore stories, use their imagination, improve fine motor skills and open up their creativity with shapes, colours and objects. Children love re-telling stories they were told with the flannel board pieces, which increases their imagination, helps develop self-expression and provides hands-on learning. (Lesson observed).

[2] Flannel: is a kind of soft woven fabric, typically made of wool or cotton and slightly milled and raised, to which images of stories can be transferred to and cut into required shapes to paste on the flannel board in the sequence of the story.

At the end of the practical lesson, the students would learn the uses and advantages of using a flannel board for storytelling and teaching in pre-schools; have the knowledge and skills on how to make flannel board stories and finally make flannel board stories of their choice, for example, *The Tortoise and the Hare.* (Lesson plan teaching portfolio).

"I'm very confident in knowledge of the lessons I teach, I studied most of these courses during my degree programmes and have been teaching them for over ten years now. I always check the curriculum to verify the knowledge students need to acquire. So it's not a difficult task at all". (Post-observation interview). In addition to the above excerpts, Jay's biographical data indicated he studied ECE in both his first degree and Master's degree programme. It was apparent from the preceding excerpts that Jay was competent in the content knowledge of the lesson observed. He was able to deliver the lesson excellently to the pre-service teachers. This was obvious in the way he explained the uses of flannel in teaching pre-school children "*The most common use of flannel board is for retelling simple stories…"* The advantages of using flannel board stories in teaching pre-school children *a flannel board story helps a child explore stories, use their imagination, improve fine motor skills.* His assertion of his competence in the content knowledge, *I'm very confident in knowledge of the lessons I teach,* enhanced his efficiency in delivering the lesson. The above finding corresponds with that of Armstrong (2015), who elucidated that when teachers are confident about their content knowledge it enhances their ability to explain and teach the content to learners.

Pedagogical Knowledge (PK). Analysis of the lesson observation revealed that Jay used demonstration to show students how to construct a flannel board for storytelling, For the demonstration, he used the following technologies: a video clip on how to make a flannel board for the story of the Tortoise and Hare, in conjunction with a data projector, internet and computer. The excerpts below attest to Jay being conversant in the teaching strategy he used for the lesson.

"*Well, I use demonstration method to teach this lesson of the module it is the most suitable teaching strategy as it allows the students the opportunity to see how to use the technologies and when time permits to engage in hands-on activities using these technologies to create the flannel board for storytelling. I sometimes use other more advanced technologies if there are male students in the class - males get the hang of using these technologies faster than the female students and they are more familiar with using technologies".* (Post-observation interview).

*In today's lesson you will watch a video clipart on how to make a flannel board story of the Tortoise and the Hare, you should watch and write down the stages before you attempt to embark in hands-on activities". (*Lesson observed*).*

The above excerpts clarify that Jay's pedagogical choices allowed for the development of technological skill, which is key for integrating technologies in one's teaching. He created the opportunity for pre-service teachers to engage in hands-on activities, which allowed them to experience how to use technologies and to learn about its features. In other words, pre-service teachers had an opportunity to learn with technologies. Thus, it can be concluded that Jay chose the most suitable strategy to achieve the lesson objectives. His pedagogical choices are aligned to Koehler et al.'s (2014) assertion that technological skills can only be developed by engaging the students in hands-on practice. In a subdued way, Jay's bias was towards female students and their inability to use technologies surfaces (*males get the hang of using these technologies faster that the female students and they are more familiar with using technologies).*

Technological Pedagogical Knowledge. Analysis of Jay's lesson plan and lesson observation showed the use of the following technologies (Microsoft PowerPoint, video, internet, computer) which were suitable to achieve the lesson objectives. A closer examination of his biographical data indicated that he attended a once-off training session on the use of various technologies. Data from the post observation bring to the fore the effort Jay put into his professional development.

*"During my first degree programme, I was not trained in the use of technology. I learnt the use of technology through trial and error over the years, I just kept practising and eventually it all just clicked together. I also attended the once-off professional development that was on offer, we were not exposed to different teaching and learning strategies. I read a lot and that's how I gain knowledge about how to use technologies like Microsoft PowerPoint to teach. I tried to use the technologies on my own to discover their features". (*Post-observation interview).

In spite of the limited training received during his studies and the lack of ample continuous professional development, Jay managed to improve his pedagogy for integrating technologies in his lectures, and improved his technological knowledge about technologies via trial and error. This finding brings to the fore Jay's agency to improve his teaching practice and pedagogical knowledge as well as his technological knowledge. In other words, Jay has realised that professional development for lecturers from the university are few and far between, thus

he has embarked on self-professional development during his classroom interactions. These findings tie in with Sebotsa, De Beer and Kriek's (2019) research, which asserts that teachers need to be self-directed learners, they need to identify learning goals for themselves and manage their learning effectively. Jay recognised his pedagogical limitation in the use of technologies and took it upon himself to engage in trial-and-error learning. The above finding reveals that if a lecturer does not set goals for his/her own learning it is unlikely that the lecturer would improve his/her pedagogical skills or knowledge.

From the foregoing, it is evident that Jay used the available technologies to train the pre-service teachers in terms of content, pedagogy, technological pedagogical knowledge and technological knowledge. He exhibited sufficient Content Knowledge (CK) postulated by Shulman (1986), as was evident in the lesson observed, teaching portfolio and assertions in the post observation interview, as earlier indicated. He knew and understood the subject he taught – creative and cultural arts, which included knowledge of concepts, theories, and procedures within creative and cultural arts; knowledge of explanatory frameworks that organise and connect ideas; and knowledge of the rules of evidence and proof (Koehler et. al., 2013). He had in-depth knowledge of the processes and methods of teaching and learning and how it envelops, among other things, overall educational purposes, values, aims and classroom management, lesson plan development and implementation, and student evaluation-Pedagogical Knowledge (Koehler et. al.,2014). This was evident in his lesson plan and lesson observed. Also, data from the post observation interview revealed his in-depth knowledge of pedagogy and Technological Pedagogical Knowledge (TPK).

6.3.3 *Presentation of Lesson Observation/Analysis of Zee (Application of Computer in Education (EST 417)*

Lesson topic: creating charts of shapes with Microsoft Excel.

The context. Zee is a university lecturer with a Doctorate degree in ECE and twenty years teaching experience. He was not trained on the use of technology during his first degree but received some training in software technologies like Microsoft word, Microsoft Excel and Microsoft PowerPoint and hardware technology like computer and overhead projector operations on the job through continuous professional development. He was not very competent in the use of technology, as was revealed in his biographical data. The lesson observation lasted for ninety minutes. It was a direct observation as was indicated in the methodology chapter (4.9.3). Zee did consent for me to observe the planning of his lesson, but

on the scheduled day, he did not come to the university as his dad had passed away and he had taken leave for five days of family responsibility leave. I realised that gaining access to observe his lesson had to be renegotiated and he consented to me observing his lesson after his five days of leave.

The Lesson: ***Introduction stage.*** An analysis of Zee's teaching Portfolio[3], revealed that out of the 72 modules offered in Early Childhood Education from year one to year four, he teaches 10 modules to final year PST only. A critical analysis of Zee's teaching portfolio showed that only one technology activity was done in their final year, namely, creating charts of shapes with Microsoft Excel via laptop and overhead projector.

The review of Zee's course pack for the lesson observed indicated that the main objective of the lesson was to have the knowledge and skill of how to create a chart on shapes with Microsoft Excel and also create a chart on various shapes using Microsoft Excel.

Zee used technologies such as internet resources, laptop, overhead projector and Microsoft Excel to demonstrate to the pre-service teachers, the creation of chart on shapes. He introduced the lesson by asking the students questions based on the previous lesson on Microsoft Excel. The pre-service teachers were made to answer a few questions as a revision of their previous knowledge such as (1) What is Microsoft Excel? (2) What is the importance of Micro soft Excel? (3) What are the uses of Microsoft Excel? The pre-service teachers were excited and participated actively in the lesson. The introduction stage of the lesson lasted for approximately fifteen minutes.

The Lesson: ***Presentation Stage.*** Zee then followed up with the main lesson for the day *(Today's lesson is on how to create a chart on shapes using Microsoft Excel).*

Content Knowledge (CK). Zee was very knowledgeable in Computer application basic concepts, theories and procedures. He was able to provide conceptual explanations for the lesson observed. He could explain the content of the lesson observed and why it is important to include the topic on shapes in the course. This was evident in his teaching:

[3] Teaching portfolio: contains all the materials that the lecturer used in his teaching including lesson plans, scheme of work, teaching resources, samples of his students' work, grade from previous assessors, documentation of his teaching, activities to improve instruction, the student evaluations of teaching, and the syllabus

From an early age, kids notice different shapes even if they don't yet know that the shapes have names. It takes longer for young children to learn the specific properties of each shape, such as the number of sides or how the shape looks. Giving preschoolers lots of practice with shapes helps them solidify their understanding of the two-dimensional structures. The knowledge of shapes gives the young children an advantage in many areas of learning (Lesson observation).

"I don't have a problem with delivery of the content of the lessons I teach. I'm a life longer learner and I am always updating my knowledge by research, keeping abreast with current trends in ECE, reading, you can never stop, I'm always trying out new techniques, assessments, I have twenty years of teaching experience in this field but I realise that students are different so I cannot use the same lesson over and over again. It has to suit the learning style of the students". (Post- observation interview).

An analysis of his lesson plan reflected the constructive alignment between his lesson objectives *(learn the importance of shapes in early childhood education and demonstrate the knowledge and skills about use of Microsoft Excel in creation of two-dimensional shapes),* and the activity pre-service teachers were to engage in as well as the assessment task *(construct a chart on shapes using Microsoft Excel).*

It was evident from the lesson observation, document analysis, post-observation interview and biological data that Zee was au fait with content knowledge for the module. He has knowledge of the curriculum requirements and knew what to teach, and how to teach the content. From the lesson observed it was conspicuous that Zee did not struggle with delivery of the content knowledge. The teaching of the concepts of shapes was influenced by Zee's own deep understanding of shapes and his knowledge on the basic concepts of computer application. His deep content knowledge surfaced when he explained the importance of shapes in building the cognitive knowledge of pre-school children in: *literacy; early math skills; problem solving; categorisation and comparisons.* In conjunction with the above excerpts, Zee, proclaimed he is a lifelong learner and that he keeps abreast with current research. The aforementioned activities contribute to his expressed confidence in his content knowledge. Furthermore, Zee, is cognisant of student learning styles and plans his lesson to capture his students' attention, and provides them with the most useful and meaningful learning experiences. The above finding resonates with Biggs' (2014) findings which emphasise that instructional planning is a complex task that requires teachers to have a deep understanding of domains, such as learning goals, students' characteristics, content to be taught and strategies to teach this content. The

lesson observed on the creation of shapes in Microsoft Excel revealed there was constructive alignment between the lesson objectives, student activities and assessment.

Pedagogical Knowledge (PK). Data from the lesson plan, observation of lesson and post observation interview bring to light Zee's level of pedagogical knowledge.

Analysis of the lesson observation revealed that Zee used three instructional techniques, namely: *Question and answer; demonstration and guided discovery*. (Lesson plan).

As strategies on how to create a chart of two- dimensional shapes using Microsoft Excel, with technologies like laptop and projector. This was evident in the following excerpts:

*"When I want to teach with technology, I employ different methods to ensure students acquire the basic technology skills, although there is dearth of resources which hampers the effective technology training of students in our department. However, I encourage the students to get their personal computers which few of them did". (*Post- observation interview).

The stages involved in making charts on shapes in Microsoft Excel are: click on the Drawing toolbar to draw any two-dimensional shapes, then use the Fill Colour, Line Colour, Line Style, Dash Style, Shadow Style, and 3-D Style buttons on the Drawing toolbar to enhance the basic shape. In addition to drawing your own shapes, you can insert any number of ready-made shapes (including lines, arrows, flow chart symbols, banners, and callouts) by selecting them from the AutoShapes pop-up menu and then sizing them in the worksheet. (Lesson observation).

The data from the lesson observation revealed that Zee used the question and answer technique to arouse the interest of the students in the lesson *(mention the importance of shapes in early childhood education)***.** As part of his demonstration, Zee demonstrated how to create a chart of two- dimensional shapes using Microsoft Excel via laptop and projector. As part of his guided discovery technique, he guided the pre-service teachers on how to create a chart on shapes using Microsoft Excel during their hands on activity. Data from the post-observation interview shows that Zee exhibited an in-depth knowledge of different teaching and learning methods.

Additionally, the lesson observed elucidated that he was able to shift from one teaching strategy to the next with ease without losing the interest of the students.

From the excerpts, one can conclude that Zee has in-depth knowledge of different teaching and learning methods for effective technology integration such as demonstration, guided discovery

and more. This was seen in the way he introduced the lesson by asking them questions, demonstrated the lesson to the students and guided the students on creating charts of shapes using Microsoft Excel. He engaged the students in hands-on practice needed for skill acquisition.

He used the student group demonstration method; divided the students into groups to perform the demonstration and also guided each group to overcome any difficulty they encountered. He possessed sufficient skills and techniques that teachers require to keep students organised, orderly, focused, attentive, on task, and academically productive during a class. From the foregoing, Zee implemented the objectives by engaging the pre-service teachers in hands-on practice as required, but due to insufficient time and lack of sufficient technology, he could not achieve the outcome before the end of the lesson as was planned.

Analysis of Zee's lesson plan and lesson observation revealed that Zee's method of assessment was both formative and summative (making of charts on shapes using Microsoft Excel). The lesson evaluation was based not only on the end result (summative) but also a continuous evaluation process (formative) required in technology training to ensure skill acquisition. Mkimbili and Kitta (2020) emphasised the significance of continuous assessment, as it is important to a teacher's capability to adapt lessons and check for student understanding. Zee ensured continuous assessment during the lesson.

From the preceding section it is visible that Zee had sufficient Pedagogical Knowledge required for the technological training of pre-service teachers. According to Herring et.al, (2016), pedagogical knowledge is a generic form of knowledge that involves all issues of student learning, classroom management, lesson plan development and implementation, and student evaluation. A teacher with deep pedagogical knowledge understands how students construct knowledge, acquire skills, and develop habits of mind and positive dispositions toward learning (ibid). He had knowledge of different teaching and learning methods (*Question and answer, Demonstration and guided discovery)*, had proper classroom management (*I can easily control my class during the demonstration or while guiding each group on their work)*, effective lesson plan development and implementation (*…the students were engaged in hands-on practice to acquire the skills needed in creating a chart on two- dimensional shapes using Microsoft Excel as was stipulated in the objectives)* and effective assessment of technology lesson (*Students should be able to show understanding of the task during the hand-on practice and finally submit a printed copy of the charts on two dimensional shapes).*

Technological Pedagogical Knowledge (TPK). Data from the post observation interview, lesson plans, lesson observation bring to the fore Zee's expertise in terms of technological knowledge and technological pedagogical knowledge.

"I used Microsoft Excel as it is suitable for creating charts on two- dimensional shapes using Microsoft Excel, I did not learn about technology during my undergraduate programme but learnt on the job through self-learning and attending the yearly continuous professional development organised by the university, although it does not focus on integrating technology in teaching. I have made personal efforts to improve my use and knowledge on technology in terms of the features, how to use the features, technology skill instruction to teach with technology, I often practise the use of the technologies and how I will integrate them in my teaching. But I am not competent in robotics. The university did not install that for us as yet". (Post- observation interview).

Teaching strategies to be used: *Question and answer, Demonstration followed by guided discovery in use of Internet resources (Microsoft Excel); overhead projector and computer (laptop)* (Lesson observed and lesson plan).

Zee's agency for self-learning is explicit in the above excerpt. Data from his biography reveals that he was not trained on the use of technology during his degree programme but learnt on the job through self-initiated continuous professional development. Via his personal efforts, he has acquired technological knowledge and skills to engage students in the use of technologies.

He engaged students in group demonstration and guided discovery to allow for their development of technological skill via hands-on practice. Further, he integrated the use of technologies into his lesson objectives, student activities and assessment. The above findings resonate with that of Hina, Dominic and Zaidi (2020), who emphasised that hands-on practice was needed for the development of technological skills.

Zee was efficient in Technological Pedagogical Knowledge which is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as a result of using particular technologies (Koehler et al., 2014). This was evident in the lesson observed (*Microsoft Excel, computer and overhead projector)* the data from the post observation interview which illuminates Zee's agency and the self-initiated effort he put into increasing his technological knowledge and technological pedagogical knowledge.

From the foregoing data, it is evident that Zee used the available technologies to train the pre-service teachers in terms of content and pedagogy due to his competence in Pedagogical Knowledge (PK) and Technological Pedagogical Knowledge (TPK). He exhibited sufficient Content Knowledge (CK) as was postulated by Shulman (1986), as was evident in the lesson observed, teaching portfolio and assertions in the post observation interview as earlier indicated. He knew and understood the subject he taught – computer applications, which included knowledge of concepts, theories, and procedures; knowledge of explanatory frameworks that organise and connect ideas; and knowledge of the rules of evidence and proof (Koehler et al., 2014). In addition, he exhibited in-depth knowledge of the processes and methods of teaching and learning and how it envelops, among other things, overall educational purposes, values, aims and classroom management, lesson plan development and implementation, and student evaluation-Pedagogical Knowledge (Koehler et. al.,2014). This was evident in his lesson plan and lesson observed: *Question and Answer, Student group demonstration and Guided Inquiry techniques,* used which encourage skill acquisition.

6.4 Summary of Cases of the Lecturers on how they Used Technologies to Train Pre-Service Teachers in Terms of Content and Pedagogy

In section 6.3, the three cases were presented on how ECE lecturers use these technologies to train pre-service teachers in terms of content and pedagogy. The cases of Lily, Jay, and Zee were presented and the focus of the presentation was on their Content Knowledge, Pedagogical Knowledge and Technological Pedagogical Knowledge. Data from their biography, lesson observed, post-observation interview and lesson plans were used to establish their content knowledge, pedagogical knowledge, technological knowledge and technological pedagogical knowledge.

Content Knowledge (CK). All the three lecturers exhibited high levels of content knowledge. This was in line with Koehler et al. (2016) postulation that teachers must know and understand the subjects that they teach, including knowledge of central facts, concepts, theories, and procedures within a given field; knowledge of explanatory frameworks that organise and connect ideas; and knowledge of the rules of evidence and proof to avoid misguiding the students.

Pedagogical Knowledge (PK). Analysis of the Pedagogical Knowledge PK of the three lecturers revealed that Lily, was not competent in Pedagogical Knowledge, but Jay and Zee were competent in Pedagogical Knowledge.

Technological Knowledge (TK) and Technological Pedagogical Knowledge (TPK). Lily was not adequately equipped in terms of technological knowledge and her technological pedagogical knowledge was limited. Unlike Jay and Zee, Lily did not display agency or initiative to empower herself to meet the curricula needs of her students, in terms of training them to use and integrate technologies in their teaching. On the other hand, Jay and Zee are agentic and are self-taught in the use of technologies; they spend hours obtaining hands-on experience in the use of technologies in their teaching. The many hours of trial-and-error practice using technologies and integrating it into their lessons advanced their technological knowledge as well as their technological pedagogical knowledge.

Lily did not support her students' learning with the available technologies in order to achieve the objectives of her lessons as regards to skill acquisition, whereas Jay and Zee supported the pre-service teachers' learning with technologies. Lachner, Backfisch and Stürmer (2019) emphasised that teachers' technological pedagogical knowledge (TPK) is considered a critical requirement for educators to efficiently use technology during teaching across content areas. This shows the importance of Technological Pedagogical Knowledge of lecturers in the integration of technology in the classroom.

Thus, it can be concluded that the pre-service teachers were effectively and efficiently trained in the use of technology in terms of content by the lecturers but the PSTs in Lily's class were not well trained in the use of technology in terms of pedagogy.

Application of Technological Pedagogical Content Knowledge Theory to the Analysis. My analysis shows that in order to appreciate the impact of technology in ECE, TPACK is an essential framework to bring to the fore the transactional relationship between ECE lecturers' use of technologies, their PK, CK and TPK. As was earlier mentioned in Chapter Three, Mishra and Koehler (2006) were dissatisfied with teachers' content knowledge and pedagogical knowledge only, without a proper integration of the technological knowledge.

The need for interconnectivity of technology integration in ECE programmes for holistic learning is evident in all the themes. Niess (2016) highlighted the importance of TPACK for successful integration of technology into teaching. As earlier mentioned, Koehler and Mishra (2006) disputed the idea of each domain of learning standing as a separate entity without adequate and equal interaction of the other domains. As such, having the Content Knowledge (CK), without the Pedagogical Knowledge (PK) and the Technological Knowledge (TK) cannot bring an all-round development of the learner. The lecturers must be well equipped with

the knowledge of the subject matter, the possible methodologies to use in teaching the stipulated content and the appropriate technologies to be used in other to drive home the lesson. There are technologies in the ECE department of the CB University, but the proportions of Technological Pedagogical Knowledge (TPK) and Pedagogical Knowledge as equated to Content Knowledge (CK) were wide apart. From my observation and analysis of the policies and post observation interview of the ECE lecturers, there is an imbalance of Content Knowledge, Pedagogical Knowledge and Technological Pedagogical Knowledge. According to Eluwole et al. (2018), the current fifth generation of computer use has witnessed great advancement in technologies, ranging from Robotics, Neutral networks. Game Playing, Desktop, Laptop, NoteBook, UtraBook, Development of true artificial intelligence and more. If the ECE lecturers lack in PK and TPK, they will not measure up in training ECE pre-service teachers on how to use technologies they will meet in ECE centres after graduating from the university. As such, the lecturers using CK, PK and TPK must be on the same high level to achieve success in teaching and learning in the ECE department. Moreover, Hennessy et al. (2015) asserted that to enhance and improve the quality of education in the Africa region, it is pivotal to develop technology use for twenty-first century teaching and learning. Also, Tondeur et al. (2017) asserted that teacher training institutions are required to provide pre-service teachers with the essential proficiencies to incorporate technology in their lessons. As such, various institutions have included introductory technology courses in their curriculum, with the primary focus on the development of pre-service teachers' technological knowledge and skills so they can transfer these technological skills in their future teaching practices.

Voogt and McKenney (2017) researched TPACK in teacher education, in which they examined how five teacher education institutes can help pre-service teachers to inculcate the Technological Pedagogical Content Knowledge required to effectively use technology for early literacy. They discovered that in recent times not much attention is given to inculcate the desired technological knowledge needed to advance early literacy through the use of technology, as many modern technologies are not used in schools and teacher educators still struggle with effective use of technologies in their content and pedagogy. This is in line with my study on how ECE lecturers teach pre-service ECE teachers to use technologies in their courses to prepare them for the task ahead in early childhood education.

Findings.

There was insufficient integration of technology courses/modules in the CB University ECE curriculum and the national ECE curriculum at large from year one to four**.** From the document

analysis, the integration of technology in the lesson of ECE in CB University is about 4% of the lesson; this was due to the poor level of technology integration in the curriculum.

There was lack of technologies for PST to engage in hands-on practice needed to acquire the desired technological skills for future use in their profession.

There was insufficient time in the timetable for the few courses/modules on technology, to enable the PST attain the desired outcome within the lesson period.

All the ECE lecturers were very efficient in Content Knowledge but not all had sufficient Pedagogical Knowledge and Technological Pedagogical Knowledge needed for effective technology integration;

There was insufficient continuous Professional Development given to the ECE lecturers in CB University to equip them technologically.

All CB University ECE lecturers trained in PST used the technology effectively in terms of content by using the university curriculum to deliver the subject matter in detail as required.

Not all CB University ECE lecturers trained in PST used the technology effectively in terms of pedagogy.

There was a disjuncture between the ECE curriculum of CB University (as was shown in Chapter Five, document analysis of the ECE curriculum for CB University) and the module template for the ECE programme offered at CB University. This disjuncture had implications for how ECE lecturers train ECE pre-service teachers to use technologies in their teaching and consequently impacted ECE pre-service teachers' TPACK.

Based on the findings, there is need to:

- integrate more technology-based courses/modules in the CB University ECE curriculum and the national ECE curriculum at large from year one to four. This would enable a continuous technological training for the pre-service teachers;
- provide ample technologies for pre-service teachers to engage in hands-on practice needed to acquire the desired technological skills for future use in their profession;
- allocate sufficient time in the timetable for courses/modules on technology, to enable the pre-service teachers attain the desired outcome within the lesson period; and
- enhance the Pedagogical Knowledge and Technological Pedagogical Knowledge of ECE lecturers through constant and effective continuous Professional Development to

enable them train the pre-service teachers effectively with the available technologies in terms of pedagogy.

6.5 Summary of Chapter Six

This chapter focused on research question 2: How do ECE lecturers use these technologies to train pre-service teachers in terms of content and pedagogy? It was established in this study that ECE lecturers used the available technologies in CB University to train the pre-service teachers very effectively in terms of content but not in terms of pedagogy. This was due to lecturers still struggling with Pedagogical Knowledge and Technological Pedagogical Knowledge required for effective integration of technology in the teaching and learning process. In addition, there was insufficient time allocated to the technology classes, less integration of technology in the curriculum and lack of technologies in CB University's Early Childhood Education department for students' use. Excerpts from the three lecturers' biographical data, lesson observation, post-observation interviews, and document analysis of their teaching portfolio attest to these.

The next chapter presents the analysis of research question 3: Why do ECE lecturers train the PST in the use of technology the way they do?

CHAPTER SEVEN

PRESENTATION AND FINDINGS: RESEARCH QUESTION THREE

7.1 Introduction

This chapter attempts to answer the third research question: Why do ECE lecturers train ECE pre-service teachers to use these technologies the way they do?

The chapter brings to the fore the contextual realities that impede lecturers use of technologies. As was mentioned in the methodology chapter, to respond to research question three, data was generated using collage, concept maps and a focus group interview. The actual collages and concept maps are presented next, followed by presentation of findings and discussion. The factors that enable and impinge the integration of technologies in training pre-service ECE teachers are presented and the chapter ends with a conclusion on findings.

7.2 Presentation of Collages and Concept Maps

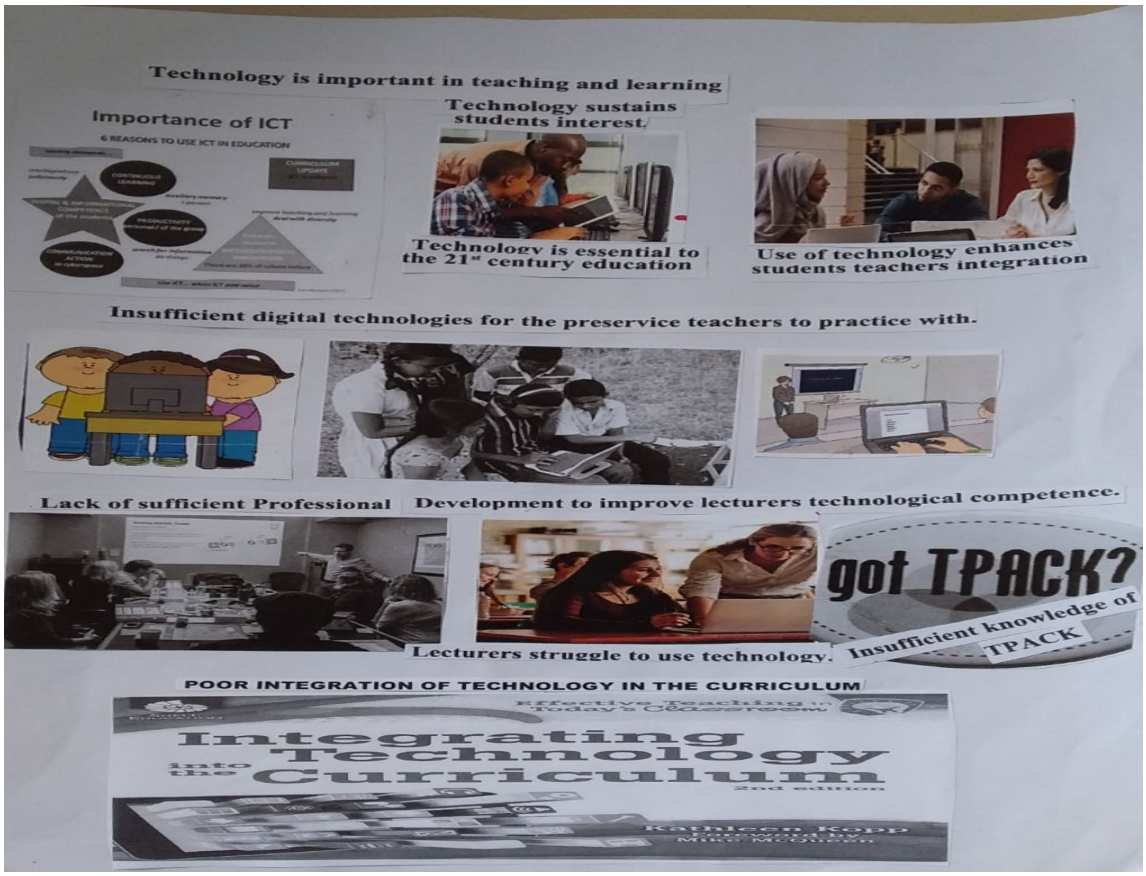

Figure 7.1: Collage Group 'a'

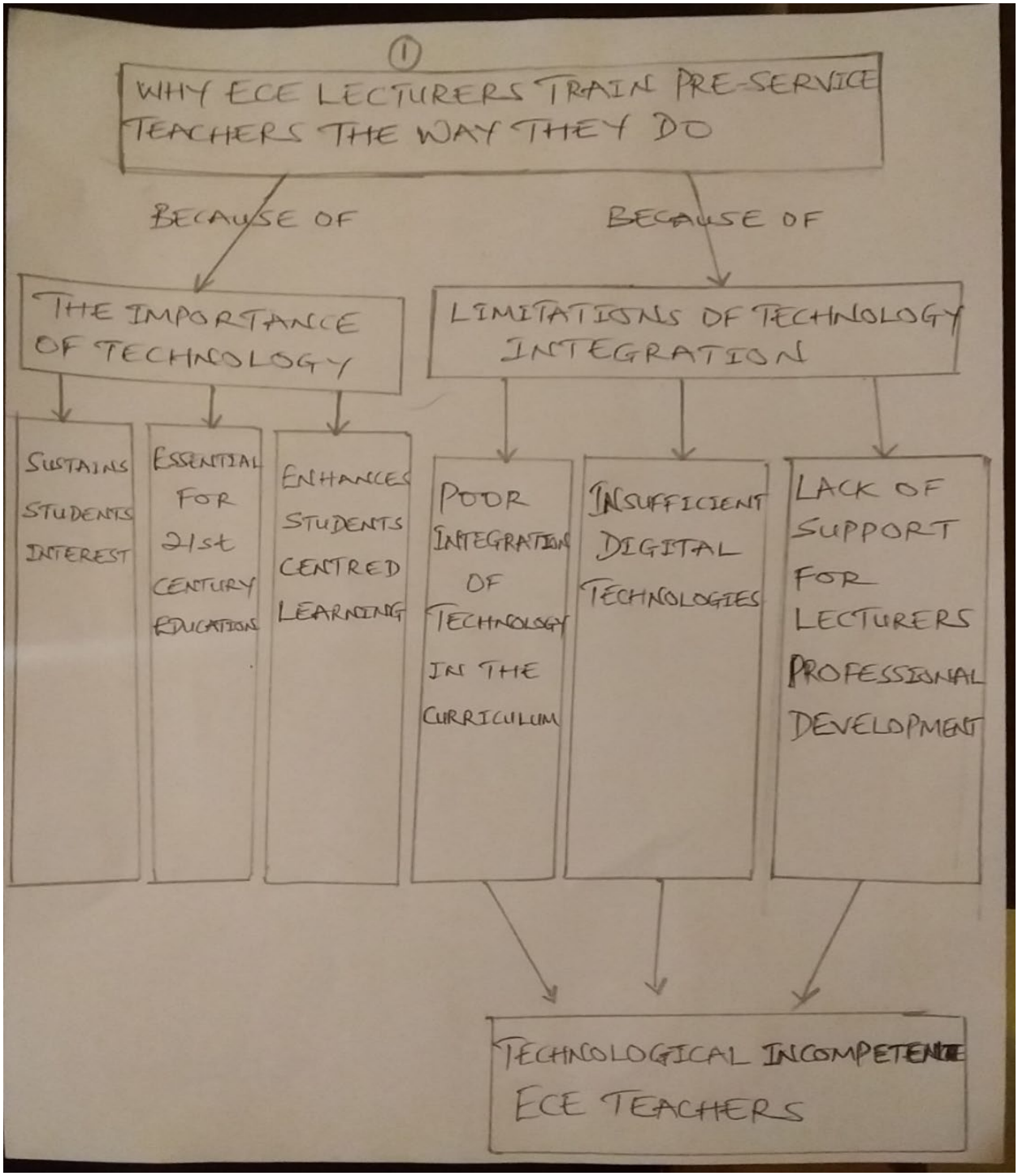

Figure 7.2: Concept Map for Group 'a' Collage

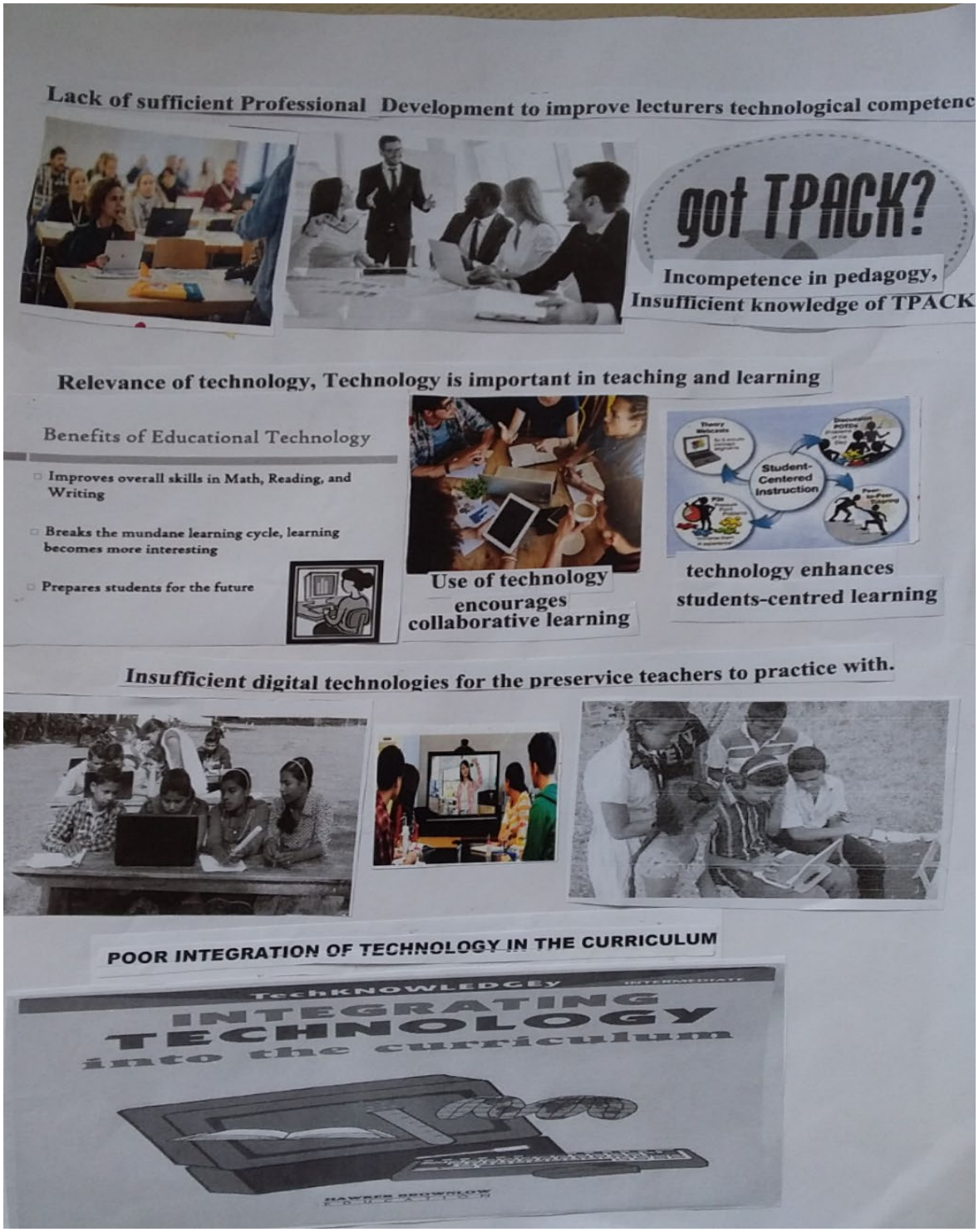

Figure 7.3:Collage Group 'b'

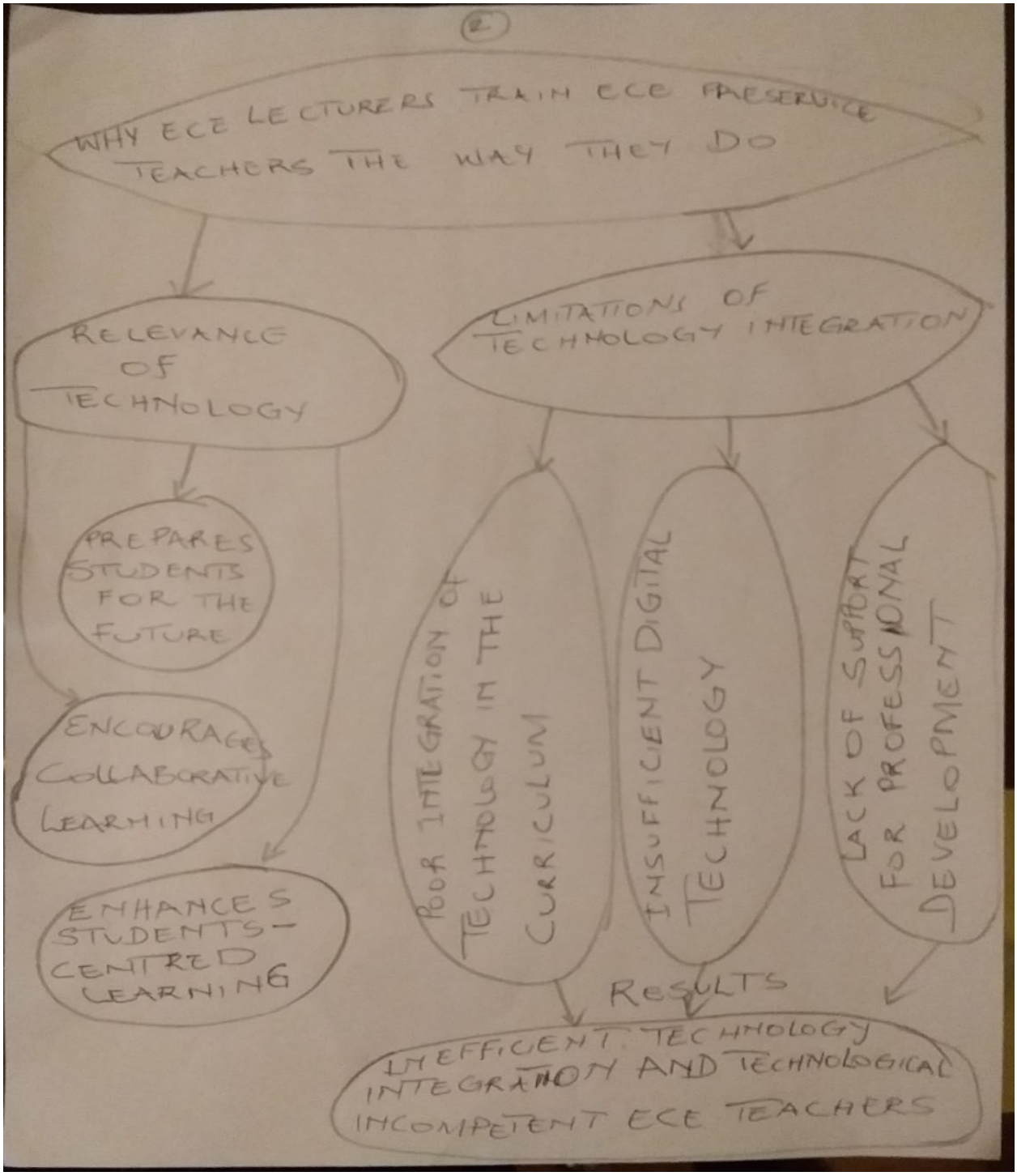

Figure 7.4:Concept Map for Group 'b' Collage

7.3 Presentation of Data and Discussion

Data from the collages, concept maps and the focus group interview were juxtaposed during the analysis process. Two themes emerged which account for why ECE lecturers train ECE pre-service teachers in the use of technology the way they do namely motivating factors and constraining factors. Each theme is presented next.

7.3.1 *Factors that Motivate ECE Lecturers to Integrate Technologies in their Teaching to Train Pre-Service Teachers*

Benefits of technology in teaching and learning. All the participants in the study stated during the focus group interview and also expressed in their collages and concept maps that they believed and have experienced that technology was useful in teaching and learning as it can enhance students' understanding in various ways, such as attracting their attention, simplifying concepts, providing information not covered in the textbooks, and increases student interactions. The participants asserted unanimously that technology is important in teaching and learning in early childhood education to prepare the pre-service teachers technologically in order to teach the children in ECE centres with technologies. Moreover, they recognised that technologies allow children to learn by what they see, hear and touch virtually, hence the ECE lecturers were motivated to train the ECE pre-service teachers with the available technologies. They emphasised the benefits of technology integration in the teaching and learning in the ECE department, as follows: to simplify complex ideas; enhance creativity; solve problems; visualise and manipulate objects; improve hand -eye coordination; provide information that is not covered in the textbooks; increase students' interactions; and increase students' motivation/ interest to learn.

Below are excerpts from some of the responses from participants about their views on the use of technology in the focus group interview, collages and concept maps:

"… *the use of technology in teaching and learning improves students' learning because they would be able to see things from the computer instead of just imagining, as they manipulate the technologies themselves, this would help them understand more. The use of technologies increases students' interactions and positively impact students learning and achievements". (*Focus Group Interview - Zee*).*

"… *the use of technologies in teaching and learning is very important because it arouses the students interests, promotes interaction among students, encourages collaborative learning, improves communication among students and enhances student teacher interactions, technology is important to simplify complex ideas, enhance creativity and problem solving techniques, technology is of immense importance in teaching and learning as it enhances visualisation and manipulation of objects*…" (Focus Group Interview - Jay).

"… *the use of technologies is vital in teaching and learning because when technology is used it can enhance students' understanding through various ways such as simplifying concepts and*

providing information that is not covered in the textbooks. Also the use of technology in teaching and learning enhances teaching methodologies and collaboration, makes learning easily accessible to all learners, creates a good atmosphere for learning to meet the needs of all learners." (Focus Group Interview - Lily).

Additionally, the ECE lecturers' choice of images in the collage portrayed that technology is beneficial to learning, for example: *The picture on the top showing a group of students that sat in front of some desktops and a teacher pointing out something through a PC to the first male student by his right which sustained the interest of the student throughout the teaching.*

Also, the next picture showing two students (a male student and a female Moslem student) and their female lecturer interacting during technology integration in the teaching and learning process.

In the same vein, the ECE lecturers expressed in their concept maps some words linked to the pictures selected for their collage, for example in concept maps a and b, lecturers highlighted the benefits of using technologies in their teaching and the training of pre-service teachers:

- *Technology sustains students' interest.*
- *Technology is essential for 21st century education.*
- *Technology enhances students centred learning.*
- *Technology prepares students for the future.*
- *Technology encourages collaborative learning.*
- *Technology enhances student-centred learning* (Concept maps group a and b).

From the above excerpts, it is evident that the ECE lecturers acknowledged the importance of technologies in teaching and learning. They believe that they are vital pedagogical tools for the teaching process without which teaching and learning would not be effective and efficient. The participants expressed the need to incorporate technology in teaching and learning as it helps to develop the TPACK of both the students and lecturers. The use of technology makes teaching easier for the lecturers so they don't have to explain so much for the students to understand. It can be inferred from the excerpts that all the participants believe that without proper integration of technology (TPACK) in education there would be inefficient teaching and learning; as a result, the Content Knowledge (CK) and Pedagogical Knowledge (PK) is not sufficient for the students' all-round development.

This is in line with Carver's (2016) findings in his study on teachers' perception of benefits of technology, which includes increased student engagement, increased student understanding, increased instructional differentiation, increased exposure to more current content material, and increased opportunities to use research and evaluation skills.

Ferrer and García (2016) affirmed in their study that technologies can improve and revolutionise teaching. In addition, King (2017) asserted that technology can be a potent tool for transforming learning. It can help support and advance interactions between teachers and students, reinvent their methodologies to learning and collaboration, shrink established parity and accessibility gaps, and adapt learning experiences to meet the needs of all learners.

These responses by the ECE lecturers are in line with Hannaway and Steyn (2016). finding that in the South African foundation phase, teachers should integrate technologies in their teaching to help simplify complex/abstract ideas that young children might struggle to learn, as well as initiate in learners the attributes of problem solving, creativity, visualisation and manipulation of objects. Similarly, Fagan (2018) asserted that integrating technologies into the classroom helps prepare students for the elaborate and technologically-connected world they will face daily.

7.3.2 *Factors that Constrain the Integration of Technologies*

Johnson et al. (2016), asserted that although lecturers in general recognise the benefits of educational technologies, they are always faced with challenges which hampers effective and efficient technology integration. The ECE lecturers alluded to the following as factors that constrain the way they train ECE pre-service teachers to use these technologies the way they do. These factors include:

- poor integration of technology in the CB University ECE curriculum;
- lack of sufficient technologies to promote effective technology training; and
- lack of support for lecturers' Professional Development (PD).

7.3.2.1 Poor integration of technology in the CB University ECE Curriculum. All the lecturers commented on the poor integration of technology in the CB University ECE curriculum which formed the basis for the learning outcomes, lesson development and the integration of technologies in their lessons. The curriculum for ECE was not consistent in the integration of technologies across all four years of the curriculum. Seventy-two (72) modules were offered in the ECE programme over four years, but only three modules (about 4%) focused on training ECE pre-service teachers in the use of technologies., which means that about 96% of the modules did not cater for integration of technologies. Furthermore, at the first and third year level there were no modules that catered for the integration of technology. Therefore, there was no sequential development of CK, TK, and TPK among the pre-service teachers in terms of the use of technologies. The excerpt below brings to the fore the ECE lecturers dismay at the design of the CB university curriculum in terms of the lack of integration of technologies in more modules across the programme.

"*There is poor integration of technology in the curriculum/module outline… there is no module on technology integration at the first year and third year level. We just deliver what is in the curriculum, and have no inputs in its design. We cannot deviate from the curriculum."* (Focus Group Interview - Lily)

"…Imagine, this course production and utilisation of instructional materials comes only once in the second semester of their second year and does not run throughout their programme. This is a course that dealt more on training pre-service teachers to use different technologies, yet it appeared only in one semester in their second year. There should be more integration of technology in the curriculum, to enable us train the pre-service teachers effectively in the use of technology." (Focus Group Interview - Jay)

"…We only think of incorporating technology when modules that require them come up as stipulated in the curriculum. This module introduction to computer education is only taught in one semester in their final year, so it is not possible for the pre-service teachers to master the use of computer soft wares before they graduate." (Focus Group Interview - Zee)

In line with the above assertion, the picture in the collages 'a' and 'b' at the bottom with the caption *Integrating Technology into the Curriculum,* showed poor integration of technology in the curriculum which was further buttressed by the concept maps in which poor integration

was represented as one of the limitations of technology integration by the ECE lecturers. (Collage/Concept map).

The above data revealed limited opportunity provided by the ECE curriculum of CB University for the integration of technologies in their teaching and learning process needed to impact the development of the pre-service teachers' Technological Knowledge (TK), Pedagogical Knowledge (PK) and Technological Pedagogical Knowledge (TPK). It can, therefore, be inferred from the excerpts above that technology was not properly incorporated in the CB University ECE curriculum, which consequently affected the incorporation of technology in their lessons. In the context of TPACK, there should be integration of Content knowledge (CK), Pedagogical knowledge (PK) as well as Technological Knowledge (TK) for a holistic education/ learning, which is one of the objectives of early childhood education in Nigeria (Obiweluzor, 2015).

This is in line with several studies which advised that for pre-service teachers to acquire the skills for effective technology integration, teacher training institutions should engage in various efforts to develop their technological, pedagogical, and content knowledge through an holistic infusion of technology in their curriculum (Mouza et al., 2014; Sun, Strobel & Newby, 2017; Tømte et al., 2015; Tondeur et al., 2014). Ogunyemi and Ragpot (2015) further asserted that the key challenges in ECE in Nigeria revolves around the curriculum.

In addition, commenting on the challenges of ECE in Nigeria, Ige (2011) stated the need to revisit the curriculum of pre-service teachers to make sure it is directed towards achieving the ECE goals of developing the affective, cognitive and psychomotor domains of these young children by proper integration of technology in both content and pedagogy.

In line with this, Eze and Akubugwo (2016) in their study acknowledged that the developmental progress of every nation is, to a large extent, linked to the National Curriculum of Education. In addition, Batane and Ngwako (2017), in their studies on technology use by pre-service teachers, recommended a review of the school curriculum and assessment procedures to ensure that they support technology use to a great extent.

7.3.2.2 Lack of Sufficient Technologies to Promote Effective Technology Training All the participants affirmed that there were insufficient technologies available at CB University to train pre-service teachers in the use of technologies in the ECE department. The lack of availability impinges the effective training of the pre-service teachers in the use of technologies in the ECE lecture rooms and laboratories. These statements were affirmed by the excerpts from the participants as stated below:

"*The environment is not conducive for technology training. Certain factors impinge on the use of technologies in the ECE lecture room such as insufficient technologies for the students so they can practise within the limited time allocated for the lesson. We don't have sufficient technologies needed to prepare the pre-service teachers for the challenges ahead technology wise, also there is no computer programming in the few technologies available. There is only one desktop, one overhead projector, one television and one audio and one DVD player in the laboratory to train the pre-service teachers and none in the classrooms. As such not all the students could practise with the available technologies during the practical."* (Focus Group Interview - Zee).

"*There are insufficient technologies, insufficient time for teaching and learning, unconducive environment, and lack of appropriate desks and chairs to put the technologies. We need power supply for technology integration, sufficient technologies for students [to] use, the department has only one projector, one television, one DVD player, one desktop stored in the laboratory and few students with laptops, besides no computer programming installed in the computer like robotics. The university should provide sufficient technologies, install computer programming like robotics and provide an enabling environment for technology training."* (Focus Group Interview - Jay).

"*The lecture rooms are not designed for technology use, even the ECE laboratory lacks proper room layout, desks, power sockets for training the pre-service teachers on the use of technology. There is not enough space in the laboratory and it is not easy carry computer or projector from one lecture room to another… there are insufficient technologies in our department. Even if I try to upgrade myself in the use of technologies, without the university installing sufficient technologies it will be difficult to pass on the knowledge to my students. Imagine where it's only one overhead projector, one desktop, one television and one DVD*

player only in the laboratory that is not spacious to accommodate the number of students we have." (Focus Group Interview - Lily).

These remarks were evident from the pictures in the collages, seen in the second and third column. *In group 'a' and 'b' collages respectively, the students are sharing the PC, the number of students ranges from three to six students were seen using one PC system, while in another picture only one student was seen with a laptop while the rest were not having any computer for hands-on practice. They were only watching and listening to the lecturer, who was demonstrating with her personal laptop in front of the classroom. The collage further showed a picture of students all sited and watching the demonstration on one technology system. This was further affirmed via the concept maps, in which the ECE lecturers expressed words like "insufficient technologies" as one of the impediments of technology integration.* (Collage/Concept map).

It can be inferred from the above excerpts that there were insufficient technologies for training pre-service teachers on how to use them at CB University. As a result, there were limited opportunities for pre-service teachers to practice using technologies to hone their Technological Knowledge (TK), and Technological Pedagogical Knowledge (TPK). Moreover, technologies available in CB University were not installed with computer programming needed in this Fourth Industrial Revolution for the development of TPACK in teaching and learning. Also, the technologies they have did not measure up with those needed, enumerated by Reinen (2013), Yen et al., (2019), Yilmaz (2016), Kuonanoja and Oinas-Kukkonen (2018): for ECE such as educational video sites, online organisation, digital storytelling, interactive websites and interactive whiteboards were needed to reinforce key educational concepts and manipulation of items. This lack of technologies no doubt contributed to the effective and efficient technological training of pre-service teachers by the ECE lecturers. There should be provision of sufficient technologies for ECE pre-service teachers to learn with.

This is in line with the findings by Eze and Akubugwo (2016) that poor ICT infrastructures, poor power supply, poor ICT laboratories, resulted to poor integration of technology in education. Batane and Ngwako (2017), in their research observed that most of the participants indicated that the school environment was not conducive for technology use as there was lack of required resources in the classrooms, namely, insufficient projectors, and only a few laptops shared among the students within limited time. Tondeur et al. (2020) also assert that there is a need for ubiquitous technology access for teachers to increase their technology expertise.

Johnson et al. (2016) maintain that the implementation of educational technology by the lecturers is not feasible if their institutions were not equipped with sufficient technologies. They further stated that since most students did not have consistent access to technologies, which made it extremely difficult for lecturers to integrate technology in their lessons.

Robotics is important for children to understand how our world works. The objects we use every day are like robots or machines, and children need to learn how machines work, that is what programming is. By introducing children to programming early on, we create a huge opportunity for them. Programming robots helps children change their attitude towards mistakes; makes children think logically and increases their imagination. Children interact with YouTube, social media sites, tablets, mobile devices and video games for hours every day (Collins & Halverson, 2018). As a result, there is a need for computer programming like robotics to be installed in the available computers in the ECE department for the training of pre-service teachers so they can use it for teaching preschool children in the ECE centres; in addition to the provision of ample technologies.

7.3.2.3 Lack of Support for Lecturers' Continuous Professional Development (CPD).

The participants revealed that it was not easy for them to acquire Continuous Professional Development (CPD) to increase their technological knowledge due to lack of support from the university and federal government of Nigeria because no special provision was made by the institution on a regular basis to support lecturers CPD. The ECE lecturers were not trained when they were studying on how to use technologies so they lacked TK and PK; they learn on the job to improve their Technological Knowledge (TK), Pedagogical Knowledge (PK) and Technological Pedagogical Knowledge (TPK). Their Continuous Professional Development was not regular, and as such, they tried to research on the internet in order to prepare very well for the technological integration. As a result, the lecturers lack TK on modern technological inventions in this Fourth Industrial Revolution. They still struggle with the use of modern technologies due to lack of confidence in using technologies, stemming from a lack of continuous professional development (CPD). This impinged on the technological knowledge (TK) of their students because they could not train them in computer programming skills like robotics when they didn't even have knowledge of it. Most of the lecturers asserted they were not taught how to use technologies during their programme in higher institutions, so they learnt on the job and therefore needed more continuous professional development to perfect in the use of technology to conveniently train pre-service teachers on how to use technologies. Most of the lecturers lacked Pedagogical Knowledge and Technological Pedagogical Knowledge needed for proper integration of technology in teaching and learning.

These were evident in the following excerpts from the participants:

"*There is no support for lecturers to acquire continuous professional development on regular basis. No financial support for us to attend seminars, workshops, conferences, courses and retreats so we can improve our technological skills and in turn, boost students' knowledge. I'm try to upgrade myself to align technology use with the ECE pre-service teachers' curriculum, but I'm not abreast with current innovations in technology like robotics and need to improve my Technological Pedagogical Knowledge."* (Focus Group Interview- Jay).

"*… I don't know about computer programming like robotics and most modern computer programming, there is no encouragement from the government for lecturers to improve our*

*CPD on the job to meet up with new innovations in this digital age. As a result, our subject knowledge is not up to date. I can't teach what I don't know to the students. I'm not excellent in selecting and using various technologies to support teaching and learning." (*Focus Group Interview - another Participant)

*"I am struggling with the use of computers, overhead projectors and other modern technology. I lack the expertise in computer programming. …when I encounter difficulties, I seek assistant from the technology department. I'm not very competent; need more training on how to use technologies. There is need for more Continuous PD on technology usage for we (lecturers) as most of us need more update[s] in the use of technology, the CPD programmes on technology organised once in a blue moon is not sufficient to get us on the track technology wise. Moreover, most of us were not trained during our pre-service training on the use of technologies, we are learning on the job, so regular Continuous PD is needed, although we make personal efforts to upgrade ourselves so we can train our students on technology use, but that is not sufficient." (*Focus Group Interview - Lily).

"There is need for regular Continuous Professional Development for we lecturers in Early Childhood Education department to improve our Technological Knowledge and Technological Pedagogical Knowledge. As for me, I learnt the use of technologies over the years through personal efforts and irregular CPD organised by the university. However, I am not competent in robotic programming as the university did not install the programme in the available technologies and no incentive to support our technological development." *(*Focus Group Interview - Zee).

The above excerpts from the focus group interview of the ECE lecturers were in agreement with their collages and concept maps' images and expressions.

*The pictures in the collages portrayed the ECE lecturers struggling with the use of technologies, as can be seen in third column of group 'a' collage. In the second picture on the third column of group 'a' collage, a lecturer was seen being directed on how to use the technology; she was struggling with by a technology expert. In addition, the images in the collages such as '**got TPACK?'** on group 'b' collage also showed that ECE lecturers lack sufficient knowledge of TPACK which is required for effective integration of technology in education* (Lau, 2018*). Moreover, the ECE lecturers also expressed in their concept maps that one of the inhibitors/limitations of proper integration of technology in their classrooms was insufficient CPD in technology usage.*

From the above excerpts it was apparent, that the lecturers were not updating their technological knowledge to meet with the new innovations in technology. They were also not abreast with new technological innovations like robotics needed in this 21st century technological knowledge. As such, there was insufficient technological training of pre-service teachers in the CB University on the use of technology. This was due to failure of CB University and the government to support ECE lecturers' professional development,as the participants commented in the focus group interview and also expressed in their collages and concept maps. Their views indicated that lecturers recognised that their professional development was the only way they could improve their skills and be abreast with new innovations in teaching and learning. The university and the government had neglected their continuous professional development by neglecting to assist them financially to attend conferences, workshops, seminars on new technology inventions, or even organise workshops regularly for them in the university. Consequently, they were not abreast with computer programming like robotics, and most of them still struggled with the use of technologies. However, they could train the pre-service teachers on how to use the available technologies with some assistance from technology department.

This suggests that changes in lecturers' professional practice should be supported by Professional Development; as such, preparing lecturers professionally is inevitable for effective technological integration in teaching and learning. Studies have shown that for proper integration of technology, educators should have Technological Pedagogical Knowledge, which is relevant to their subject content in order to select relevant technologies (Khoza, 2016).

These excerpts are in line with certain assertions in literature: Buabeng-Andoh (2015), in his study on how technology resources were being used in secondary schools in Ghana, affirmed the low technology usage due to insufficient professional development of teachers. This confirms a link in lecturers' professional development and the use of technology in the classroom. It is, therefore, quintessential to develop lecturers' technological skills so they can be effective in the use of technology in their professional practices. In same vein, Kankaanranta et al. (2017) stated that lecturers needed continuous professional development to be effective and efficient in their career. Evers, Kreijns and Van der Heijden (2015) also asserted that continuous professional development is essential to keep educators up-to-date with the continuously changing practices.

Ibrahim et al. (2018) also recommended that for teachers and students to play active roles in teaching and learning activities, there should be teacher training and continuous professional development-oriented policies that support ICT-related teaching models. According to Eze and Akubugwo's (2016) findings, the teachers were not given the required attention needed for their Continuous Professional Development in ICT, which affected the technological impact on their students. Wynants and Dennis (2018) in their study on continuous professional development in an online context, also affirmed the need for it to enhance technology integration in teaching and learning.

This is in line with Tom-Lawyer's (2016) findings that Nigerian colleges were not using technology adequately due to lecturers' incompetence in the use of technology. Akinwale et al. (2017) discovered that some of the challenges in incorporating ICT (Information and Communication Technology) into teacher education in Nigeria were: lack of ICT pedagogy professionalism; and insufficient knowledge on the part of most lecturers training these pre-service teachers, in the use of technology. In same vein, Johnson et al. (2016) affirmed that lecturers' effective integration of technology in their lessons was not feasible without effective continuous professional development on new technologies.

Moreover, Kara and Cagiltay (2017) asserted that in-service educators recognised the advantage of using technologies as it makes the teacher's job easier, allows the teacher to use different materials, accelerates teaching, helps the teacher in classroom management and saves time. However, these scholars also noted that lecturers were having difficulties as they were uncertain how, when and where technologies could be incorporated into the content to be taught, and how to link technologies to their existing pedagogy. From the above statements it is evident that there is a need for regular continuous professional development of the ECE lecturers on the use of technology to improve their expertise. This would further help the lecturers train the pre-service teachers better on the use of technologies.

The need to prepare pre-service teachers to be familiar with the use of technologies in this Fourth Industrial Revolution cannot be overemphasised. It is apparent that through international research, many early childhood educators lack content knowledge in the use of technologies and appropriate pedagogies for incorporating technologies in the teaching and learning process (Murcia, Campbell & Aranda 2018). Moreover, technologies are fast growing and having a tremendous effect on the young children, which has become part of their daily lives. Technologies' immense benefit to young children is quite applaudable.

When supported by well-designed and developmentally appropriate technologies in a play-based learning environment, young children engage in simple coding or early programming, which affords them the opportunity to explore and experience problem-solving, computational thinking and mathematical reasoning involving measurement, spatial awareness and geometric visualisation (Murcia et al. 2018). Teaching and learning has been influenced by the Fourth Industrial Revolution through technology, both inside and outside the classroom. Robotics could provide a playful bridge for integrating the teachers' development of technological pedagogical content knowledge with children's learning projects (Elkin et al. 2018). It is essential to upgrade the lecturers' knowledge in robotics and computer programming through a continuous professional development programme so they can be relevant and effective in training pre-service teachers on how to use technologies. This in turn would enable the pre-service teachers to be competent in the use of technologies in teaching in ECE centres, as technology has become part of their lives, both at school and outside.

7.4 Summary from the Themes

Based on the content analysis of research question three, I drew the following conclusions:

There is a need to revisit the National Curriculum of ECE in Nigeria for proper integration of 21st century technologies when subsequently the ECE lecturers pack would improve.

All the lecturers affirmed that integration of technology enhances teaching and learning.

There is a need for the provision of sufficient technologies in the ECE department for the lecturers to train the pre-service teachers.

There was poor integration of technology in the lessons given by ECE lecturers due to insufficient technological integration in the ECE curriculum. The curriculum is a guide to lesson plan for the lecturers, so if there is no stipulation of technology in the curriculum the lecturers cannot do otherwise. This means that the level of integration of technology in the lecturers' lessons, to a large extent, depends on the curriculum.

Most of the lecturers have the Content Knowledge (CK) but lack Technological Knowledge (TK) and Technological Pedagogical Knowledge (TPK); as they were not actually trained in the use of technology during their studies, the Continuous Professional Development is not frequently organised to update the lecturers technologically.

All the lecturers affirmed that the major problem of the low integration of technology in the training of pre-service teachers was lack of provision of the basic modern technologies needed by the university/government, and the level of technology integration in the curriculum and course/module outline.

7.5 Summary of Chapter Seven

Chapter Seven focused on Research Question 3: Why do ECE lecturers train ECE Pre-service Teachers to use these technologies the way they do? It was established in this study that ECE lecturers lack continuous professional development needed to be proficient in the use of technology to improve their TK and TPK. As such, they still struggle with the use of technology, which hampered the effective training of pre-service teachers in its use. In addition, there was lack of sufficient technologies for effective training of ECE pre-service teachers in the use of technology, also its poor integration in the curriculum. However, the ECE lecturers tried their best to train the pre-service teachers in the use of technologies despite all these lapses. However, it was not very efficient due to the immense importance of technology in teaching and learning. Moreover, the technologies available were not also installed with modern programming, like robotics.

Based on these findings:

- There is a need to revisit the ECE curriculum both at the national level and in universities.
- A new policy that incorporates more technologies in all ramifications should be put in place for the objectives of the ECE programme to be achieved.
- Both the government and the university should equip the ECE department with sufficient modern technologies needed in this Fourth Industrial Revolution in which to train pre-service teachers.
- Above all, there should be constant continuous professional development of ECE lecturers, technology-wise, to enable them to be abreast with the use of technology so they can effectively train the ECE pre-service teachers in its use.

It was established in this study that ECE lecturers used technologies in the training of pre-service teachers for the development of the three domains of learning, namely, psychomotor, affective and cognitive domains.

In the next chapter I provide a review of findings, recommendations and conclusions to this qualitative study.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

The focus of this chapter is to provide a review of findings, recommendations and conclusions to the qualitative study. The analysis of the findings were produced using diverse data generation methods, namely, interview protocol, document analysis, observation schedule, focus group discussion, collages and concept maps. The study, which aimed to explore how ECE lecturers train ECE pre-service teachers in the use of technology at CB University in Nigeria was underpinned by three research questions:

1) What technologies are used by ECE lecturers to train ECE pre-service teachers?
2) How do ECE lecturers use these technologies to train pre-service teachers in terms of content and pedagogy?
3) Why do ECE lecturers train ECE Pre-service Teachers to use these technologies the way they do?

8.2 Summary of Key Research Findings

8.2.1 *Findings for Research Question 1*

Table 8.1: Summary of Findings from Research Question 1

Research Question 1	Overall findings
What technologies are used by ECE lecturers to train ECE pre-service teachers?	It was established in this study that ECE lecturers used technologies in the training of pre-service teachers for the development of the three domain of learning namely Psychomotor, Affective and Cognitive domains. There appeared to be an almost one on one alignment between the technologies ECE lecturers were expected to use when they train ECE pre-service teachers (as stipulated by the CB University curriculum) and the technologies lecturers claimed to use when they train ECE pre-service teachers. The ECE curriculum of CB University did not embrace the latest technologies available to promote the skills required for the 4IR.

Research Question 1	Overall findings
	Some of the technologies contained in the ECE curriculum of CB University and those ECE lecturers claimed to use were very old and dated.

8.2.2 *Findings for Research Question 2*

Table 8.2: Summary of Findings from Research Question 2

Research Question 2	Major Findings
How do ECE lecturers train pre-service teachers in the use of technology in terms of content and pedagogy?	There was insufficient integration of technology courses/modules in the CB University ECE Curriculum and the National ECE Curriculum at large. There was lack of technologies for PST to engage in hand-on practice needed to acquire the desired technological skills for future use in their profession. There was insufficient time in the time table for the few courses/modules on technology, to enable the PST attain the desired outcome within the lesson period. The ECE lecturers were very efficient in Content Knowledge (CK) but lack sufficient Pedagogical Knowledge (CK) and Technological Pedagogical Knowledge (TPK) needed for effective technology integration. There was insufficient Continuous Professional Development (CPD) given to the ECE lecturers in CB University to equip them technologically.

Research Question 2	Major Findings
	The CB University ECE lecturers trained the PST in the use of technology effectively in terms of content but ineffectively in terms of pedagogy.

8.2.3 *Findings for Research Question 3*

Table 8.3: Summary of Findings and Themes from Research Question 3

Research Question 3	Overall finding	Themes
Why do ECE lecturers train ECE Pre-service Teachers to use these technologies the way they do?	ECE lecturers trained the pre-service teachers the way they did because of the immense relevance of technology in this 21st century although the training was not efficient and effective due to some constraining factors: ECE lecturers lacked Professional Development needed to be proficient in the use of technology as such they still struggled with the use of technology which hampered the effective training of pre-service teachers in the use of Technology. In addition, there were insufficient technologies for effective training of ECE pre-service	Poor integration of technology in the CB University ECE currculum. Lack of sufficient technologies to promote effective technology training Lack of support for Lecturers' Continuous Professional Development (CPD) Benefits of technology in teaching and learning

Research Question 3	Overall finding	Themes
	teachers in the use of technology, also poor integration of Technology in the curriculum.	

Theme 1: Poor Integration of Technology in the CB University ECE Curriculum

All the participants affirmed the need for more integration of technology in the national ECE curriculum and subsequently in the CB University ECE curriculum, as the CB University draws its curriculum from the national curriculum. For effective and efficient training of pre-service teachers in the use of technology, there is a need for the technology modules/courses to run from first year to final year, not just in their second year and final year. The lecturers can only train the pre-service teachers as was stipulated in the curriculum, so they are limited in the technology training of them due to the poor integration of technology in the curriculum.

Theme 2: Lack of Sufficient Technologies to Promote Effective Technology Training

The technologies in the ECE department were not sufficient for the pre-service teachers' hands-on practice needed for proper integration of technologies. Only one desktop was provided by the university for technology training and only a few students had their PC to use for technology classes. Due to insufficient technologies, about five students used one laptop for hands-on practice, and a large group of pre-service teachers use the only available desktop in turns in the absence of laptops. It was not possible for the lecturers to get the desired outcome of the lessons under such conditions. As a result, there was ineffective training of pre-service teachers in the use of technology in CB University.

Theme 3: Lack of Support for Lecturers' Continuous Professional Development (CPD)

All the participants lamented on the need for their continuous professional development in order to be abreast with the modern technological innovations and strategies so that they could apply such knowledge in the training of pre-service teachers in the use of technology. ECE lecturers have a significant role to play in the effective training of the pre-service teachers. They need continuous professional development since they were not trained in the use of technology during their programme of study and were learning on the job. They asserted that they were not able to train the pre-service teachers in terms of pedagogy as required because they were not well groomed in technology through continuous professional development.

Theme 4: Benefits of Technology in Teaching and Learning

The immense benefits of technology in teaching and learning were greatly applauded by all the participants. They asserted unanimously that technology is important in teaching and learning in early childhood education to prepare the pre-service teachers technologically so they could teach the children in ECE centres with same technologies. This was a major factor that motivated ECE lecturers to integrate technologies in their teaching to train pre-service teachers despite the challenges mentioned above. They emphasised the benefits of technology integration in the teaching and learning in ECE department to: simplify complex ideas; enhance creativity; solve problems; visualise and manipulate objects; improve hand-eye coordination; provide information that is not covered in the textbooks; increase student interactions; and increases students motivation/ interest to learn.

8.3 Recommendations

Based on the findings the following recommendations are made'

There is a need for the ECE department of CB University to align its university policy to the national ECE policy by creating more curriculum space for integration of technologies in the training of ECE PST.

CB University should allocate sufficient time in the timetable for courses/modules on technology to enable the PST attain the desired outcome (TPACK) within the lesson period.
There is a need for the CB University to equip the ECE department with the latest and ample technologies needed in this Fourth Industrial Revolution for PSTs to engage in hands-on practice in order to acquire the desired technological skills (TPACK) for future use in their profession.

Universities should enhance the Pedagogical Knowledge (PK) and Technological Pedagogical Knowledge (TPK) of ECE lecturers through constant and effective continuous professional development to enable them to train pre-service teachers effectively with the available technologies in terms of pedagogy.

There is a need to revisit the ECE curriculum, both at the national level and in universities for integration of more technology based courses/modules in the university ECE curriculum and the national ECE curriculum at large, from year one to four. This would enable continuous technological training for the pre-service teachers.

There is a need for ECE lecturers to engage in continuous PD technology-wise, to be abreast with the use of technology so they can effectively train ECE pre-service teachers in the use of technology.

There should be provision of ICT (Information and Communication Technology) skilled man-power, or experts, to help in the training of ECE pre-service teachers. Their services are inevitable as they are needed in the repairs/upkeep of the equipment and subsequently in the accomplishment of technology integration.

Recommendations for Further Study. In the light of the importance of technology in teaching and learning in early literacy, the study recommends further studies to explore how lecturers in higher institutions in Nigeria integrate technology in their daily lessons to prepare students to adapt to their professions as technology has become the order of the day.
Further studies should be done to explore the barriers to the use of technologies in higher education in Nigeria.

8.4 Addressing the Knowledge Gap (New Contribution from the Study)

The study was distinct in many ways. Firstly, the sample was ECE lecturers, a relevant group in the training of pre-service Early Childhood Education teachers, who are further employed as teachers in Early Childhood Education centres to teach pre-schoolers. Quite unique in this study is the novel approach to data collection method through the use of collages and concept maps. These are in addition to individual interviews, focus group interviews, lesson observation and document analysis.

It is clear from this study that for ECE pre-service teachers to be technologically competent, the ECE lecturers must have Content Knowledge, Pedagogical Knowledge and Technological Pedagogical Knowledge in order to train them for their future profession, technology-wise. In this regard, ECE pre-service teachers' technological training is dependent on the ECE lecturers' technological competence. This resonates with Mishra and Koehler (2006), who postulate that for proper integration of technology in teaching and learning, educators/lecturers must acquire technological, pedagogical content knowledge (TPACK).

Although the use of TPACK was very useful in underpinning this study, there is some limitation to this model as it did not take full cognisance of the context.

Although the TPACK model diagram (Figure 8.1) situated the interconnecting rings/circles in an area marked "context", it does not specify or define the context. Hence, I argue that TPACK's theorisation did not include room for explaining teachers' socio-cultural backgrounds (context) when investigating pedagogical practices.

Context is central in learning. Context shapes the learning experience. Context affects every aspect of the learning process. For effective learning, external learning environment such as quality of equipment/facilities and the training level of the teacher must be considered. Context allows us to address the fact that learning is not just a mental activity that occurs in a vacuum; rather, many interacting factors (physical, cultural, social, mental and emotional) affect learning and performance. The context determines how pre-service teachers use technologies.

According to Tessmer and Richey (1997), context is a multilevel body of factors in which learning and performance is rooted. Roussinos and Jimoyiannis (2019) confirm in their study that teachers' perception of TPACK was influenced by gender, teaching experience and level of technological training. In same vein, Blackwell et al. (2016) examined the effect of such factors that affect effective integration of technology in education, such as student background, teacher attitudes and school support. Moreover, Walsh (2017) asserted that it is not adequate to expect that a teacher who is experienced in content, pedagogy and technology will use technology effectively without the context also being conducive to doing so.

It is evident from my study that ECE lecturers' TPACK knowledge and effective training of PST in the use of technology were based on such socio-cultural background (context) like institutional support, level of technological training and availability of technologies. Therefore, socio-cultural contexts influenced ECE lecturers' pedagogical knowledge and technological pedagogical knowledge required for effective training of pre-service teachers in the use of technology. It can be inferred that for educators to effectively integrate technology in their lessons; they do not only need to acquire Technological Pedagogical Content Knowledge (TPACK) but their socio-cultural context must be conducive too. It is acknowledged that while ECE lecturers' lack of Technological Knowledge and Technological Pedagogical Knowledge affected their effective training of pre-service teachers in the use of technology, their socio-cultural background (context) contributed to poor integration of technology in their lesson, and invariably inefficient training of ECE pre-service teachers in the use of technology.

Based on the foregoing, I advance, therefore, for a modification to the TPACK framework. There is need to refine the TPACK components to reflect the complexity of technology

integration in classrooms and the complex role of contexts (Figure 8.2). This is in line with Porras-Hernandez and Salinas-Amescua (2013) and Yeh et al.'s (2014) suggestions. This study argues that teachers' pedagogical and technological practices cannot be fully understood without considering the social and cultural backgrounds of the educators.

THE OLD TPACK MODEL

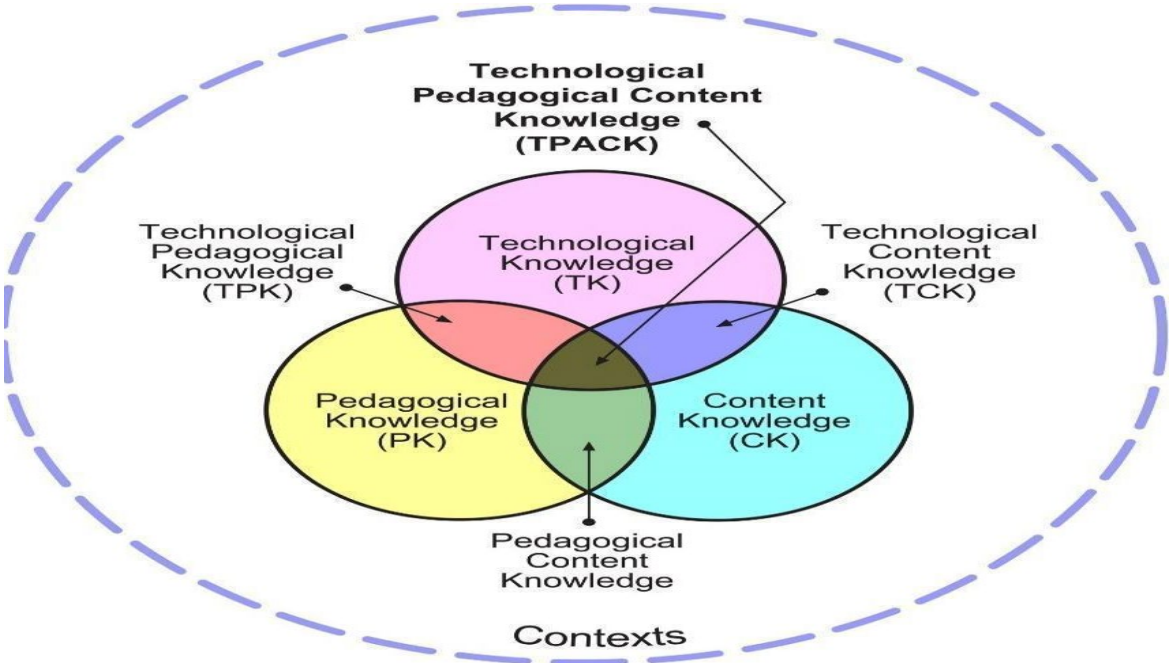

Figure 8.1: The Old TPACK Model Diagram

Source: Herring, Koehler & Mishra. (2016) *Handbook of technological pedagogical content knowledge (TPACK) for educators*. Routledge.

A NEW TPACK MODEL.

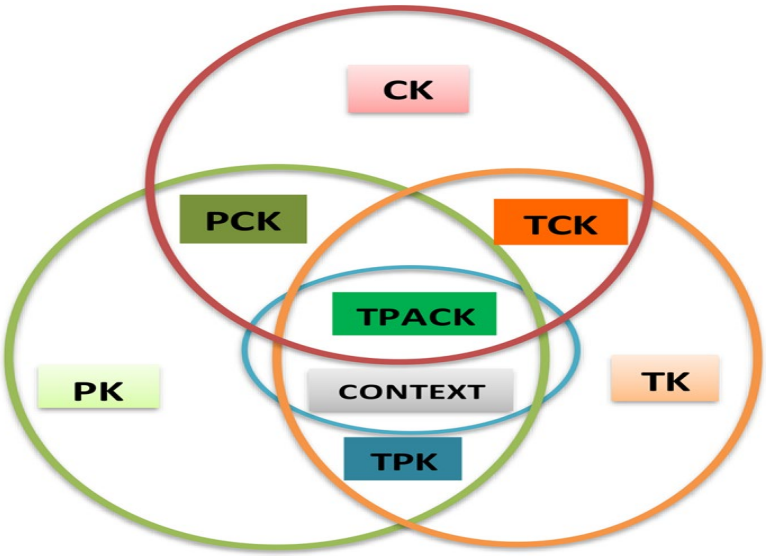

Figure 8.2:. Suggested New TPACK Framework Integrating the Complexity Role of Context Level

8.4.1 *Comparison of Old and New TPACK Models*

In the old TPACK model, the seven TPACK constructs do not integrate the context as a basic factor for its process but in the new TPACK model, context is an integral part of the TPACK construct operation. In other words, the old TPACK model defined the teachers' knowledge of TPACK as a basic requirement for effective integration of technology in teaching and learning, irrespective of whether the context in which they operate is conducive or not. However, the new TPACK model projects the teachers' socio-cultural context as a basic determinant of teachers' effective integration of technology in education alongside their knowledge of TPACK. The new model of TPACK is relevant for the researchers' point of view about the strong association between teachers' conceptualisation of pedagogical practice and their socio-cultural background (context). This framework may help researchers not only survey teachers use of technologies in education; but ascertain what to address and which areas to concentrate on when change is required to improve pedagogical practices. It may also enlighten educational professional development programme designers that link pedagogy with technologies. This new TPACK model is timely, as the old TPACK model failed to explain the connection between technological pedagogical content knowledge and socio-cultural background (context). The old TPACK Model does not reveal what my participants have shown me: that the integration of technology in education is not only influenced by the level of TPACK

knowledge of the educators but also their socio-cultural background (context). The new TPACK model helps to fill this critical gap in knowledge.

The framework contributes to the field of technology integration research by explaining what happens in many pedagogical contexts where the anticipated factors in response to technology use were not observed. The new TPACK framework is useful for analysing teachers' past and present experiences when exploring their pedagogical and technological training, and would help identify which aspects need to be considered when designing teachers' professional development.

The proposed framework helps to make connections between the personified socio-cultural aspects of teachers' experiences and how they relate to their existing pedagogical practices of using technologies. This study recommends using the new TPACK model to understand other factors that must be put in place for teachers to effectively integrate technology in education apart from developing the knowledge of TPACK, such as their level of technological training, institutional support in continuous professional development, technology-wise, and availability of learning resources (technologies).

It would therefore help researchers to explain the influence of socio-cultural backgrounds in their use of technologies.

8.5 Conclusion. This chapter summarised the findings that emerged from this study, which illuminated how, when and why ECE lecturers train pre-service ECE teachers in the use of technologies. The findings presented in Chapters Five, Six and Seven indicated lack of the required technology training of pre-service teachers in the use of technology in the ECE department of CB University. It brought teachers together to express and demonstrate how they train pre-service teachers in the use of technology, and why they do so the way they do. Based on the findings, recommendations were given for all stake holders.

REFERENCES

Adeosun, O. (2014). Teacher education programmes and the acquisition of 21st century skills: Issues and challenges in Nigeria. https://www.researchgate.net/publication/318888744

Adhabi, E. A., & Anozie, C. B. (2017). Literature Review for the Type of Interview in Qualitative Research. *International Journal of Education*, *9*(3), 86. https://doi.org/10.5296/ije.v9i3.11483

Afunde, N. L. (2015). *An investigation of the integration of Information Communication Technology in teaching of science subjects at the Namibian College of Open Learning* [Unpublished doctoral dissertation, University of Namibia].

Akkaya, R. (2016). Research on the development of middle school mathematics pre-service teachers' perceptions regarding the use of technology in teaching mathematics. *EURASIA Journal of Mathematics, Science and Technology Education*, *12*(4). https://doi.org/10.12973/eurasia.2016.1257a

Akinrotimi,A.A & Olowe, P.K (2016). Challenges in implementation of early childhood education in Nigeria: The way forward. *Journal of Education and Practice*, 7(7), 33-38. https://files.eric.ed.gov/fulltext/EJ1095294.pdf

Akinwale, Olubosede, Gbadebo, & Omolola. (2017). Challenges of Information and Communication Technologies (ICTs) Integration in Nigerian Teacher Education Programme: Students' Perspectives. *E-Journal of the Global Summit on Education* 2017 (GSE 2017). (E-ISSN 2289-6880). https://worldconferences.net/journals/gse/papergse/v5/067.pdf

Aladé, F., Lauricella, A. R., Beaudoin-Ryan, L., & Wartella, E. (2016). Measuring with Murray: Touchscreen technology and preschoolers' STEM learning. *Computers in Human Behavior*, *62*, 433–441. https://doi.org/10.1016/j.chb.2016.03.080

Alakärppä, I., Jaakkola, E., Väyrynen, J., & Häkkilä, J. (2017). Using nature elements in mobile AR for education with children. *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services* (pp. 1-13). https://doi.org/10.1145/3098279.3098547

Akar, H. (2020). The effect of smart board use on academic achievement: a meta-analytical and thematic Study. *International Journal of Education in Mathematics, Science and Technology*, *8*(3), 261. https://doi.org/10.46328/ijemst.v8i3.908

Aldhafeeri, F., Palaiologou, I., & Folorunsho, A. (2016). Integration of digital technologies into play-based pedagogy in Kuwaiti early childhood education: teachers' views, attitudes and aptitudes. *International Journal of Early Years Education*, *24*(3), 342–360. https://doi.org/10.1080/09669760.2016.1172477

Alshenqeeti, H. (2014). Interviewing as a data collection method: A critical review. *English Linguistics Research*, *3*(1). https://doi.org/10.5430/elr.v3n1p39

Altun, D. (2019). Investigating Pre-Service Early Childhood Education Teachers' Technological Pedagogical Content Knowledge (TPACK) Competencies Regarding Digital Literacy Skills and Their Technology Attitudes and Usage. *Journal of Education and Learning*, *8*(1), 249. https://doi.org/10.5539/jel.v8n1p249

Andyani, H., Setyosari, P., Wiyono, B., & Djatmika, E. T. (2020). Does Technological Pedagogical Content Knowledge Impact on the Use of ICT In Pedagogy? *International Journal of Emerging Technologies in Learning (IJET)*, *15*(03), 126. https://doi.org/10.3991/ijet.v15i03.11690

Anfara Jr, V. A., & Mertz, N. T. (Eds.). (2014). Theoretical Frameworks in Qualitative Research. Thousand Oaks, CA: Sage. *Adult Education Quarterly*, *59*(3), 267–269. https://doi.org/10.1177/0741713609332386

Armstrong, P. (2015). Teacher characteristics and student performance: An analysis using hierarchical linear modelling. *South African Journal of Childhood Education*, *5*(2), 23. https://doi.org/10.4102/sajce.v5i2.393

Austin, N., Hampel, R., & Kukulska-Hulme, A. (2017). Video conferencing and multimodal expression of voice: Children's conversations using Skype for second language development in a telecollaborative setting. *System*, *64*, 87–103. https://doi.org/10.1016/j.system.2016.12.003

Batane, T., & Ngwako, A. (2016). Technology use by pre-service teachers during teaching practice: Are new teachers embracing technology right away in their first teaching experience? *Australasian Journal of Educational Technology*. https://doi.org/10.14742/ajet.2299

Baydas, O., & Goktas, Y. (2016). Influential factors on preservice teachers' intentions to use ICT in future lessons. *Computers in Human Behavior*, *56*, 170–178. https://doi.org/10.1016/j.chb.2015.11.030

Beckers, T., Koekkoek, B., Hutschemaekers, G., & Tiemens, B. (2018). Potential predictive factors for successful referral from specialist mental-health services to less intensive treatment: A concept mapping study. *PLOS ONE*, *13*(6). https://doi.org/10.1371/journal.pone.0199668

Belotto, M. (2018). Data analysis methods for qualitative research: managing the challenges of coding, interrater reliability, and thematic analysis. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2018.3492

Bernard, H. R. (2017). *Research methods in anthropology: Qualitative and quantitative approaches*. Rowman & Littlefield.

Bers, M., Seddighin, S., & Sullivan, A. (2013). *Ready for robotics: Bringing together the T and E of STEM in early childhood teacher education*. Journal of Technology and Teacher Education. https://www.learntechlib.org/primary/p/41987/

Bertram, C., & Christiansen, I. M. (2014). *Understanding research: An introduction to reading research,* Van Schaik Publishers.

Bibi, S., & Khan, S. H. (2017). TPACK in action: A study of a teacher educator's thoughts when planning to use ICT. *Australasian Journal of Educational Technology*, *33*(4). https://doi.org/10.14742/ajet.3071

Biggs, B. A. (2014). *Content area reading instruction for secondary teacher candidates: a case study of a state-required online content area reading course*. University of Minnesota Digital Conservancy. https://hdl.handle.net/11299/162631

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking. *Qualitative Health Research*, *26*(13), 1802–1811. https://doi.org/10.1177/1049732316654870

Birkollu, S. S., Yucesoy, Y., Baglama, B., & Kanbul, S. (2017). Investigating the attitudes of pre-service teachers towards technology based on various variables. *TEM Journal*, *6*(3), 578- 583.

Blackwell, C. K., Lauricella, A. R., Wartella, E., Robb, M., & Schomburg, R. (2013). Adoption and use of technology in early education: The interplay of extrinsic barriers and teacher attitudes. *Computers & Education*, *69*, 310-319. https://doi.org/10.1016/j.compedu.2013.07.024

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40. https://doi.org/10.3316/qrj0902027

Brun, M., & Hinostroza, J. E. (2014). Learning to become a teacher in the 21st century: ICT integration in Initial Teacher Education in Chile. *Journal of Educational Technology & Society*, *17*(3), 222-238. https://www.jstor.org/stable/10.2307/jeductechsoci.17.3.222

Bruno, L. P., Scott, L. A., & Willis, C. (2018). A Survey of alternative and traditional special education teachers' perception of preparedness. *International Journal of Special Education*, *33*(2), 295-312.

Brunsek, A., Perlman, M., McMullen, E., Falenchuk, O., Fletcher, B., Nocita, G., Kamkar, N., & Shah, P. S. (2020). A meta-analysis and systematic review of the associations between professional development of early childhood educators and children's outcomes. *Early Childhood Research Quarterly*, *53*, 217–248. https://doi.org/10.1016/j.ecresq.2020.03.003

Buabeng-Andoh, C. (2015). ICT usage in Ghanaian secondary schools: teachers' perspectives. *The International Journal of Information and Learning Technology*, *32*(5), 300–312. https://doi.org/10.1108/ijilt-09-2015-0022

Burbules, N. C., & Callister, T. A. (2018). The risky promises and promising risks of new information technologies for education. *Watch It*, 1–18. https://doi.org/10.4324/9780429503153-1

Burnett, C. (2010). Technology and literacy in early childhood educational settings: A review of research. *Journal of Early Childhood Literacy*, *10*(3), 247–270. https://doi.org/10.1177/1468798410372154

Carver, L. B. (2016). Teacher perception of barriers and benefits in K-12 technology usage. *Turkish Online Journal of Educational Technology-TOJET*, *15*(1), 110-116. https://files.eric.ed.gov/fulltext/EJ1086185.pdf

Chilisa, B., & Kawulich, B. (2012). Selecting a research approach: Paradigm, methodology and methods. *Doing social research: A global context*, *5*(1), 51-61.

Cirillo, V., Pianta, M., & Nascia, L. (2018). Technology and occupations in business cycles. *Sustainability*, *10*(2), 463. https://doi.org/10.3390/su10020463

Clark, R. C., & Mayer, R. E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*. Wiley. https://doi.org/10.1002/9781118255971

Cohen, L., Manion, L., & Morrison, K. (2017). Inferential statistics. *Research Methods in Education*, 776–801. https://doi.org/10.4324/9781315456539-41

Collins, A., & Halverson, R. (2018). *Rethinking education in the age of technology: The digital revolution and schooling in America.* (2nd ed.). Teachers College Press.

Conceição, S. C. O., Samuel, A., & Yelich Biniecki, S. M. (2017). Using concept mapping as a tool for conducting research: An analysis of three approaches. *Cogent Social Sciences*, *3*(1), 1404753. https://doi.org/10.1080/23311886.2017.1404753

Creasy, K. L. (2015). Defining professionalism in teacher education programs. *Online Submission*, *2*(2), 23-25.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage.

Creswell, J. W. (2014). A concise introduction to mixed methods research, Sage.

Curry, J. H., & Whitney-Emberton, J. (2016). Review of Integrating Educational Technology into Teaching, 7th Edition by M.D. Roblyer. *TechTrends*, *60*(2), 190–191. https://doi.org/10.1007/s11528-016-0032-9

Cypress, B. S. (2017). Rigor or reliability and validity in qualitative research: Perspectives, strategies, reconceptualization, and recommendations. *Dimensions of Critical Care Nursing*, *36*(4), 253-263. https://doi.org/10.1097/dcc.0000000000000253

Daniel, B. K. (2018). Empirical verification of the "TACT" framework for teaching rigour in qualitative research methodology. *Qualitative Research Journal*, *18*(3), 262–275. https://doi.org/10.1108/qrj-d-17-00012

Denscombe, M. (2014). *The good research guide: for small-scale social research projects*. McGraw-Hill Education.

Dillon, M. B., Radley, K. C., Tingstrom, D. H., Dart, E. H., & Barry, C. T. (2019). The effects of tootling via classdojo on student behavior in elementary classrooms. *School Psychology Review*, *48*(1), 18–30. https://doi.org/10.17105/spr-2017-0090.v48-1

Dong, C. (2016). Preschool teachers' perceptions and pedagogical practices: young children's use of ICT. *Early Child Development and Care*, *188*(6), 635–650. https://doi.org/10.1080/03004430.2016.1226293

Drigas, A., & Kokkalia, G. (2014). ICTs and special education in kindergarten. *International Journal of Emerging Technologies in Learning (IJET)*, *9*(4), 35-42. https://doi.org/10.3991/ijet.v9i4.3662

Ejike, P. E. (2017). Digital tech: Improving access to education in Nigeria [Haller Prize 2nd place]. https://africanarguments.org

El Hussein, M. T., Jakubec, S. L., & Osuji, J. (2016). The FACTS: A mnemonic for the rapid assessment of rigor in qualitative research studies. *Journal of Nursing Education*, *55*(1), 60–60. https://doi.org/10.3928/01484834-20151214-15

Elkin, M., Sullivan, A., & Bers, M. U. (2018). Books, butterflies, and 'bots: integrating engineering and robotics into early childhood curricula. *Early Mathematics Learning and Development*, 225–248. https://doi.org/10.1007/978-981-10-8621-2_11

Eluwole, O. T., Udoh, N., Ojo, M., Okoro, C., & Akinyoade, A. J. (2018). From 1G to 5G, what next? *International Journal of Computer Science*, *45*(3) http://www.iaeng.org/IJCS/issues_v45/issue_3/IJCS_45_3_06.pdf

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5, 1-4. - References - Scientific Research Publishing. (n.d.). https://www.scirp.org/reference/ReferencesPapers.aspx?ReferenceID=2258299

Evers, A. T., Kreijns, K., & Van der Heijden, B. I. J. M. (2015). The design and validation of an instrument to measure teachers' professional development at work. *Studies in Continuing Education*, *38*(2), 162–178. https://doi.org/10.1080/0158037x.2015.1055465

Eze, R. O., & Akubugwo, I. G. (2016). Evaluation of the integration of computer/ICT education by teachers in junior secondary schools in Nigeria: A Case Study of Abia State. *Evaluation*, *6*(7). https://www.iiste.org/Journals/index.php/IKM/article/download/31724/32596

Fagan, S. (2018). Web-based inquiry: a potential solution for resource-poor high school biology classrooms? https://digitalcommons.hamline.edu

Falk-Ross, F., & Linder, R. (2018). Advocating for increased use of digital literacies for future middle school teachers for literacy instruction. *Preparing middle level educators for 21st century schools: Enduring beliefs, changing times, evolving practices*, 203-226. https://www.pace.edu/school-of-education/sections/meet-the-faculty/faculty-profile/ffalkross

Federal Ministry of Education (2013). *Guidelines for implementing national policy on integrated early childhood development in Nigeria. Abuja, Nigeria*. https://www.idpublications.org/wp-content/uploads/2016/04/ pdf

Federal Republic of Nigeria (2013). *National policy on education*. (3rd ed). Lagos Nigeria, NERDC.

Ferrer, M. F., & García, E. C. (2016). The influence of the internet for pedagogical innovation: using twitter to promote online collaborative learning. *International Journal of Educational Technology in Higher Education*, (13), 16.

FitzPatrick, B. (2019). Validity in qualitative health education research. *Currents in Pharmacy Teaching and Learning*, *11*(2), 211-217. https://doi.org/10.1016/j.cptl.2018.11.014

Flick, U. (2015). *Introducing research methodology: a beginner's guide to doing a research project* (2). Sage.

Flick, U. (2018). *An introduction to qualitative research (6)*. Sage.

Follari, L. (2015). *Foundations and best practices in early childhood education: History, theories, and approaches to learning*. Pearson Higher Education AU. https://www.pearsonhighered.com/assets/preface/0/1/3/4/0134747984.pdf

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (1993). *How to design and evaluate research in education* (Vol. 7). McGraw-hill.

Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's paradigm shift: Revisiting triangulation in qualitative research. *Journal of social change*, *10*(1), 2. https://doi.org/10.5590/josc.2018.10.1.02

Gentles, S. J., Charles, C., Ploeg, J., & McKibbon, K. A. (2015). Sampling in qualitative research: Insights from an overview of the methods literature. *The Qualitative Report*, *20*(11), 1772-1789. https://doi.org/10.46743/2160-3715/2015.2373

Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. *Computer Assisted Language Learning*, *27*(1), 70-105. https://doi.org/10.1080/09588221.2012.700315

Good, T. L., & Lavigne, A. L. (2017). *Looking in classrooms*. Routledge.

Gormley, K., & McDermott, P. (2015). Searching for evidence—teaching students to become effective readers by visualizing information in texts. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *88*(6), 171-177. https://doi.org/10.1080/00098655.2015.1074878

Govender, N., & Khoza, S. (2017). Technology in education for teachers. In L. Ramrathan, L.Le Grange, and P. Higgs, (eds.), *Education Studies for initial teacher development.* Juta, 66-79.

Gur, H. (2015). A short review of TPACK for teacher education. *Educational Research and Reviews*, *10*(7), 777-789.

Heale, R., & Forbes, D. (2013). Understanding triangulation in research. *Evidence Based Nursing*, *16*(4), 98–98. https://doi.org/10.1136/eb-2013-101494

Hallström, J., Elvstrand, H., & Hellberg, K. (2015). Gender and technology in free play in Swedish early childhood education. *International journal of technology and design education*, *25*(2), 137-149. https://doi.org/10.1007/s10798-014-9274-z

Hancock, D. R., & Algozzine, B. (2017). *Doing case study research: A practical guide for beginning researchers*. Teachers College Press. https://student.cc.uoc.gr/uploadFiles/192-202.pdf

Hannaway, D. M., & Steyn, M. G. (2016). Teachers' experiences of technology-based teaching and learning in the Foundation Phase. *Early Child Development and Care*, *187*(11), 1745–1759. https://doi.org/10.1080/03004430.2016.1186669

Harisha, R. P., & Padmavathy, S. (2013). Knowledge and use of wild edible plants in two communities in Malai Madeshwara Hills, Southern India. *International Journal of Botany*, *9*(2), 64–72. https://doi.org/10.3923/ijb.2013.64.72

Harrison, M., Baker, J., Twinamatsiko, M., & Milner-Gulland, E. J. (2015). Profiling unauthorized natural resource users for better targeting of conservation interventions. *Conservation Biology*, *29*(6), 1636-1646.

Hennessy, S., Haßler, B., & Hofmann, R. (2015). Challenges and opportunities for teacher professional development in interactive use of technology in African schools. *Technology, Pedagogy and Education*, *24*(5), 1–28. https://doi.org/10.1080/1475939x.2015.109246

Herring, M. C., Koehler, M. J., & Mishra, P. (Eds.). (2016). *Handbook of technological pedagogical content knowledge (TPACK) for educators*. Routledge. https://doi.org/10.4324/9781315771328

Hina, S., Dominic, P. D. D., & Zaidi, K. S. (2020). Use of interactive tools for teaching and learning practices in higher education institutions. *International Journal of Business Innovation and Research*, *22*(4), 469-487

Hsu, C. Y., Tsai, M. J., Chang, Y. H., & Liang, J. C. (2017). Surveying in-service teachers' beliefs about game-based learning and perceptions of technological pedagogical and content knowledge of games. *Journal of Educational Technology & Society*, *20*(1), 134-143.

Ibhaze, F. O. (2016). Issues and challenges of implementation of early childhood education in Nigeria. *International Journal of Scientific and Research Publications*, *6*(5), 176-179

Ibrahim, S., Talba, U., & Danjuma, E. (2018). An Assessment of Secondary School Teachers' Uses of ICT's in Borno State, Nigeria. *International Journal of Recent Innovations in Academic Research*, *2*(5), 251-262.

Ifinedo, E., Rikala, J., & Hämäläinen, T. (2020). Factors affecting Nigerian teacher educators' technology integration: Considering characteristics, knowledge constructs, ICT practices and beliefs. *Computers & Education*, *146*, 103760.

Ige, A. M. (2011). The challenges facing early childhood care, development and education (ECCDE) in an era of universal basic education in Nigeria. *Early Childhood Education Journal*, *39*(2), 161-167.

Imazeki, J. (2014). Bring-Your-Own-Device: Turning Cell Phones into Forces for Good. *The Journal of Economic Education*, *45*(3), 240–250. https://doi.org/10.1080/00220485.2014.917898

Iyamu, T. (2018). Collecting qualitative data for information systems studies: The reality in practice. *Education and Information Technologies*, *23*(5), 2249-2264.

Jain, A. K., Acharya, R., Jakhar, S., & Mishra, T. (2018, April). Fifth generation (5G) wireless technology "Revolution in telecommunication". In *2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)* (pp. 1867-1872). IEEE.

Jeong, H. I., & Kim, Y. (2017). The acceptance of computer technology by teachers in early childhood education. *Interactive Learning Environments*, *25*(4), 496-512.

Johnson, A. M., Jacovina, M. E., Russell, D. G., & Soto, C. M. (2016). *Challenges and solutions when using technologies in the classroom*. ERIC Clearinghouse.

Johnson, L., Becker, S. A., Cummins, M., Estrada, V., Freeman, A., & Hall, C. (2016). *NMC horizon report: 2016 higher education edition*. The New Media Consortium.

Johnson, M., O'Hara, R., Hirst, E., Weyman, A., Turner, J., Mason, S., & Siriwardena, A. N. (2017). Multiple triangulation and collaborative research using qualitative methods to explore decision making in pre-hospital emergency care. *BMC Medical Research Methodology*, *17*(1), 1-11.

Kankaanranta, M., Koivula, M., Laakso, M. L., & Mustola, M. (2017). Digital games in early childhood: Broadening definitions of learning, literacy, and play. In *Serious games and edutainment applications.* pp. 349-367. Springer, Cham.

Kara, N., & Cagiltay, K. (2017). In-service preschool teachers' thoughts about technology and technology use in early educational settings. *Contemporary Educational Technology*, *8*(2), 119-141.

Kent, A. M., & Giles, R. M. (2017). Preservice Teachers' Technology Self-Efficacy. *SRATE Journal*, *26*(1), 9-20.

Kerckaert, S., Vanderlinde, R., & van Braak, J. (2015). The role of ICT in early childhood education: Scale development and research on ICT use and influencing factors. *European Early Childhood Education Research Journal*, *23*(2), 183-199.

Kermani, H., & Aldemir, J. (2015). Preparing children for success: integrating science, math, and technology in early childhood classroom. *Early Child Development and Care*, *185*(9), 1504–1527. https://doi.org/10.1080/03004430.2015.1007371

Khanare, F. P., & de Lange, N. (2017). 'We are never invited': School children using collage to envision care and support in rural schools. *South African Journal of Education*, *37*(1).

Khoza, S. B. (2016). Can educational technology be defined from South African University facilitators'understanding? *Empowering the 21st Century Learner*. SAICET, 2016 Proceedings.pdf

King, J., & South, J. (2017). Reimagining the role of technology in higher education: A supplement to the national education technology plan. *US Department of Education, Office of Educational Technology*.

Kitchin, R. (2014). Big data, new epistemologies and paradigm shifts. *Big Data & Society*, 1(1), 2053951714528481.

Kivunja, C., & Kuyini, A. B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education*, *6*(5), 26-41.

Knolton, D. V. (2014). *Technological, pedagogical, content knowledge (TPACK): An exploratory study of adjunct faculty technology proficiency.* [Doctoral dissertation, Kansas State University].

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education*, *193*(3), 13–19. https://doi.org/10.1177/002205741319300303

Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The technological pedagogical content knowledge framework. In *Handbook of research on educational communications and technology* (pp. 101-111). Springer, New York, NY. https://doi.org/10.4324/9781315759630

Koh, J., Chai, C., Benjamin, W., & Hong, H.-Y. (2015). Technological Pedagogical Content Knowledge (TPACK) and Design Thinking: A Framework to Support ICT Lesson Design for 21st Century Learning. *The Asia-Pacific Education Researcher*, *24*(3), 535–543. https://doi.org/10.1007/s40299-015-0237-2

Kozma, R. B., & Isaacs, S. (Eds.). (2011). *Transforming education: The power of ICT policies*. Unesco.

Kukulska-Hulme, A., & Viberg, O. (2018). Mobile collaborative language learning: State of the art. *British Journal of Educational Technology*, *49*(2), 207-218 https://doi.org/10.1111/bjet.12580

Kuonanoja, L., & Oinas-Kukkonen, H. (2018). Recognizing and mitigating the negative effects of information technology use: a systematic review of persuasive characteristics in information systems. *Lecture Notes in Business Information Processing*, 14–25. https://doi.org/10.1007/978-3-319-96367-9_2

Lachner, A., Backfisch, I., & Stürmer, K. (2019). A test-based approach of modeling and measuring technological pedagogical knowledge. *Computers & Education*, *142*, 103645. https://doi.org/10.1016/j.compedu.2019.103645

Lascarides, V. C., & Hinitz, B. F. (2013). *History of early childhood education* (Vol. 982). Routledge. https://doi.org/10.4324/9780203814215

Lau, W. (2018). Relationships between pre-service teachers' social media usage in informal settings and technological pedagogical content knowledge. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(12). https://doi.org/10.29333/ejmste/94228

Lauricella, A. R., Blackwell, C. K., & Wartella, E. (2016). The "New" technology environment: the role of content and context on learning and development from mobile media. *Media Exposure During Infancy and Early Childhood*, 1–23. https://doi.org/10.1007/978-3-319-45102-2_1

Lew, S., Yang, A. H., & Harklau, L. (2018). Qualitative methodology. *The Palgrave Handbook of Applied Linguistics Research Methodology*, 79–101. https://doi.org/10.1057/978-1-137-59900-1_4

Lewis, S. (2015). Qualitative inquiry and research design: choosing among five approaches. *Health Promotion Practice*, *16*(4), 473–475. https://doi.org/10.1177/1524839915580941

Lincoln, Y. S., & Guba, E. G. (1985). Establishing trustworthiness. *Naturalistic inquiry*, *289*(331), 289-327.

Liu, X., & Pange, J. (2015). Early childhood teachers' perceived barriers to ICT integration in teaching: a survey study in Mainland China. *Journal of Computers in Education*, *2*(1), 61-75. https://doi.org/10.1007/s40692-014-0025-7

Livingstone, S., Marsh, J., Plowman, L., Ottovordemgentschenfelde, S. & Fletcher-Watson, B. (2014). Young children (0-8) and digital technology: a qualitative exploratory study-national report-UK. Joint Research Centre, European Commission, Luxembourg.http://eprints.Ise.ac.uk/60799/

Newcomer, K. E., Hatry, H. P., & Wholey, J. S. (2015). Focus group interviewing. In *Handbook of practical program evaluation*, *506*. 7–35. https://doi.org/10.1002/9781119171386.ch1

Maeko, M. S. A. (2020). Teaching and Learning Through Hands-on Activities in Civil Technology Teacher Training Programmes at South African Universities. *Journal of Human Ecology*, *71*(1-3). https://doi.org/10.31901/24566608.2020/71.1-3.3182

Mandal, P. C. (2018). Qualitative data analysis and its nature: debates and discussion. *International Journal of Society Systems Science*, *10*(2), 148-158. https://doi.org/10.1504/ijsss.2018.10013668

Maniram, R., & Maistry, S. M. (2018). Enabling well-being and epistemological access through an authentic assessment intervention: A case study of a higher education programme. *South African Journal of Higher Education*, *32*(6), 305-325. https://doi.org/10.20853/32-6-2982

Manolev, J., Sullivan, A., & Slee, R. (2018). The datafication of discipline: ClassDojo, surveillance and a performative classroom culture. *Learning, Media and Technology*, *44*(1), 36–51. https://doi.org/10.1080/17439884.2018.1558237

Mayaba, N. N., & Wood, L. (2015). The value of using folktales as an intervention tool to enhance resilience for children orphaned and rendered vulnerable by HIV and AIDS. *Education as Change*, *19*(1), 10–35. https://doi.org/10.1080/16823206.2015.1024143

McGee, K. E., & Welsch, J. G. (2020). Using Technology to Build Interactions Within and Beyond the Literacy Classroom. In *Handbook of Research on Integrating Digital Technology with Literacy Pedagogies,* 260-286. IGI Global.

Merriam, S. B. (2015). Qualitative research: Designing, implementing, and publishing a study. In *Handbook of research on scholarly publishing and research methods* (pp. 125-140). IGI Global.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. Wiley.

Mertala, P. (2019). Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. *Computers in Human Behavior*, *101*, 334–349. https://doi.org/10.1016/j.chb.2019.08.003

Meyers, E. M., Nathan, L. P., & Stepaniuk, C. (2017). Children in the cloud: Literacy groupware and the practice of reading. *First Monday*. https://doi.org/10.5210/fm.v22i2.6844

Mfune, O. (2013). Extending Conservation to Farmlands in Zambia: Prescribed Practices and Reality. *Journal of Sustainable Development*, *7*(1). https://doi.org/10.5539/jsd.v7n1p46

Milne, L. (2013). Nurturing the designerly thinking and design capabilities of five-year-olds: technology in the new entrant classroom. *International Journal of Technology and Design Education*, *23*(2), 349–360. https://doi.org/10.1007/s10798-011-9182-4

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Mkimbili, S., & Kitta, S. K. (2020). The rationale of continuous assessment for development of competencies in Tanzania secondary schools. *Advanced Journal of Social Science*, *6*(1), 64–70. https://doi.org/10.21467/ajss.6.1.64-70

Ministry of Education (2013). National Policy on Education- World Bank Group. Nigeria**:**

Mouza, C., Karchmer-Klein, R., Nandakumar, R., Yilmaz Ozden, S., & Hu, L. (2014). Investigating the impact of an integrated approach to the development of preservice teachers' technological pedagogical content knowledge (TPACK). *Computers & Education*, *71*, 206–221. https://doi.org/10.1016/j.compedu.2013.09.020

Mpungose, C. B. (2020). Student teachers' knowledge in the era of the Fourth Industrial Revolution. *Education and Information Technologies*, *25*(6), 5149–5165. https://doi.org/10.1007/s10639-020-10212-5

Muir, T., Callingham, R., & Beswick, K. (2016). Using the IWB in an early years mathematics classroom: an application of the TPACK framework. *Journal of Digital Learning in Teacher Education*, *32*(2), 63–72. https://doi.org/10.1080/21532974.2016.1138913

Murcia, K., Campbell, C., & Aranda, G. (2018). Trends in early childhood education practice and professional learning with digital technologies. *Pedagogika*, *68*(3). https://doi.org/10.14712/23362189.2018.858

Ndibalema, P. (2014). Teachers' attitudes towards the use of information communication technology (ICT) as a pedagogical tool in secondary schools in Tanzania:The case of Kondoa District. International Journal of Education and Research,2(2),1-16. http://.handle.net/20.500.12661/2384

Newcomer, K. E., Hatry, H. P., & Wholey, J. S. (2015). Planning and Designing Useful Evaluations. *Handbook of Practical Program Evaluation*, 7–35. https://doi.org/10.1002/9781119171386.ch1

Nelson, M. J., Voithofer, R., & Cheng, S.-L. (2019). Mediating factors that influence the technology integration practices of teacher educators. *Computers & Education*, *128*, 330–344. https://doi.org/10.1016/j.compedu.2018.09.023

Neumann, M. M. (2018). Using tablets and apps to enhance emergent literacy skills in young children. *Early Childhood Research Quarterly*, *42*, 239–246. https://doi.org/10.1016/j.ecresq.2017.10.006

Neumann, M. M., & Neumann, D. L. (2015). The use of touch-screen tablets at home and pre-school to foster emergent literacy. *Journal of Early Childhood Literacy*, *17*(2), 203–220. https://doi.org/10.1177/1468798415619773

Newman, L., & Obed, L. (2015). The Nigerian integrated early childhood development policy: perspectives on literacy learning. *South African Journal of Childhood Education*, *5*(1), 17. https://doi.org/10.4102/sajce.v5i1.353

Niess, M. L. (2018). Introduction to teachers' knowledge-of-practice for teaching with digital technologies. *Teacher Training and Professional Development*, 145–159. https://doi.org/10.4018/978-1-5225-5631-2.ch007

Niess, M. L. (2016). Technological pedagogical content knowledge (TPACK) framework for K-12 teacher preparation. *Advances in Educational Technologies and Instructional Design*. https://doi.org/10.4018/978-1-5225-1621-7

Nikolopoulou, K., & Gialamas, V. (2015). ICT and play in preschool: early childhood teachers' beliefs and confidence. *International Journal of Early Years Education*, *23*(4), 409–425. https://doi.org/10.1080/09669760.2015.1078727

Nwanekezi, A. U., & Onyekuru, B. (2014). Need for specialist teachers in early childhood education (ECE) delivery for sustainable development in Nigeria. *African Research Review*, *8*(2), 294. https://doi.org/10.4314/afrrev.v8i2.17

Obadiah, S. A., Sa'ad, I. & Hussaini, A. (2017). Strategies for promoting creativity in early childhood education in Nigeria. *Journal of Resourcefulness and Distinction*, *15*(1).

Obiweluozor, N. (2015). Early childhood education in Nigeria, policy implementation: Critique and a way forward. *African Journal of Teacher Education*, *4*(1). https://doi.org/10.21083/ajote.v4i1.2930

Ogunyemi, F. T., & Ragpot, L. (2015). Work and play in early childhood education: Views from Nigeria and South Africa. *South African Journal of Childhood Education*, *5*(3), 1-7. https://doi.org/10.4102/sajce.v5i3.344

Okewole, J. O., Abuovbo, I. O. V., & Abosede, O. O. (2015). An evaluation of the implementation of early childhood education curriculum in Osun State. *Journal of Education and Practice*, *6*(4), 48-54.

Olofsson, A. D., Fransson, G., & Lindberg, J. O. (2020). A study of the use of digital technology and its conditions with a view to understanding what 'adequate digital competence' may mean in a national policy initiative. *Educational Studies*, *46*(6), 727–743. https://doi.org/10.1080/03055698.2019.1651694

Olowe, P. K., & Kutelu, B. O. (2014). Perceived Importance of ICT in Preparing Early Childhood Education Teachers for the New Generation Children. *International journal of Evaluation and Research in Education*, *(IJERE)*, *3*(2), 119-124. https://doi.org/10.11591/ijere.v3i2.5405

Oluwafemi, O. L., Nma, A., Osita, O., & Olugbenga, O. (2014). Implementation of Early Childhood Education: A Case Study in Nigeria. *Universal Journal of Educational Research*, *2*(2), 119–125. https://doi.org/10.13189/ujer.2014.020203

Omwenga, E., Nyabero, C., & Okioma, L. (2015). Assessing the influence of the PTTC principal's competency in ICT on the teachers' integration of ICT in teaching science in PTTCs in Nyanza Region, Kenya. *Journal of Education and Practice*, *6*(35), 142-148. https://eric.ed.gov/?id=EJ1086387

Onyema, E. M., Ogechukwu, U., & Anthonia, E. C. D. (2019). Potentials of mobile technologies in enhancing the effectiveness of inquiry-based learning approach. *International Journal of Education (IJE)*, *2*(01).

O'Sullivan, M. K., & Dallas, K. B. (2010). A collaborative approach to implementing 21st century skills in a high school senior research class. *Education Libraries*, *33*(1), 3-9.

Osler, A., & Starkey, H. (2017). *Teacher education and human rights*. Routledge.

Osmanoglu, A. (2016). Prospective teachers' teaching experience: teacher learning through the use of video. *Educational Research*, *58*(1), 39–55. https://doi.org/10.1080/00131881.2015.1117321

Ottenbreit-Leftwich, A., Liao, J. Y.-C., Sadik, O., & Ertmer, P. (2018). Evolution of teachers' technology integration knowledge, beliefs, and practices: how can we support beginning teachers use of technology? *Journal of Research on Technology in Education*, *50*(4), 282–304. https://doi.org/10.1080/15391523.2018.1487350

Ovbiagele, A. O., & Mgbonyebi, D. C. (2018). Quality assurance and skill acquisition in office technology and management programme for national development. *Nigerian Journal of Business Education (NIGJBED)*, *5*(2), 63-76.

Oviawe, J. I., Uwameiye, R., & Uddin, P. S. (2017). Bridging skill gap to meet technical, vocational education and training school-workplace collaboration in the 21st century. *International Journal of Vocational Education and Training Research*, *3*(1), 7-14. https://doi.org/10.11648/j.ijvetr.20170301.12

Özgür, H. (2020). Relationships between teachers' technostress, technological pedagogical content knowledge (TPACK), school support and demographic variables: A structural equation modeling. *Computers in Human Behavior*, *112*, 106468. https://doi.org/10.1016/j.chb.2020.106468

Park, M.-H., Dimitrov, D. M., Patterson, L. G., & Park, D.-Y. (2016). Early childhood teachers' beliefs about readiness for teaching science, technology, engineering, and mathematics. *Journal of Early Childhood Research,* 15(3), 275–291. https://doi.org/10.1177/1476718x15614040

Park, E. K., & Hargis, J. (2018). New perspective on TPACK framework in the context of early childhood education: the "A" stands for affective. *International Journal for the Scholarship of Teaching and Learning* 12(2), 1−9. doi:10.20429/ijsotl.2018.120217

Penuel, W. R., Bates, L., Gallagher, L. P., Pasnik, S., Llorente, C., Townsend, E., … VanderBorght, M. (2012). Supplementing literacy instruction with a media-rich intervention: Results of a randomized controlled trial. *Early Childhood Research Quarterly*, *27*(1), 115–127. https://doi.org/10.1016/j.ecresq.2011.07.002

Porras-Hernández, L. H., & Salinas-Amescua, B. (2013). Strengthening pack: A broader notion of context and the use of teacher's narratives to reveal knowledge construction. *Journal of Educational Computing Research*, *48*(2), 223–244. https://doi.org/10.2190/ec.48.2.f

Qasem, A. A., & Viswanathappa, G. (2016). Blended Learning Approach to Develop the Teachers' TPACK. *Contemporary Educational Technology*, *7*(3). 264-276. *Qualitative Health Research*, *26*(13), 1802-1811. https://doi.org/10.30935/cedtech/6176

Quesenberry, A. C., Mustian, A. L., & Clark-Bischke, C. (2016). Tuning in: strategies for incorporating technology into social skills instruction in preschool and kindergarten. *Young Children*, 71(1), 74-80. http://www.naeyc.org/yc/node/333

Rahi, S. (2017). Research design and methods: a systematic review of research paradigms, sampling issues and instruments development. *International Journal of Economics & Management Sciences*, *06*(02), 1-5. https://doi.org/10.4172/2162-6359.1000403

Rahmah, A. (2015). Digital Literacy Learning system for Indonesian Citizen. *Procedia Computer Science*, *72*, 94–101. https://doi.org/10.1016/j.procs.2015.12.109

Reinen, B. K. (2013). ECE Technology: 10 trending tools for teachers. *Early Childhood Teacher*. http://www. earlychildhoodteacher. org/blog/ecetechnology-10-trending-tools-for-teachers.

Rogowsky, B. A., Terwilliger, C. C., Young, C. A., & Kribbs, E. E. (2017). Playful learning with technology: the effect of computer-assisted instruction on literacy and numeracy skills of preschoolers. *International Journal of Play*, *7*(1), 60–80. https://doi.org/10.1080/21594937.2017.1348324

Roussinos, D., & Jimoyiannis, A. (2019). Examining primary education teachers' perceptions of TPACK and the related educational context factors. *Journal of Research on Technology in Education*, *51*(4), 377–397. https://doi.org/10.1080/15391523.2019.1666323

Salavati, S. (2016). *Use of digital technologies in education: The complexity of teachers' everyday practice.* [Doctoral dissertation, Linnaeus University Press].

Sebotsa, T., De Beer, J., & Kriek, J. (2019, October). *Self-directed learning and teacher professional development: An adapted profile of implementation*. Proceedings of the 8th Teaching & Education Conference, Vienna. https://doi.org/10.20472/tec.2019.008.025

Sharkins, K. A., Newton, A. B., Albaiz, N. E., & Ernest, J. M. (2015). Preschool Children's Exposure to Media, Technology, and Screen Time: Perspectives of Caregivers from Three Early Childcare Settings. *Early Childhood Education Journal*, *44*(5), 437–444. https://doi.org/10.1007/s10643-015-0732-3

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14. https://doi.org/10.3102/0013189x015002004

Siddiquah, A., & Salim, Z. (2017). The ICT facilities, skills, usage, and the problems faced by the students of higher education. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(8).4987-4994. https://doi.org/10.12973/eurasia.2017.00977a

Sifuna, D. N. (2018). Early childhood care and education (ECCE) in Sub-Saharan Africa: a critical but neglected sector of education. *Papers in Education and Development*, (31).

Smith, B., & McGannon, K. R. (2018). Developing rigor in qualitative research: Problems and opportunities within sport and exercise psychology. *International Review of Sport and Exercise Psychology*, *11*(1), 101-121. https://doi.org/10.1080/1750984x.2017.1317357

Sooter, T. (2013). Early Childhood Education in Nigeria: Issues and Problems. *Journal of Educational and Social Research*. *3*(5), 173. https://doi.org/10.5901/jesr.2013.v3n5p173

Steffens, K., Bannan, B., Dalgarno, B., Bartolomé, A. R., Esteve-González, V., & Cela-Ranilla, J. M. (2015). Recent developments in technology-enhanced learning: a critical assessment. *RUSC. Universities and Knowledge Society Journal*, *12*(2), 73-86. https://doi.org/10.7238/rusc.v12i2.2453

Summers, D. (2016). Collage strategy. *Knowledge Visualization and Visual Literacy in Science Education*, 141–198. https://doi.org/10.4018/978-1-5225-0480-1.ch007

Steinhoff, A. (2016). The use of technology in early childhood classrooms. *Technology Materials Usage in Early Childhood Classrooms ...* (n.d.). https://www.researchgate.net/publication/331318828

Sullivan, A., & Bers, M. U. (2016). Robotics in the early childhood classroom: learning outcomes from an 8-week robotics curriculum in pre-kindergarten through second grade. *International Journal of Technology and Design Education*, *26*(1), 3-20. https://doi.org/10.1007/s10798-015-9304-5

Sullivan, J. R. (2012). Skype: An appropriate method of data collection for qualitative interviews?. *The Hilltop Review*, 6(1), 10. https://doi.org/%2010.4135/9781446268391

Sultanee, F. (2017). Technology Integration in Ontario Elementary Schools. https://hdl.handle.net/1807/77208

Sun, Y., Strobel, J., & Newby, T. J. (2017). The impact of student teaching experience on pre-service teachers' readiness for technology integration: A mixed methods study with growth curve modeling. *Educational Technology Research and Development*, 65(3), 597–629. https://doi.org/10.1007/s11423-016-9486-x

Sundqvist, P., & Nilsson, T. (2016). Technology education in preschool: providing opportunities for children to use artifacts and to create. *International Journal of Technology and Design Education*, *28*(1), 29–51. https://doi.org/10.1007/s10798-016-9375-y

Sutton, J., & Austin, Z. (2015). Qualitative Research: Data Collection, Analysis, and Management. *The Canadian Journal of Hospital Pharmacy*, 68(3).226. https://doi.org/10.4212/cjhp.v68i3.1456

Swanson, R. A., & Chermack, T. J. (2013). *Theory building in applied disciplines*. Berrett-Koehler Publishers.

Takacs, Z. K., Swart, E. K., & Bus, A. G. (2015). Benefits and pitfalls of multimedia and interactive features in technology-enhanced storybooks: A meta-analysis. *Review of Educational Research*, *85*(4), 698-739. https://doi.org/10.3102/0034654314566989

Tayo, O., Thompson, R., & Thompson, E. (2016). Impact of the digital divide on computer use and internet access on the poor in Nigeria. *Journal of Education and Learning*, *5*(1), 1-6. https://doi.org/10.5539/jel.v5n1p1

Tessmer, M., & Richey, R. C. (1997). The role of context in learning and instructional design. *Educational Technology Research and Development*, *45*(2), 85–115. https://doi.org/10.1007/bf02299526

Thomas, S. (2016). Future Ready Learning: Reimagining the Role of Technology in Education. 2016 National Education Technology Plan. *Office of Educational Technology, US Department of Education*.

Thomas, O. A., & Oladejo, M. A. (2017). Teacher-Trainees' Perceptions of ICT (Information Communication Technology) Integration in Nigerian Teacher Education Programme. *Educare*, *10*(1).

Toh, L. P. E., Causo, A., Tzuo, P. W., Chen, I. M., & Yeo, S. H. (2016). A review on the use of robots in education and young children. *Journal of Educational Technology & Society*, *19*(2), 148-163.

Tømte, C., Enochsson, A. B., Buskqvist, U., & Kårstein, A. (2015). Educating online student teachers to master professional digital competence: The TPACK-framework goes online. *Computers & Education*, *84*, 26-35. https://doi.org/10.1016/j.compedu.2015.01.005

Tom-Lawyer, O. (2016). Developing the Basic English Language Skills in Nigerian Colleges of Education: A Case Study of Three Colleges of Education. *International Journal of Applied Linguistics and English Literature*, *5*(3), 99-112. https://doi.org/10.7575/aiac.ijalel.v.5n.3p.99

Tondeur, J., Pareja Roblin, N., van Braak, J., Voogt, J., & Prestridge, S. (2017). Preparing beginning teachers for technology integration in education: Ready for take-off?. *Technology, Pedagogy and Education*, 26(2), 157-177. https://doi.org/10.1080/1475939x.2016.1193556

Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2020). Enhancing pre-service teachers' technological pedagogical content knowledge (TPACK): a mixed-method study. *Educational Technology Research and Development*, *68*(1), 319-343. https://doi.org/10.1007/s11423-019-09692-1

Tondeur, J., Van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. *Educational technology research and development*, 65(3), 555-575. https://doi.org/10.1007/s11423-016-9481-2

Tondeur, J., Van Braak, J., Siddiq, F., & Scherer, R. (2016). Time for a new approach to prepare future teachers for educational technology use: Its meaning and measurement. *Computers & Education*, 94, 134–150. https://doi.org/10.1016/j.compedu.2015.11.009

Trochim, W. M. (2017). Hindsight is 20/20: Reflections on the evolution of concept mapping. *Evaluation and Program Planning*, 60, 176-185. doi:10.1016/j.evalprogplan.2016.08.009

Valtonen, T., Sointu, E., Kukkonen, J., Mäkitalo, K., Hoang, N., Häkkinen, P., Tondeur, J. (2019). Examining pre-service teachers' Technological Pedagogical Content Knowledge as evolving knowledge domains: A longitudinal approach. *Journal of Computer Assisted Learning*, *35*(4), 491–502. https://doi.org/10.1111/jcal.12353

Voogt, J., & McKenney, S. (2016). TPACK in teacher education: are we preparing teachers to use technology for early literacy? *Technology, Pedagogy and Education*, *26*(1), 69–83. https://doi.org/10.1080/1475939x.2016.1174730

Walsh, J. (2017). Models of technology integration TPACK and SAMR. *TLN Journal*, *24*(2), 28-32. https://search.informit.com.au/documentSummary;dn=359012848238460;res=IELHSS

Waltz, T. J., Powell, B. J., Matthieu, M. M., Damschroder, L. J., Chinman, M. J., Smith, J. L., & Kirchner, J. E. (2015). Use of concept mapping to characterize relationships among implementation strategies and assess their feasibility and importance: results from the Expert Recommendations for Implementing Change (ERIC) study. *Implementation Science*, *10*(1), 1-8. https://doi.org/10.1186/s13012-015-0295-0

Weng, J., & Li, H. (2018). Early technology education in China: A case study of Shanghai. *Early Child Development and Care*, *190*(10), 1574–1585. https://doi.org/10.1080/03004430.2018.1542383

Willmann, K. L. (2017). Examining the integration of technology in the early childhood classroom. ERIC. https://eric.ed.gov/?q=technology%2Bin%2Bclassroom&pg=10

Wynants, S., & Dennis, J. (2018). Professional Development in an Online Context: Opportunities and Challenges from the Voices of College Faculty. *Journal of Educators Online*, *15*(1). https://doi.org/10.9743/jeo2018.15.1.2

Wyse, S. E. (2014). Advantages and disadvantages of face-to-face data collection. *Retrieved March*, *29*, 2015.

Yeh, Y.-F., Hsu, Y.-S., Wu, H.-K., Hwang, F.-K., & Lin, T.-C. (2013). Developing and validating technological pedagogical content knowledge-practical (TPACK-practical) through the Delphi survey technique. *British Journal of Educational Technology*, *45*(4), 707–722. https://doi.org/10.1111/bjet.12078

Yelich Biniecki, S. M., & Conceição, S. C. (2015). Using Concept Maps to Engage Adult Learners in Critical Analysis. *Adult Learning*, *27*(2), 51–59. https://doi.org/10.1177/1045159515604148

Yen, C.-J., Tu, C.-H., Sujo-Montes, L. E., Harati, H., & Rodas, C. R. (2019). Using Personal Learning Environment (PLE) Management to Support Digital Lifelong Learning. *International Journal of Online Pedagogy and Course Design*, *9*(3), 13–31. https://doi.org/10.4018/ijopcd.2019070102

Yildiz Durak, H. (2019). Modeling of relations between K-12 teachers' TPACK levels and their technology integration self-efficacy, technology literacy levels, attitudes toward technology and usage objectives of social networks. *Interactive Learning Environments*, 1–27. https://doi.org/10.1080/10494820.2019.1619591

Yilmaz, F. G. K., & Durak, H. (2018). Examining pre-service teachers' opinions about digital story design. *Education and Information Technologies*, *23*(3), 1277-1295. https://doi.org/10.1007/s10639-017-9666-2

Yilmaz, R. M. (2016). Educational magic toys developed with augmented reality technology for early childhood education. *Computers in Human Behavior*, *54*, 240–248. https://doi.org/10.1016/j.chb.2015.07.040

Yin, R. K. (2017). *Case study research and applications: Design and methods*. Sage .

Yom, S. (2015). From methodology to practice: Inductive iteration in comparative research. *Comparative Political Studies*, *48*(5), 616-644.Sage. https://journals.sagepub.com/doi/abs/10.1177/0010414014554685

Zacharis, G. K. (2020). Investigating the Factors Influencing Pre-Service Teachers' Acceptance to Use Mobile Devices for Learning. *Mobile Learning Applications in Early Childhood Education*, 183–208. https://doi.org/10.4018/978-1-7998-1486-3.ch010

Zander, K., Stolz, H., & Hamm, U. (2013). Promising ethical arguments for product differentiation in the organic food sector. A mixed methods research approach. *Appetite*, *62*, 133-142.

Zander, K., Stolz, H., & Hamm, U. (2013). Promising ethical arguments for product differentiation in the organic food sector. A mixed methods research approach. *Appetite*, *62*, 133–142. https://doi.org/10.1016/j.appet.2012.11.015

Zeichner, K. M. (2017). The Struggle for the Soul of Teaching and Teacher Education in the US. *The Struggle for the Soul of Teacher Education*, 19–39. https://doi.org/10.4324/9781315098074-2

Zina, O. (2021). *The essential guide to doing your research project*. Sage. https://www.amazon.com/Essential-Guide-Doing-Research-Project-ebook/dp/B01MYCNM9M

Zipke, M. (2017). Preparing Teachers to Teach with Technology: Examining the Effectiveness of a Course in Educational Technology. *The New Educator*, *14*(4), 342–362. https://doi.org/10.1080/1547688x.2017.1401191

Zomer, R. N. (2014). Technology use in early childhood education: a review of the literature. https://palolofaaiuaso.blogspot.com/2018/04/reference.html

APPENDICES

APPENDIX 1: Ethical Clearance from University of Kwazulu-Natal

12 February 2019

Mrs Chiedozie B Chinonyerem 218085236
School of Education
Edgewood Campus

Dear Mrs Chinonyerem

Protocol reference number: HSS/0065/019M
Project Title: An exploration of how Early Childhood Education Lecturers train Pre-service teachers to use Technologies at a Nigerian Universities.

Full Approval – Expedited Application

In response to your application received 17 January 2019, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

Dr Shamila Naidoo

/px

cc Supervisor: Dr A Singh-Pillay
cc. Academic Leader Research: Dr SB Khoza
cc. School Administrator: Ms S Jeenarain, Ms M Ngcobo, Mr SN Mthembu and Ms H Shezi

Humanities & Social Sciences Research Ethics Committee
Dr Shamila Naidoo (Deputy Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 Facsimile: +27 (0) 31 260 4609 Email: / /
Website:

APPENDIX 2: Consent Letter from LASU

LAGOS STATE UNIVERSITY
Office of the Registrar & Secretary to Council
Registrar & Secretary: AMUNI Mohammed Olayinka mnim

LASU/REG/OTHERUNI/41 December 10, 2018

Chiedozie Blessing Chinonyerem
Ph.D Student
School of Education
College of Humanities
University of KwaZulu-Natal
Edgewood Campus
South Africa

Dear Chiedozie,

APPROVAL TO CONDUCT RESEARCH IN LAGOS STATE UNIVERSITY

Kindly refer to your letter dated November 27, 2018 on the above subject.

I write at the instance of the Registrar to convey the approval of the Vice-Chancellor on your request to conduct a research in Lagos State University on the use of technologies by Early Childhood Education (ECE) lecturers in the training of pre-service ECE teachers

You are advised to ensure anonymity and confidentiality of the data collected.

The Vice-Chancellor wishes you a successful research.

Yours sincerely,

[redacted]

OLORI, Adewunmi Samuel
Senior Assistant Registrar [Registrar's Office]
For: Registrar and Secretary to Council

Lagos State University, Badagry Expressway,
P.O. Box 0001, LASU Post Office, Ojo, Lagos, Nigeria
+234 802 305 1809
E-mail: registrar@lasu.edu.ng Website: www.lasu.ed.ng

APPENDIX 3: Letter of Informed Consent: The Registrar LASU

School of Education,

College of Humanities,

University of KwaZulu-Natal,

Edgewood Campus,

22 November 2018

The Registrar,

Lagos University,

Nigeria.

Sir,

Permission to conduct research

My name is Mrs. Chiedozie Blessing. I am a PhD candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in learning more about the use of technologies by early childhood education lecturers in the training of pre-service ECE teachers. To gather the information, I need your consent to conduct this study at your institution. I will also need access to ECE lecturers from year 1 to 3 in Faculty of Education specifically in the Department of Early childhood education.

To gather data I will need to observe ECE lectures for a duration of a week and thereafter conduct an interview with them. The duration of the interview is 30 minutes. The interviews will be scheduled during non-lecturing times. ECE lecturers will also be involved in collage making and concept mapping which will last about 30 minutes. These two activities will also be conducted afters lecturing hours. The findings of the research will not be used for any purpose other than the doctoral dissertation. The data will be stored by my supervisor and disposed of at the end of the research. Pseudonyms will be used to protect the identity of your university as well as the identity of the ECE lecturers in this study. All information disclosed

will be kept in confidence. Participation in this research is voluntary and should you find that you wish to withdraw or terminate your permission for the research, you may do so without any negative consequences. Informed consent will also be sought from the ECE lecturers.

If you are willing to grant me access to your school please indicate (by ticking as applicable)

	Granted	Not granted
Access		

You have the right to withdrawal from the study without any negative consequences

I can be contacted at: Tel. No - [redacted]

e-mail : [redacted]

My supervisor is Dr. A. Singh- Pillay who is located at the School of Education, Science and Technology cluster, Edgewood campus of the University of KwaZulu-Natal.

Contact details: email: pillaya5@ukzn.ac.za Phone number: 031-26053672

You may also contact the Research Office through:

Ms Londiwe Shezi

HSSREC Research Office,

Tel: 031 260 3436 E-mail: shezil@ukzn.ac.za.

Thank you for your contribution to this research.

DECLARATION

I …… (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I am also aware that I have the right to withdraw from the study at any time without any negative consequences.

_____ _____

Signature: Date

APPENDIX 4: Informed Consent Letter: Participants (ECE lecturers)

School of Education, College of Humanities,

University of KwaZulu-Natal,

Edgewood Campus,

22 November, 2018

Dear Participant

INFORMED CONSENT LETTER

My name is Mrs. Chiedozie Blessing Chinonyerem, I am a PhD candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in learning more about the use of technologies by early childhood education lecturers in the training of pre-service ECE teachers at Lagos University.

To gather the information, I will need to observe ECE lectures for a duration of a week and thereafter conduct an interview with them. The duration of the interview is 30 minutes. The interviews will be scheduled during non-lecturing times. The findings of the research will not be used for any purpose other than the doctoral dissertation. . ECE lecturers will also be involved in collage making and concept mapping which will last about 30 minutes. These two activities will also be conducted after lecturing hours. The findings of the research will not be used for any purpose other than the doctoral dissertation. The data will be stored by my supervisor and disposed of, at the end of the research. Pseudonyms will be used to protect the identity of your university as well as the identity of the ECE lecturers in this study. All information disclosed will be kept in confidence. Participation in this research is voluntary and should you find that you wish to withdraw or terminate your permission for the research, you may do so without any negative consequences.

In addition I also require permission to audio record our meetings.

Please note that:

Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.

Lecture will be observed for one week

The interview may last for about 30 minutes.

The collage making and concept mapping may last for 30 minutes

Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.

Data will be stored in secure storage and destroyed after 5 years.

You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.

You have the right to withdraw from the research at any time without any negative consequences

Your involvement is purely for academic purposes only, and there are no financial benefits involved.

If you are willing to have your lectures observed, be interviewed thereafter and have the observation and interview audio recorded please indicate (by ticking as applicable) whether or not you are willing to allow the recording by the following equipment:

	Willing	Not willing
Audio equipment		

I can be contacted at: Tel. No -

e-mail :

My supervisor is Dr. A. Singh-Pillay who is located at the School of Education, Science and Technology cluster, Edgewood campus of the University of KwaZulu-Natal.

Contact details: email: pillaya5@ukzn.ac.za Phone number: 031-26053672

You may also contact the Research Office through: Sabelo Mthembu (Mr)

University of KwaZulu-Natal
College of Humanities
School of Education
Research and Higher Degrees
Tel: 031 260 3919
E-mail: mthembus4@ukzn.ac.za

DECLARATION

I…… (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project and I am aware that I have the right to withdraw without any negative consequences

_____

Signature Date …..

APPENDIX 5: Data Generation Instruments: Interview Protocol

Section A. Biographical information

1. Gender……
2. Age…….
3. Training Qualification……
4. Years of lecturing……
5. Position……..
6. Special training to use technologies…….
7. Technology competence……

Section B

Section B: Individual interview questions

What technologies are available in the ECE department at CB University for use in the ECE teacher training programme?

Which of these technologies do you use in your lecture room based on the three domains of learning?

Cognitive skill

Affective Skill

Psycho-motor Skill?

APPENDIX 6: Observation Scheduler

Factor observed	Researcher comment
Planning of lesson	
Lesson Objectives	
Introduction of lesson	
Strategies used :	
Learner activities:	
Lecture venue:	

What technologies used:	

To what extent does the technologies used support investigation/lesson objectives?	
How were they used:	
Classroom Management	
What strategies was employed to assessing learning:	
How effective is the technology at achieving the main lesson objective(s) and its fit to syllabus.	
How good are the technologies used at encouraging group work and collaborative learning?	
Does the activity fit within the timetable? To what extent does it support skill practice and application?	
Knowledge of content	
Knowledge of pedagogy	
Technological Knowledge	

Technological Pedagogical Knowledge	
How these technologies were used for teaching content and pedagogy	
learning outcome for lesson:	

APPENDIX 7: Lesson Plan/Teaching Portfolio - Document Analysis Schedule

Factors observed	Researchers Comment
What were the lesson objectives	
Assessment strategies employed	
Stages involved	
Does the lesson plan align with the ECE curriculum?	
Teaching methods incorporated in the lesson plan?	
Duration of technology lessons.	
Does the lesson plan incorporate the use of technologies?	
Number of modules on technology taught by the lecturer yearly	

APPENDIX 8: Document Analysis Schedule of CB University ECE Curriculum/ National ECE Curriculum/ Teaching Portfolios based on Nigeria National Policy on Technology Integration.

Factors Observed	Researcher comment
Number of modules offered from year one to year four	
Number of modules/courses that incorporate technology from year one to four	
Does the lesson plan incorporate the use of technologies?	
Do the module outlines/ curriculum/teaching portfolio incorporate the use of technologies in terms of pedagogy and content knowledge?	
How and when in terms of context and content?	
Modules/ Courses on Technology : year; semester	
Technologies used in the training of pre-service teachers based on the three domain of learning namely: 1.Cognitive skill 2.Affective skills 3.Psychomotor skills	

APPENDIX 9: Post-Observation Interview Questions

How competent are you in teaching your subject matter and incorporating technology in your lesson?

What teaching strategies do you employ in your technology lessons?

What software applications do you use in your technology lessons?

Is there support of lecturers when it comes to the use of technologies- please elaborate?

How would you rate your level of knowledge about technologies available to you?

How was this knowledge developed?

How competent do you perceive yourself to select and use various media to support teaching and learning?

To what extent can you integrate technology across the curriculum?

How capable are you of determining why, when, and how to use technology in education?

Have you been trained to use the available technologies? For how long? what type of training did you receive?

APPENDIX 10: Focus Group Interview Questions based on the Collage and Concept Map Produced by the ECE Lecturers.

Why do you consider the integration of technology in your lessons important?

To what extent did you incorporate technology to enhance teaching and learning in the lessons you taught this semester?

How competent are you in the use of technologies?

How conducive is the learning environment for technology integration?

How sufficient is your current subject knowledge and technological knowledge to teach this topic (e.g. programming skills for robotics?

How easy is it to acquire CPD to increase your technological knowledge or to align technology use with the ECE pre-service teachers' curriculum?

APPENDIX 11: Individual Interview Responses on what Technologies were Used by the ECE Lecturers to Train Pre-Service Teachers in the Use of Technology

Participant1: "*I use Digital Toys, television/DVD player, Power point, internet resources Digital Toys, computer- desktop and laptops overhead projector, Electronic musical instrument for affective domain and Laptop, Overhead projector, electronic musical instrument for psychomotor skill*."

Participant 2: "*I used mainly Digital Toys, Television, tape recorder and the internet for cognitive skills, Digital toys, Television, mobile telephones, laptops, for Affective skills and for psychomotor skills I use laptop, the internet, mobile phone*.

Participant 3: "*I use Radio, Digital toys and Overhead projector once in a while for cognitive skills, Digital Toys, Laptops, electronic musical instrument for affective skills and Computer, Television, DVD player, for psychomotor skills*.

Participant 4: *"I use laptop, Television and DVD player, Computer, the internet and my mobile phone for cognitive skills, Digital Toys, mobile telephones, Video/ Television, Laptops, the internet for Affective skills and Laptop, television and DVD player, mobile phones, the internet for psychomotor skills*.

Participant 5: *"Digital Toys, mobile telephones, Video/ Television, Laptops, the internet for the cognitive domain, Digital Toys, mobile telephones, Video/ Television, Laptops, the internet for the Affective skills while I use Digital Toys, mobile telephones, Video/ Television, Laptops, the internet for psychomotor skills*.

Participant 6: *I use laptop, television and DVD player, cell phone for the cognitive skill training, Digital Toys, mobile telephones, Video/ Television, Laptops, the internet for the affective skill and Laptop, the internet, mobile phone for the psychomotor skills*.

Participant 7: *I use laptop, Overhead projector, Television/DVD player, Digital toys for the cognitive skill, Digital Toys, mobile telephones, Video/ Television, Laptops, the internet for the Affective skills and Laptop, television and DVD player, mobile phones, the internet for the Psychomotor skills.*

Participant 8: *I use laptop and Television/ DVD player, the internet, mobile phone for cognitive skill, Digital Toys, mobile telephones, Video/ Television, Laptops, the internet for the Affective and Mobile phone, the internet, laptop, overhead projector*.

APPENDIX 12-14: The complete profile of the factors observed in teaching Pre-service Teachers how to use technologies by the three lecturers

APPENDIX 12: Presentation of Lesson Observation: Lecturer Lily

Section- : Creative and Cultural Arts II (THA 224)

Lesson Topic: Creation of Poster of a Cartoon Character

Factor observed	Researcher comment
Planning of lesson	Lecturer Lily planned her lesson on how to create a poster of a cartoon character, on a table in her office. The office was neat. She afterwards taught the lesson in the ECE laboratory.
Lesson Objectives	-To create a poster of a cartoon character- Mickey Mouse, using Microsoft PowerPoint. - To have the knowledge and skills about use of Microsoft Power Point in creation of a poster on cartoon character.
Introduction of lesson	Lecturer Lily introduced the topic for the day within 10 minutes by asking questions to the students: "Mention different cartoon characters they know and the moral, cultural and social values these characters convey to children and their warning". What can children learn from the character you just mentioned?"
How these technologies were used for teaching content and pedagogy	Lily explained the importance of cartoon to preschoolers': Cartoons are essential part of every childhood, and in teaching and learning process, with the help of cartoons kids can learn about the world around them, life issues, and moral values like "being proactive, patience is a virtue, being polite. Also

	cartoon captures the interest of preschoolers' as they identify with the cartoon characters. Lily then demonstrated to the students how to create a cartoon poster on Mickey Mouse using Microsoft PowerPoint. Lily presented the lesson through power point slides on the screen through the overhead projector, in stages- The layout, the background colour, drawing tools; font colour and font size using Microsoft PowerPoint. The pre-service teachers were not involved in hand on activities due to lack of technologies. Only one desktop computer and the lecturer's laptop. The pre-service teachers were given assignment in groups of five to produce posters on cartoon character and submit.
Strategies used :	Question and answer/Demonstration
Learner activities:	Watching the demonstration and taking note
Lecture venue:	The venue was in the laboratory, the walls were very colorful with charts hanging on the walls; non-digital toys, models of human bodies, a baby cot near the wall; a television and DVD player were placed at one end of the whiteboard in front on an elevated platform, an overhead projector was hanging from the ceiling of the laboratory and a desktop computer on a desk in front of the laboratory. The laboratory was not spacious, few desks, the laboratory was overcrowded and not conducive for technology training. There were 50 ECE pre-service teachers seated in the lab built to accommodate 20 students.

Technologies used by the lecturers:	Internet resources, laptop and Overhead projector and Microsoft PowerPoint
Classroom Management	Lily lacked effective classroom management; she couldn't control the class while demonstrating the lesson. She focused more on the power point presentation while some students were making noise. There was poor time management during the demonstration of the stages.
What strategies was employed to assessing learning :	Questions and answer: List types of Cartoon Character you know. List the moral values that can be learnt from the cartoon character you mentioned. A Project creating a cartoon poster of Minnie mouse etc.
How effective is the technology at achieving the main lesson objective(s) and its fit to syllabus.	The technology used was not effective in achieving the main lesson objective which was for the pre-service teachers to have the knowledge and skills about use of Microsoft PowerPoint in creation of a poster on cartoon character. There were no technologies available for the students to practice along with the lecturer during the demonstration of the lesson. As such there is no justification that the syllabus has been taught. Besides, only one computer application was used in the creation of cartoon, instead of exposing the PST to divers computer applications that can be used for creation of cartoon posters like Publisher, AdobeSpark, Adobe Illustrator and Photoshop so PST can be exposed to divers applications that can be used for the creation of cartoon posters not just only Photoshop.

How good are the technologies used at encouraging group work and collaborative learning?	It was not possible to encourage group work and collaborative learning without sufficient technologies available for the students. In this case, none of the students have laptops and only one desktop was provided by the University for ECE department.
Does the activity fit within the timetable? To what extent does it support skill practice and application?	The time was not sufficient for the lecturer demonstration and the pre-service teachers' hand-on practice, even if there were technologies available for the PST to practice. The timetable did not support skill practice and application to a reasonable extent. Only one hour thirty minutes allocated for the lesson.
pedagogical strategies	Lily employed question and answer at the introduction of her lesson to induce the interest of the students and was not maintained throughout the lesson. She used teach-demonstration technique. Pre-service teachers did not engage in hand-on practice but only listened, watched and took notes.
Objectives /learning outcome for lesson:	Objectives clearly stated, but insufficient technologies for the practical, as a result it was impossible to get the desired outcome.

APPENDIX 13: Presentation of Lesson Observation: Lecturer Jay

Section: Production and Utilization of Instructional Materials/Technology (EST 224)

Lesson Topic: Production and Uses of Flannel in Teaching

Factor observed	Researcher comment
Planning of lesson	Lecturer Jay did not consent to my observing his lesson planning but consented to my observing his presentation of the lesson.
Lesson Objectives	- To have the knowledge and skills on how to construct flannel board stories. - To make a flannel board story of their choice
Introduction of lesson	Lecturer Jay introduced the topic for the day by telling the students the topic of the lesson which is making *a flannel board on a story of the Tortoise and the Hare*. Jay stated the value of using flannel boards for story telling in teaching preschool children. There was no engagement of the pre-service teachers during the introduction of the lesson. The lesson lasted for seven minutes.
How these technologies were used for teaching content and pedagogy	Jay demonstrated to the students how to construct a flannel board for storytelling. Jay used a video clip on how to make a flannel board for the story of the Tortoise and Hare which he projected from the computer via overhead projector. He said "In today's lesson you will watch a video clipart on how to make a flannel board story of the Tortoise and the Hare, you should watch and write down the stages before you attempt to embark in hands on activities."

	He further explained that the most common use of flannel board is for retelling simple stories from a book or making up stories of our own, fairy tales and more. A flannel board helps a child explore stories, use their imagination, improve fine motor skills and open up their creativity with shapes, colours and objects. Children love re-telling stories they were told with the flannel board pieces, this increases their imagination, helps develop self-expression and provides hands-on learning…… The PST then shared themselves in group for hand on activities with the available technologies.
Strategies used	Demonstration
Learner activities	Hand on practice on construction of flannel board stories of their choice.
Lecture venue	The venue was in the lecture theatre which could accommodate 60 students. It was equipped with a data projector, but the furniture in the lecture theatre were very old and much of them were damaged.

Technologies used by the lecturers:	Internet resources, computer, data projector and Video clip, Power Point.
Classroom Management	Jay had effective classroom management; he controlled the class while demonstrating the lesson. There was proper time management during the demonstration of the stages.
What strategies was employed to assessing learning :	Hand on practice on construction of flannel board stories.

How effective is the technology at achieving the main lesson objective(s) and its fit to syllabus.	The technology used was partly effective in achieving the main lesson objective; which was to have the knowledge and skills on how to construct flannel board stories of their choice. Although, the students engaged on hand on practice in groups of ten each, with the only available technology- one desktop- the desired skills and knowledge were not efficiently acquired due to insufficient time and insufficient technologies.
How good are the technologies used at encouraging group work and collaborative learning?	It was not possible to encourage group work and collaborative learning without sufficient technologies available for the students. In this case, none of the students have laptops and only one desktop was provided by the University for ECE department; which they used for hand on practice within the limited time.
Does the activity fit within the timetable? To what extent does it support skill practice and application?	The time was not sufficient for the lecturer demonstration and the pre-service teachers' hand-on practice. The timetable did not support skill practice and application to a reasonable extent. Only one hour thirty minutes allocated for the lesson.
pedagogical strategies	Demonstration and hand – on practice
Objectives/learning outcome for lesson:	Objectives clearly stated, but insufficient technologies for the practical, as a result it was impossible to get the desired outcome.

APPENDIX 14: Presentation of Lesson Observation: Lecturer Zee
Section: Application of Computer in Education (EST 417)

Lesson Topic: Creating Charts of Shapes with Microsoft Excel

Factor observed	Researcher comment
Planning of lesson	Lecturer Zee did consent to my observing his lesson planning but on the scheduled day, Zee did not come to the university as his dad had passed away and he had taken leave for 5 days of family responsibility leave. We, therefore, renegotiated and he consented to me observing his lesson after the 5 days of leave.
Lesson Objectives	-learn the importance of shapes in Early Childhood Education. -demonstrate the knowledge and skills about use of Microsoft Excel in creation of two-dimensional shapes.
Introduction of lesson	Lecturer Zee introduced the lesson by asking the students questions based on the previous lesson on Microsoft Excel. The pre-service teachers were made to answer few questions as a revision of their previous knowledge such as (1) What is Microsoft Excel? (2) What is the importance of Micro soft Excel? (3) What are the uses of Microsoft Excel? The pre-service teachers were excited and lifted up their hands and responded to the questions… He then asked them to *"*mention the importance of shapes in Early Childhood Education**."** The introduction stage of the lesson lasted for approximately fifteen minutes.
How these technologies were used for teaching content and pedagogy	Zee explained the importance of the lesson on shapes to the pre-service teachers: *"From an early age, kids notice different shapes even if they don't yet know that the shapes have names. It takes longer for young*

	children to learn the specific properties of each shape, such as the number of sides or how the shape looks. Giving preschoolers lots of practice with shapes helps them solidify their understanding of the two-dimensional structures. The knowledge of shapes gives the young children an advantage in many areas of learning." He then used technologies such as internet resources, laptop, overhead projector and Microsoft Excel to demonstrate to the pre-service teachers, the creation of chart on shapes. Zee presented the lesson through the overhead projector and computer in stages- "the stages involved in making charts on shapes in Microsoft Excel are- click on the Drawing toolbar to draw any two dimensional shape, then use the Fill Colour, Line Colour, Line Style, Dash Style, Shadow Style, and 3-D Style buttons on the Drawing toolbar to enhance the basic shape. In addition to drawing your own shapes, you can insert any number of ready-made shapes (including lines, arrows, flow chart symbols, banners, and callouts) by selecting them from the AutoShapes pop-up menu and then sizing them in the worksheet." He then guided the pre-service teachers on how to create a chart on Shapes using Microsoft Excel during their hands on activity in groups. He employed Student Group Demonstration method.
Strategies used :	Question and Answer; Demonstration, Guided Discovery technique.
Learner activities:	Sourcing the internet to gather, analyze and synthesize information on creation of charts on shapes using Microsoft Excel. Hand on practice on construction of charts on shapes using Microsoft Excel.

Lecture venue:	The venue was in the laboratory, not spacious, few desks; the laboratory was not conducive for technology training.

Technologies used by the lecturers:	internet resources, laptops, overhead projector and Microsoft Excel
Classroom Management	Zee had effective classroom management; he controlled the class while demonstrating the lesson and guiding each group on their work. There was proper time management during the demonstration of the stages.
What strategies was employed to assessing learning :	To construct a chart on shapes using Microsoft Excel
How effective is the technology at achieving the main lesson objective(s) and its fit to syllabus.	The technology used was partly effective in achieving the main lesson objective-demonstrate the knowledge and skills about use of Microsoft Excel in creation of two-dimensional shapes. The pre-service teachers were able to acquire the skill to reasonable extent though not all of them as it was only the few who had their laptops actually used their computers to practice, while the rest in their group observed.
How good are the technologies used at encouraging group work and collaborative learning?	It was not possible to encourage group work and collaborative learning without sufficient technologies available for the students. In this case, only one desktop provided by the University for ECE department and few students laptops were used for the hand-on practice.
Does the activity fit within the timetable? To what extent does it support skill practice and application?	The time was not sufficient for the lecturer demonstration and the pre-service teachers' hand-on practice. The timetable did not support skill practice and application to a reasonable extent. Only one hour thirty minutes allocated for the lesson.

pedagogical strategies	Question and answer; Student Group Demonstration and Guided discovery and hand – on practice
Objectives /learning outcome for lesson:	Objectives achievable but only few of the students have laptops and the time allocated to the lesson was not sufficient which affected the learning outcome- the preservice teachers could not acquire the skills effectively.

APPENDIX 15-17

APPENDIX 15: Lesson Plan- Document Analysis of Lecturer Lily

Factors observed	Researchers Comment
What were the lesson objectives	-To create a poster of a cartoon character- Mickey Mouse, using Microsoft PowerPoint. - To have the knowledge and skills about use of Microsoft PowerPoint in creation of a poster on cartoon character.
Assessment strategies employed	Questions and answer: List types of Cartoon Character you know. List the moral values that can be learnt from the cartoon character you mentioned Project: A Project creating a cartoon poster of Minnie mouse etc
Stages involved	The steps involved in making poster on cartoon character are- The layout, the background colour, drawing tools, font colour and font size using Microsoft PowerPoint
Does the lesson plan align with the ECE curriculum?	The lesson was planned based on the ECE curriculum.
Teaching methods incorporated in the lesson plan?	Question: *List types of Cartoon Character you know and their moral values* Demonstration: *practical demonstration of how to create a poster on Cartoon Character*
Duration of technology lessons.	1hour 30 minutes
Does the lesson plan incorporate the use of technologies?	Technologies such as Internet resources, Laptop and Overhead projector and Microsoft PowerPoint were incorporated in the lesson.

Number of modules on technology taught by the lecturer yearly	Lecturer Lily taught 10 modules to year 1 and 2 ECE pre-service teachers. Only one module- Creative and Cultural Arts II (THA 224) taught at year 2 dealt on technologies.

APPENDIX 16: Lesson Plan- Document Analysis of Lecturer Jay

Factors observed	Researchers Comment
What were the lesson objectives	At the end of the Practical lesson: -the students would learn the uses and advantages of using a flannel board for storytelling and teaching in pre-schools; -have the knowledge and skills on how to make flannel board stories and finally make flannel board stories of their choice example The Tortoise and the Hare.
Assessment strategies employed	Hand on practice on construction of flannel board stories
Stages involved	Open google and type in story of tortoise and the hare clipart for example. Click on the images and drag to the PowerPoint slide, print out and paste on the fabric transfer, then on the flannel and press with an electric iron to transfer the images on the flannel, then cut out the images on the flannel to place on the flannel board
Does the lesson plan align with the ECE curriculum?	The lesson was planned based on the ECE curriculum.
Teaching methods incorporated in the lesson plan?	Students Group Demonstration: *practical demonstration of how to construct a flannel board story of the Tortoise and the Hare in groups.* , the students were divided into groups to assist the teacher in turn to perform the demonstration.
Duration of technology lessons.	1hour 30 minutes
Does the lesson plan incorporate the use of technologies?	Technologies such as Internet resources, Computer, projector and Microsoft

	PowerPoint and video clip were incorporated in the lesson.
Number of modules on technology taught by the lecturer yearly	Lecturer Jay teaches 12 modules to year 2 and 3 ECE pre-service teachers. Only one module- Production and Utilization of Instructional Materials/ Technology (EST 224) taught at year 2 dealt on technologies.

APPENDIX 17: Lesson Plan- Document Analysis of Lecturer Zee

Factors observed	Researchers Comment
What were the lesson objectives	-learn the importance of shapes in Early Childhood Education cartoon. -demonstrate the knowledge and skills about use of Microsoft Excel in creation of two-dimensional shapes.
Assessment strategies	Students should be able to show understanding of the task during the hand-on practice and finally submit a printed copy of the charts on two dimensional shapes.
Stages involved	click on the Drawing toolbar to draw any two dimensional shape, then use the Fill Colour, Line Colour, Line Style, Dash Style, Shadow Style, and 3-D Style buttons on the Drawing toolbar to enhance the basic shape. In addition to drawing your own shapes, you can insert any number of ready-made shapes (including lines, arrows, flow chart symbols, banners, and callouts) by selecting them from the AutoShapes pop-up menu and then sizing them in the worksheet
Does the lesson plan align with the ECE curriculum?	The lesson was planned based on the ECE curriculum.
Teaching methods incorporated in the lesson plan?	Students Group Demonstration: practical demonstration of how to construct two dimensional shapes using Microsoft Excel, the students were divided into groups and guided on the work.
Duration of technology lessons.	1hour 30 minutes

Does the lesson plan incorporate the use of technologies?	Technologies such as Internet resources, Computer, projector and Microsoft Excel.
Number of modules on technology taught by the lecturer yearly	Lecturer Zee teaches 10 modules to final year ECE pre-service teachers only. Only one module - Application of Computer in Education (EST 417) dealt on technologies.

APPENDIX 18: Post Observation Interview responses

Question: How competent are you in teaching your subject matter (CK) and incorporating technology in your lesson based on the curriculum?

All of the content is not a problem for me at all, I learnt about Creative and cultural arts during my degree program course of study although we were not taught with technologies but the content is the same. Moreover, I have improved in knowledge of the subject matter over nine years of teaching this course, my teaching is guided by the curriculum.

It is important for our pre-service teachers to use the different technologies in their teaching to teach children stories about ethic, values, morals, what's right and wrong and to teach them about the Nigerian culture"*(Lily)*

I'm very confident in knowledge of the lessons I teach, I studied most of these courses during my degree programmes and have been teaching them for over ten years now. I always check the curriculum to verify the knowledge students need to acquire. So it's not a difficult task at all. (Jey)

I don't have problem with delivery of the content of the lessons I teach. I'm a life longer learner and I am always updating my knowledge by research, keeping abreast with current trends in ECE, reading, you can never stop, I'm always trying out new techniques, assessments, I have twenty years of teaching experience in this field but I realise that students are different so I cannot use the same lesson over and over again. It has to suit the learning style of the students. (Zee)

What teaching strategies do you employ in your technology lessons (PK)?

"When I want to teach with technology, the methods I only think of using is demonstration method at least to show the students what they need to know about the lesson. *Besides I don't know much about other instructional strategies suitable for training student to use technologies in their teaching.. I think demonstration is okay-*

…….Ahh, are there types of demonstration method, I'm not aware of that… Because of my teaching methods students often don't pay attention during the lecture" (Lily)

"*Well, I use demonstration method to teach this lesson of the module it is the most suitable teaching strategy as it allows the students the opportunity to see how to use the technologies and when time permits to engage in hands on activities, using these technologies to create the*

flannel board for storytelling. I sometimes use other more advanced technologies if there are male students in the class- males get the hang of using these technologies faster that the female students' ad they are more familiar with using technologies."(Jay)

When I want to teach with technology, I employ different methods to ensure students acquire the basic technology skills, although there is dearth of resources which hampers the effective technology training of students in our department. However, I encourage the students to get their Personal Computers which few of them did. (Zee)

Question: What software applications do you use in your technology lessons (TPK)?

I used Microsoft PowerPoint because I don't know of any other software application like Photoshop you talked of, also we don't have enough technologies for training PST. We have only one desktop in the department which can be used but how can fifty students use one desktop to practice, so I chose to demonstrate with my laptop while they watch. This is a major hindrance of technological training of PST in our department Besides we are not giving time to practice along with the resource personnel to master the technology training, this impacts one negatively and also affects my training the PST in the use of technology since I cannot go beyond what I know."(Lily)

During my first degree program, I was not trained in the use of technology. I learnt the use of technology through trial and error over the years , I just kept practising and eventually it all just clicked together. i also attended the once off professional development that was on offer , we were not exposed to different teaching and learning strategies. I read a lot and that were I gain knowledge about how to use technologies like Microsoft Power Point to teach. I tried to use the technologies on my own to discover their features.(Jay)

I used Microsoft Excel as it is suitable for creating charts on two- dimensional shapes using Microsoft Excel, I did not learn about technology during my undergraduate programme but learnt on the job through self-learning and attending the yearly continuous Professional Development organised by the University although it does not focus on integrating technology in teaching ., I have made personal efforts to improve my use and knowledge on technology in terms of the features, how to use the features, technology skill instruction to teach with technology*, I often practice the use of the technologies and how I will integrate them in my teaching. But I am not competent in robotics. The University did not install that for us as yet.(Zee)*

Question: How would you rate your level of knowledge about technologies available to you (TPK)?

During my first degree program, I was not trained in the use of technology. I learnt the use of technology through trial and error over the years, I just kept practising and eventually it all just clicked together. I also attended the once off professional development that was on offer, we were not exposed to different teaching and learning strategies. I read a lot and that's how I gain knowledge about how to use technologies to teach. I tried to use the technologies on my own to discover their features. (Jay)

Question: How competent are you in classroom management and lesson plan development and implementation of technology lessons (PK)?

"*It is not easy having full control of the class while demonstrating the lesson. As you observed, I struggled to set up the overhead projector, so I had to focus more on getting it done than having the students to pay attention. Beside I am not very efficient in using technology. So I had to focus on getting the lesson done, so I get this assessment task over. . " (Lily)*

It's not easy implementing technology lessons as planned because it require a lot of planning and time consuming.(Lily)

I can easily control my class during the demonstration or while guiding each group on their work. (Zee)

I implemented the lesson by making sure that the students were engaged in hand-on practice to acquire the skills needed in creating a chart on two- dimensional shapes using Microsoft Excel as was stipulated in the objectives. (Zee)

APPENDIX 19: Document Analysis Schedule of CB University ECE Curriculum/ National ECE Curriculum Based on ECE Lecturers' Teaching Portfolios

Factors Observed	Researcher comment
Number of modules offered from year one to year four	Seventy-two modules/courses
Number of modules/courses that incorporate technology from year one to four	Three modules/courses
Does the lesson plan incorporate the use of technologies?	Yes but in only modules/courses that incorporate technology
Do the module outlines/ curriculum/teaching portfolio incorporate the use of technologies in terms of pedagogy and content knowledge?	yes
How and when in terms of context and content?	During lesson activities
Modules/ Courses on Technology : year; semester	EST 224- Production and Utilization of Instructional Materials (offered in the second year) THA 224- Creative and Cultural Arts II (offered in the second year) iii) EST 417 Application of Computer in Education
Technologies used in the training of pre-service teachers based on the three domain of learning namely: 1.Cognitive skill 2.Affective skills	Television, Audio player, DVD player, Digital Toys, overhead projector, desktop, laptops, E- books, Power Point, internet resources, mobile phone Television, DVD player, computer- desktop and laptops, overhead projector, Audio player, Digital Toys.

3.Psychomotor skills	Electronic musical instruments, mobile telephone/ cell phones, the internet Television, DVD player, computer- laptop/desktop, overhead projector, electronic musical instrument, internet resources

APPENDIX 20: Focus Group Interview Responses

Focus group discussion: transcripts

Question: Why do you consider the integration of technology in your lessons important?

"*…..the use of technology in teaching and learning improves students' learning because they would be able to see things from the computer instead of just imagining, as they manipulate the technologies themselves, this would help them understand more. The use of technologies increases students' interactions and positively impact students learning and achievements"* (Focus Group Interview-Zee)

"*…the use of technologies is vital in teaching and learning because when technology is used it can enhance students' understanding through various ways such as simplifying concepts and providing information that is not covered in the textbooks. Also the use of technology in teaching and learning enhance teaching methodologies and collaboration, makes learning easily accessible to all learners, creates a good atmosphere for learning to meet the needs of all learners."* (Focus Group Interview- Lily)

"*…the use of technologies in teaching and learning is very important because it arouses the students interests, promotes interaction among students, encourages collaborative learning, improves communication among students and enhances student teacher interactions, technology is important to simplify complex ideas, enhance creativity and problem solving techniques, technology is of immense importance in teaching and learning as it enhances visualisation and manipulation of objects*……" (Focus Group Interview- Jay)

Question: To what extent did you incorporate technology to enhance teaching and learning in the lessons you taught this semester?

"*There is poor integration of technology in the curriculum/course outline; the curriculum for ECE has no technological modules from their year one to four. Only two modules in their second year deals on technology and one module in their final year. There is no module on technology in their first year and third year. We just deliver what is in the curriculum, and have no inputs in its design. We cannot deviate from the curriculum. As a result, there is little technological impact in our lessons as we have to follow what is stipulated in the course outline.* (Focus Group Interview- Lily)

"*I incorporated technology in my lessons to a lower extent this semester because the course outline does not integrate technology to a reasonable extent. It appears sparingly, so I train the students in the use of technologies once in a while any year or semester it is stipulated in*

the curriculum. Imagine, this course production and utilization of instructional materials comes only once in the second semester of their second year and does not run throughout their program. This is a course that dealt more on training pre-service teachers to use different technologies, yet it appeared only in one semester in their second year. There should be more integration of technology in the curriculum, to enable us train the pre-service teachers effectively in the use of technology." (Focus Group Interview- Jay)

"*I incorporated technology to a very low degree this semester because most of our lessons were not rich in technology except three modules out of 72 modules in a four year program.. We only think of incorporating technology when modules that require them comes up as stipulated in the curriculum. This module introduction to computer education is only taught in one semester in their final year, so it is not possible for the pre-service teachers to master the use of computer soft wares before they graduate.* " (Focus Group Interview-Zee)

"*I aligned technology sparingly with the pre-service teacher curriculum because the curriculum did not stipulate the use of technology in the teaching of most courses so we deal more with the content little of technology in our lessons. As a result, I train the pre-service teachers on the use of technologies occasionally, when it is stipulated in the curriculum."* (Focus Group Interview- another participant)

"*…. the curriculum is not rich in technology, it appears sparingly, so I teach technologies once in a while any year or semester it is stipulated in the curriculum. Like this course THA 224, I teach, is offered only in one module in second semester of their second year."(another Paeticipant)*

Question: How conducive is the learning environment for technology integration(do you have sufficient technologies)?

"The *environment is not conducive for technology training. Certain factors impinge on the use of technologies in the ECE Lecture room such as insufficient technologies for the students so they can practice within the limited time allocated for the lesson. We don't have sufficient technologies needed to prepare the pre-service teachers for the challenges ahead technology wise, also there are no computer programming in the few technologies available. There is only one desktop, one overhead projector, one television and one audio and one DVD player in the laboratory to train the pre-service teachers and none in the classrooms. As such not all the students could practice with the available technologies during the practical." (Focus Group Interview-Zee)*

"There is insufficient technologies, insufficient time for teaching and learning, unconducive environment, and lack of appropriate desks and chairs to put the technologies. We need power supply for technology integration, sufficient technologies for students use, the department have only one projector, one television, one DVD player, one desktop stored in the laboratory and few students with laptops, besides no computer programming installed in the computer like robotics. The university should provide sufficient technologies, install computer programming like robotics and provide an enabling environment for technology training." (Focus Group Interview- Jay)

"The lecture rooms are not designed for technology use, even the ECE laboratory lacks proper room layout, desks, power sockets for training the pre-service teachers on the use of technology. There is not enough space in the laboratory and it is not easy carry computer or projector from one lecture room to another"….there is insufficient technologies in our department. Even if I try to upgrade myself in the use of technologies, without the university installing sufficient technologies it will be difficult to pass on the knowledge to my students. Imagine where its only one overhead projector, one desktop, one television and one DVD player only in the laboratory that is not spacious to accommodate the number of students we have." (Focus Group Interview-Lily)

Question: How competent are you in the use of technologies? How sufficient is your current subject knowledge and technological knowledge to teach this topic (e.g. programming skills for robotics? How easy is it to acquire CPD to increase your technological knowledge or to align technology use with the ECE pre-service teachers' curriculum?

"*There is no support for lecturers to acquire continuous professional development on regular basis. No financial support for us to attend seminars, workshops, conferences, courses and retreats so we can improve our technological skills and in turn, boost students' knowledge. I'm try to upgrade myself to align technology use with the ECE pre-service teachers' curriculum, but I'm not abreast with current innovations in technology like robotics and need to improve my Technological Pedagogical Knowledge"(*Focus Group Interview- Participant 3-Jay)

"*…I don't know about computer programming like robotics and most modern computer programming, there is no encouragement from the government for lecturers to improve our CPD on the job to meet up with new innovations in this digital age. As a result, our subject knowledge is not up to date. I can't teach what I don't know to the students. I'm not excellent*

*in selecting and using various technologies to support teaching and learning." (*Focus Group Interview- Participant 2)

*"I am struggling with the use of computers, overhead projectors and other modern technology. I lack the expertise in computer programming. …… when I encounter difficulties, I seek assistant from the technology department. I'm not very competent; need more training on how to use technologies. There is need for more Continuous PD on technology usage for we (lecturers) as most of us need more update in the use of technology, the CPD programmes on technology organised once in a blue moon is not sufficient to get us on the track technology wise. Moreover, most of us were not trained during our pre-service training on the use of technologies, we are learning on the job, so regular Continuous PD is needed, although we make personal efforts to upgrade ourselves so we can train our students on technology use, but that is not sufficient." (*Focus Group Interview- Participant 5- Lily)

"There is need for regular Continuous Professional Development for we lecturers in Early Childhood Education department to improve our Technological Knowledge and Technological Pedagogical Knowledge. As for me, I learnt the use of technologies over the years through personal efforts and irregular CPD organised by the university. However, I am not competent in robotic programming as the university did not install the program in the available technologies and no incentive to support our technological development." *(*Focus Group Interview- Participant 1- Zee)

APPENDIX 21: Summary of Categories from the Collages, Concept Maps and Focus Group Interview Responses

Categories that emerged

1. Motivating factors to the use of technology namely:

- Importance of Technology

2. Inhibiting factors to the use of technology namely:

- Poor integration of Technology in the ECE Curriculum
- Lack of sufficient technologies
- Lack of constant CPD for ECE lecturers on technology.

APPENDIX 22: Editing Certificate

[redacted]

Tamboerskloof

Cape Town

8001.

14 May 2021.

LANGUAGE EDITING

This is to certify that I language-edited the dissertation, "An exploration of how early childhood education lecturers train pre-service teachers to use technologies at a Nigerian university", by Blessing Chinonyerem Chiedozie for the PhD degree in the School of Education, at the University of Kwa-Zulu-Natal.

[redacted]

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APPENDIX 23: Turnitin Report

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