CASE STUDY OF COMPTENCIES OF TECHNOLOGY EDUCATION E-TUTORS IN CONSTRUCTION OF DESIGN PROCESS AT AN OPEN AND DISTANCE E-LEARNING INSTITUTION

by

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DECLARATION

I, Mpipo Zipporah Sedio declare that **A CASE STUDY OF COMPTENCIES FOR TECHNOLOGY EDUCATION E-TUTORS IN CONSTRUCTION OF DESIGN PROCESS AT AN OPEN AND DISTANCE e-LEARNING INSTITUTION** is my own work and that all the resources used or quoted have been acknowledged and referenced.

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DEDICATION

This thesis is a dedication to the Sedio, Mathibe, Mokoka, Mzila and Qubeka families. This achievement is an inspiration for coming generations to aspire further and seek more knowledge and to believe in yourselves.

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ABSTRACT

The occurrence of Open Distance and e-Learning revolutionized Higher Education Institutions for students to access instruction at anytime and anywhere. Students benefitted instruction of anytime and anywhere in one of the Technology Education courses in ODeL from the e-tutors. As a result of the support from the e-tutors, the curriculum was designed to place a strong emphasis on the design process as the core around which the teaching of the curriculum should revolve. However, it is still not clear how effective is the content knowledge which relates to the design process from the e-tutors.

In acknowledgment from such a gap, this study aimed to determine the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process within Technology Education specialization. In order to achieve this purpose, two theories, namely Transactional distance and Connectivism were coined together with the Technological Pedagogical Content Knowledge (TPACK) framework to underpin the study. The philosophical worldview is pragmatism having employed mixed method. Participants in this study were 145 students who registered a year programme for two modules in the Bachelor of Education (B.Ed.) programme at a Higher Education institution were surveyed to collect the quantitative data. Data from the face-to-face semi-structured interviews were collected with five e-tutors from the research sites. Online observations data were collected from the e-tutor sites of the institution's learning management system (LMS). The results suggest that e tutors still lack the technology knowledge in order to deliver the content aimed for the design process in an ODeL environment. Also, it was evidenced that the e-tutors have not acquired pedagogical strategies for driving the pedagogy for the design process in an ideal context of ODeL. It should also be borne in mind that findings for the content knowledge indicated that the e-tutors still lack the knowledge for exploiting content knowledge of the design process to suit an ODeL environment. These findings highlight a need for technology to support e tutors' pedagogical strategies towards a meaningful understanding of the design process and its

implications across ODeL contexts.

Key words: E-tutor; E-tutoring; Design process; Distance Education; Open Distance and e-learning; Technology Education; Technology.

KHUTLISO

Ketsahalo ea Open Distance le e-Learning e ntlafalitse litsi tsa thuto e phahameng bakeng sa baithuti ho fihlella taeo nako efe kapa efe le kae kapa kae. Baithuti ba ile ba rua molemo taelong ea nako efe kapa efe le kae kapa kae ho e 'ngoe ea lithuto tsa Technology Technology ho ODeL ho tsoa ho li-tutors. Ka lebaka la ts'ehetso e tsoang ho li-tutors, kharikhulamo e ne e etselitsoe ho hatisa ka matla ts'ebetso ea moralo e le khubu eo thuto ea kharikhulamo e lokelang ho potoloha ho eona. Leha ho le joalo, ha ho sa hlaka hore na tsebo ea litaba e sebetsa hantle hakae e amanang le tšebetso ea moralo ho tsoa ho li-tutors.

Ho ananela lekhalo le joalo, phuputso ena e ne e ikemiselitse ho tseba kamano lipakeng tsa theknoloji ea "e-tutors", thuto ea thuto, tsebo ea litaba ea ts'ebetso ea moralo oa ho ruta ka har'a tsebo ea thuto ea Technology. Bakeng sa ho fihlela sepheo sena, ho ile ha qaptjoa likhopolo tse peli, e leng Transactional distance le Connectivism hammoho le sebopeho sa Technological Pedagogical Content Knowledge (TPACK) ho tšehetsa thuto. Pono ea lefatše ea filosofi ke pragmatism e sebelisang mokhoa o tsoakaneng. Barupeluoa thutong ena e ne e le baithuti ba 145 ba ngolisitseng lenaneo la selemo bakeng sa li-module tse peli lenaneong la Bachelor of Education (B.Ed.) setsing sa Thuto e Phahameng ba ile ba hlahlojoa ho bokella lintlha tse ngata. Lintlha tse tsoang lipuisanong tsa sebopeho sa sefahleho li ile tsa bokelloa le barupeli ba bahlano ba tsoang libakeng tsa lipatlisiso. Lintlha tsa tlhaiso-leseling ka inthanete li ile tsa bokelloa ho tsoa litsing tsa e-tutor tsa sistimi ea taolo ea ho ithuta ea setheo (LMS). Liphetho li fana ka maikutlo a hore barupeli ba ntse ba haelloa ke tsebo ea mahlale a morao-rao molemong oa ho fana ka litaba tse reretsoeng ts'ebetso ea boqapi tikolohong ea ODeL. Hape, ho ile ha pakoa hore li-e-tutors ha li e-so fumane maano a thuto ea ho khanna lithuto tsa thuto bakeng sa moetso oa moralo ka mokhoa o loketseng oa ODeL. Hape ho lokela ho hopoloa hore liphuputso tsa tsebo ea litaba li bontšitse hore li-e-tutors li ntse li haelloa ke tsebo ea ho sebelisa tsebo ea litaba tsa moralo oa moralo ho latela tikoloho ea ODeL. Liphuputso tsena li totobatsa tlhoko ea mahlale a morao-rao ho ts'ehetsa maano a thuto a barupeli ho fihlela kutloisiso e hlakileng ea ts'ebetso ea moralo le litlamorao tsa ona maemong a ODeL.

Mantsoe a bohlokoa: E-tutor; E-tutoring; Moralo oa ts'ebetso; Thuto ea hole; Sebaka se bulehileng le e-learning; Thuto ea Theknoloji; Theknoloji.

ISIQINISEKISO

Ukutholakala kwe-Open Distance ne-e-Learning kuguqula izikhungo zemfundo ephakeme zabafundi ukuthi bathole imfundo nganoma yisiphi isikhathi noma kuphi. Abafundi bahlomule ngokufundiswa nganoma isiphi isikhathi noma kuphi kwesinye sezifundo zeTechnology Education ku-ODeL kubafundisi be-e. Njengomphumela wokwesekwa okwenziwa abafundisi be-e-tutors, ikharikhulamu yakhelwe ukugcizelela kakhulu inqubo yokwakhiwa njengongqikimba okumele kufundiswe ngayo ikharikhulamu. Kodwa-ke, akukacaci ukuthi lusebenza kangakanani ulwazi lokuqukethwe oluphathelene nenqubo yokwakha evela kubafundisi be-e.

Ngokwazisa ngaleligebe elinje, lolu cwaningo luhlose ukucacisa ubudlelwano phakathi kwezobuchwepheshe be-e-tutors, ubuchwepheshe bokufundisa, ulwazi lokuqukethwe lwenqubo yokwakhiwa kokufundisa ngaphakathi kobuchwepheshe be-Technology Education. Ukufeza le njongo, imibono emibili, okungukuthi iTransactional distance neConnectivism yahlanganiswa kanye nohlaka lweTechnological Pedagogical Content Knowledge (TPACK) ukusekela ucwaningo. Umbono wezwe wefilosofi yi-pragmatism esebenzisa indlela exubile. Ababambe iqhaza kulolu cwaningo bekungabafundi abayi-145 ababhalise uhlelo lonyaka lwamamojula amabili kuhlelo lweBachelor of Education (B.Ed.) esikhungweni seMfundo ePhakeme bahlolisiswa ukuqoqa imininingwane yobungako. Imininingwane evela ezingxoxweni ezihlelekile ezenziwe ubuso nobuso zaqoqwa nama-e-tutors amahlanu avela kumasayithi ocwaningo. Idatha yokubuka eku-inthanethi yaqoqwa kusuka kumasayithi e-e-tutor ohlelo lokuphatha lokufunda (LMS). Imiphumela iphakamisa ukuthi abafundisi be-e basenalo ulwazi lobuchwepheshe ukuze bakwazi ukuletha okuqukethwe okuhloselwe inqubo yokwakhiwa endaweni ye-ODeL. Futhi, kufakazelwe ukuthi abafundisi be-e abakawatholi amasu okufundisa okushayela inqubo yokuqamba ngendlela efanelekile ye-ODeL. Kumele futhi kukhunjulwe ukuthi okutholakele kolwazi lokuqukethwe kukhombisile ukuthi ama-e-tutors asenalo ulwazi lokusebenzisa ulwazi lokuqukethwe kwenqubo yokwakhiwa ukuze ivumelane nemvelo ye-ODeL. Lokhu okutholakele kugqamisa isidingo sobuchwepheshe ukuxhasa amasu e-tutors 'pedagogical maqondana nokuqonda okunenjongo kwenqubo yokwakhiwa nemithelela yayo kuzo zonke izingqikithi ze-ODeL.

Amagama abalulekile: I-E-tutor; Ukufundiswa nge-E; Inqubo yokuklama; Ukufunda amabanga; I-Open Distance ne-e-learning; Imfundo Yezobuchwepheshe; Ubuchwepheshe.

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LIST OF ACRONYMS

A	**Agree**
CAPS	**Curriculum Assessment Policy Statement**
CHE	**Council for Higher Education**
CK	**Content Knowledge**
DE	**Distance Education**
D	**Disagree**
ET	**Educational Technology**
HE	**Higher Education**
ICT's	**Information and Communication Technologies**
N	**Neutral**
NQF	**National Qualifications Framework**
ODeL	**Open and Distance eLearning**
PCK	**Pedagogical and Content Knowledge**
PBL	**Problem Based Learning**
PK	**Pedagogical Knowledge**
RQ	**Research Question**
SA	**Strongly Agree**
SD	**Strongly Disagree**
TK	**Technological Knowledge**
TCK	**Technological Content Knowledge**
TPK	**Technological Pedagogical Knowledge**
TE	**Technology Education**
TPACK	**Technological Pedagogical and Content Knowledge**
UNISA	**University of South Africa**

CHAPTER 1

1.1 INTRODUCTION

In the past two decades, Higher Education (HE) institutions operating in an Open Distance and e-Learning (ODeL) spaces began offering first year Technology Education courses. The courses were a response in teacher education programmes to introduce students to the real world of how problems are analysed and solved. Furthermore, there was a goal to address the entrepreneurial skills needed for industries, Peters (2006:95). In substantiation to Peters (2006), Li, Schoenfeld, diSessa, Graesser, Benson, English & Duschl, (2019:97) further attested that the design process in school education differs from professional education in terms of its emphasis on identity development in different professional fields such as architecture, fashion and engineering. Moreover, being successful in today's highly technological and globally competitive world requires students to develop and use different set of design process skills than were needed before Razzouk & Shute (2019:330).

In view of the above, there is a growing acceptance that the curriculum itself places a strong emphasis on the design process as the core around which the teaching of the curriculum should revolve. This is in line with the goal of introducing the design process to students who would develop an understanding of how the process is implemented. Typically, the design process itself is recommended to be implemented in procedural steps which include the investigation, design, make, evaluate and communicate (Department of Basic Education 2011:11).

Given the expectations around the design process, during the course development, there was no explicit consideration which was given as to how the students would experience interacting with the design process steps online.

In the light of the above, attempts were made to provide a supportive environment for the e-tutors to teach the design process. The process of support began with professional training given to the e-tutors. An expectation is that after the initial training, e-tutors were

able to adapt and deliver the pedagogy of the design process using appropriate online teaching strategies. The success of the design process depends on the pedagogy from the online teaching strategies which were adopted by the e-tutors. It was assumed that all the e-tutors who were appointed to implement the design process were able to implement strategies within expected levels of proficiency.

The learning space around e-tutoring relies heavily on technology. Technology is a key factor in nurturing successful online teaching practices (Baran & Correia 2014:98). Ideally, the process of e-tutoring needs a supportive environment designed with technologies. E-tutors are key role players tasked to deliver the design process online using and understanding different technologies. Online students have expectations about the nature and extent of the technical support from their e-tutors. Assumptions were created around e-tutors who implemented the design process that they were able to change from traditional modes to instructional needs of teaching using and integrating technologies.

The content knowledge for the design process is considered as one of the promising ways of transforming learning in ODeL contexts. The fulfilment of this mandate is dependent on the content knowledge of the e-tutors. This is a possibility since their appointments were based on their knowledge of content in their subject specialisations. Therefore, the primary focus in this study is for the e-tutors to facilitate and present specified topics for content knowledge within the design process. The perceived importance of design process as a content to be taught received a significant focus. However, its implementation has not translated fully into practice (Roberts 2013:204). As things stand, this section on content knowledge within the design process forms the basis around which the study pursues.

Throughout the implementation of the design process, e-tutors use technology as a tool for teaching and for integration during teaching. It means e-tutors exploit some form of technologies to deliver the design process. In addition, the process of presenting the design process relied heavily on strategies or approaches from the e-tutors. The two variables together with the content knowledge from the e-tutors set the stage for the successful online learning experiences of the online students. The knowledge of

technologies and the pedagogical knowledge together with the content knowledge are constituents which serve as important variables this study focused on. This conglomeration of variables is what is known as Technological Pedagogical and Content Knowledge (TPACK) framework in literature. It is assumed that online students who are facilitated with the design process were well prepared to implement the design process well into their future of teaching careers. Given the descriptions above, the variables laid a foundation for conceptual framework this study pursued. All these concepts will be briefly explained in Chapter 2.

1.2 CONTEXT OF THE STUDY

The context of this study was an Open Distance and e-Learning institution at the University of South Africa (UNISA). Even though the context of ODeL is well supported by the institution, the need to understand the tutors' TPACK knowledge is vital. The current study was conducted in the Department of Science and Technology Education, College of Education at UNISA. The College of education develop students to become future teachers in seven disciplines: Adult Basic Education and Training, Curriculum Studies, Early Childhood Education, Inclusive Education, Philosophy of Education, Science and Technology Education Mathematics Education. Within the Department of Science and Technology Education, the staff component in the Technology Education unit has five staff members with more than 30 000 students in enrolment for different modules. Students who registered for two modules of Economic Literacy and Entrepreneurship (PFC103S) and Learning Area Didactics (LADTECX) within the department were selected for the study. Both the staff and students are physically separated but connected through technology. The technology is exploited by e-tutors to support the students. E-tutors are the main agents responsible for the support of the students (McPherson & Nunes 2014:17).

Since technology is at the core for daily teaching and learning activities, recruiting and contracting e-tutors is recommended in this South Africa's ODeL University because it can enhance quality of interactions (Lee, Hong, & Choir 2017:22) in student support. This agrees with the 2013 Institutional Operational Plan at UNISA, all the National Qualification

Framework (NQF) Level 5 (1st year) modules across the University colleges were expected to have e-tutors appointed for the support of distance students. The employment of e-tutors at UNISA is based largely on technological, pedagogical and content knowledge of the subject discipline they offer. Furthermore, e-tutors are expected to demonstrate certain competencies in supporting students online, though the concept of online learning (e-learning) which is a new literacy at Unisa.

Tutoring services have been widely used to benefit students in Higher Education [HE] (Booth, Capraro, Capraro, et al., 2014:12). Much as advanced tutoring systems have been operated for decades in European countries and particularly by the majority of, HE institutions worldwide (Price et al 2017). Tutoring models vary by institution, culture and mode of learning (Hagnauer & Volet 2014:49). Further literature (Dekker, Pechenizkiy, & Vleeshouwers 2009) attests that student support, mainly at first-year level is vital in HE institutions.

In the same vein, it was Alan Tait (2003) who writes,

> Students want support, student support, especially student guidance, tutor support and effective information, all provide a range of activities that impact not only in terms of teaching but also affectively, that is to say reinforcing the student sense of confidence, self-esteem and progress (p.4).

1.3 PROBLEM STATEMENT

E-tutors serve as the primary source of student understanding of the subject content knowledge. At the same time, e-tutors should also have special responsibilities of knowing and understanding the subject that they teach within their given field (Shulman 1986:9; Mishra and Koehler, 2006:1026). Despite these requirements for e-tutors' content knowledge for implementing the design process, the extent of their content knowledge saliently features during their selection. Even though the technical infrastructure often sufficiently exists, the content knowledge needed to efficiently transfer new insights into new online experiences is often lacking from e-tutors (Rapp, Gulbahar & Adnan 2016:12). As things stand from the literature cited, it is still not clear how effective is the content knowledge which relates to the design process to the e-tutors. It is also still to be established how much an impact the acquisition of such content knowledge influences the effective teaching of the design process. The researcher held a view that understanding the variables of technological knowledge, pedagogical knowledge and content knowledge would be important to evaluate how the e-tutors construct their teaching of the design process in an ODeL space.

1.4 PURPOSE OF THE STUDY

The purpose of this study is to determine the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process within Technology Education specialisation.

1.5 OBJECTIVES OF THE STUDY

- To explore the e–tutors' acquisition of the technological skills for online content delivery.
- To establish the influence of the e-tutors' pedagogical knowledge on students' learning of design process.

- To determine the influence of the e-tutors' content knowledge on effective teaching and learning of design process.

1.6 THE STUDY'S MAIN RESEARCH QUESTION

An overarching research question of the study was**:**

What is the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process in Technology Education?

The question was substantiated by three sub research questions (RQs):

- RQ1: To what extend have e-tutors acquired technological skills for online content delivery?
- RO2: How does the e-tutors' acquired pedagogical knowledge influence the students' learning of design process?
- RQ3: How do e-tutors' content knowledge influence effective teaching and learning of design process?

1.7 SIGNIFICANCE OF THE STUDY

Numerous studies have already established that many of the services used to support students learning in Higher Education of learning have had minimal results (Netanda, Mamabolo & Themane 2019; Sedio & Ramorola 2018; Pitsoe 2016; Tait 2004; Ludwig-Hardman & Dunlap 2003). Unfortunately, much of the support services were more on interventions and quality. In such cases, little is revealed about the knowledge and skills and how they affect e-tutors' online practice (Jopling 2009; 2012; Shelley et al 2006; Whitney 2007). This gap is what this research sought to address.

This study contributes to the literature on e-tutors' technological pedagogical content knowledge generally and more specifically to the literature on Technology Education subject matter (content knowledge). Simultaneously, the study also wants to make a

methodological contribution through the development of an approach used to capture and categorise e-tutors' knowledge of Technology education content.

1.8 RATIONALE OF THE STUDY

In order to understand the design process, it is necessary to explore the relationship between the technological pedagogical and content knowledge of Technology Education e-tutors who implement the design process. Literature, (Berland & Steingut 2014; Mitcham 1994; National Research Council [NRC] 2012) confirmed that the design process is viewed as a possible approach to meet the set goal of increased supply of qualified technologists and engineers nationwide. However, there is no sufficient evidence of e-tutors' practices of daily teaching and learning towards understanding of the use of technology as an integral part during the teaching of the design process.

The second variable which featured for the delivery of the design process involves the pedagogical knowledge of the e-tutors. It has been stated that Higher Education (HE) institutions within ODeL settings have experienced phenomenal growth. Nonetheless, the professional support (e-tutors) still lags behind to optimise pedagogical strategies which revolutionise the learning opportunities for the students in ODeL environments (Council for Higher Education [CHE] 2007); Jhrree 2005; Mupa, Chiome & Chabaya 2012; Sife, Lwoga & Sanga 2007). In the light of the literature insights, there is an assumption that the e-tutors, who implement the design process, employ incorrect pedagogical strategies which do not benefit students in an ODeL environment.

Given the central position (Potgieter 2013; Gelderblom 2014; Singh–Pillay & Appiah 2016; Singh–Pillay & Ohemeng–Appiah 2016) for design in ODeL spaces, competent e-tutors who will support online students with skills for content knowledge have become significant. The content knowledge for the design process is associated with cognitive skills of investigating, designing (development of initial ideas), making, evaluating and communicating (Curriculum Assessment and Policy Statement CAPS (2011:7). In the light of the aspects mentioned, research on the design process is uncommon. There appears to be limited studies that focus on the implementation of the design process in

an ODeL environment. Consequently, a gap exists that this study aimed to address. It is against this background that this study sought to explore the relationship between the technological pedagogical and content knowledge of Technology Education e-tutors who implement the design process.

1.9 THEORETICAL PERSPECTIVE

The proliferation of Information and Communication Technology (ICT) in recent years has changed the educational landscape (Kop & Fournier 2010:2) which provides opportunities to learn. It is from these new educational landscapes that new theoretical perspectives surface. For the purpose of this study these theories include transactional distance (Moore 1991), Connectivism (Siemens 2004) and Technological Pedagogical and Content Knowledge (Graham, Borup & Smith 2011). These theories are summarised in the next section, and a brief description thereof is provided in Chapter two.

1.9.1 The theory of transactional distance

Theory of transactional distance largely considers distance as a pedagogical phenomenon, and a space of potential misunderstanding between the inputs of instructors and those of learners (Moore 1991:3). Transactional distance theory consists of three elements: dialogue, structure and learner autonomy, all of which interrelate across learner-instructor, learner-learner, learner-content and learner-interface interactions (Moore 1993:7). In Moore's view, **dialogue** is an important element of all teaching and learning. It is defined as a two-way communication and interaction in its many forms (Jung 2001:7). This simply means that learning takes place synchronously. Furthermore, learning in this regard involves an evaluation as well as an analysis of the quality of the dialogue that occurs (Cheng & Willits 1999:37). In this study dialogue took place between students and their e-tutors.

Structure refers to course organisation and the impact it has upon student engagement (Moore 1993:5). In transactional distance theory, structure represents the rigidity of flexibility of the course organisation and course delivery (Ibid). Moore (1993:3) advices

that the more rigid the course organisation, structure, and delivery is, the higher the level of transaction distance experienced by student. For the purpose of this study the structure was provided between two modules Technology Education modules within an ODeL context.

Learner autonomy represents the learner's perception of both independent and interdependent participation in the course and is directly related to the student's level of self-directed learning (Moore 1993:7). According to Moore (1993), learner autonomy is a less obvious element of all teaching and learning but constitutes an essential element of transactional distance theory and student engagement in distance education. Learner autonomy in this study took place between the learner online postings which were responded to by the e-tutors.

To reduce the learning distance experienced by students, Moore (1993:2) suggests that instructors need to pay attention to all three elements of transactional distance theory. A concise depiction by Moore and Kearsley (2005:224) is that the transaction in distance is the interplay (dialogue) between teachers and learners in special environments (structure).

1.9.2 Connectivism

Connectivism has been coined by Goerge Siemens and Stephen Downes as the learning theory for digital age (Duke, Harper & Johnston 2013:4). Connectivism is the integration of principles explored by chaos, network complexity and self - organization theories driven by an understanding that decisions are based on rapidly altering foundations (Siemens 2004:5). This would mean that 'learning takes place across networked learning communities and information technologies' (Dunaway 2011:675). In light of the above, connectivism has been selected for this study on the basis that learner support in a digital platform will occur across network connections. In this network, students research, share knowledge, and make sense of the digital learning space provided.

1.9.3 Technological Pedagogical and Content Knowledge (TPACK) framework

Drawing from the study problem as well as different authors' (Potgieter 2013; Gelderblom 2014; Singh–Pillay & Appiah 2016; Singh–Pillay & Ohemeng–Appiah 2016) views on the knowledge e-tutors should possess, this study was located within the framework of Technological Pedagogical Content Knowledge (TPACK). TPACK was established by Mishra and Koehler (2005b; 2006a) to explain the types of knowledge teachers need in order to integrate technology into their teaching. This conceptual framework was selected for this study on the basis that e-tutors can effectively integrate their content knowledge (design process) to promote their student learning. TPACK is a useful framework in terms of the thinking for designing and evaluating the amount and organisation of teacher knowledge for various content areas (Tee & Lee 2011; Shulman 1986). Most researchers currently use TPACK as a framework for investigating teachers' integration of digital technologies during teaching (Graham, Borup & Smith 2011:532).

The framework is relevant to this study due to the fact that it described the kind of knowledge needed by teachers for effective technology integration (Koehler & Mishra 2008; Mishra & Koehler 2006b), and defines the competencies and skills needed by teachers to integrate technology (Shulman 1987; 1986), or alternatively how they teach particular content using technology. In this study, the kind of knowledge would be the one e-tutors need to effectively drive the teaching and learning of the design process content to students at a distant learning institution.

Based on the expositions together with the purpose of this study, the two theories (Connectivism and Transactional Distance) including the TPACK framework underpinned this study. The following research matrix encapsulates how each theory and the TPACK framework were used in the study.

Table 1.1 Research study matrix

RESEARCH MATRIX			
Research Questions	**Objectives**	**Instruments**	**Theories and Conceptual Framework**
Main RQ: **To what extend does the relationship between the e-tutors' technological, pedagogical, content knowledge influence the teaching of the design process in Technology Education?**			
RQ1 To what extend have e-tutors acquired technological skills for online content delivery?	To explore the e–tutors' acquisition of the technological skills for online content delivery.	➢ Questionnaires ➢ Online observations ➢ Semi structured interviews	➢ TPACK framework ➢ Connectivism ➢ Transactional Distance Theory
RQ2 How does the e-tutors' acquired pedagogical knowledge influence the students' learning of design process?	To establish the influence of the e-tutors' pedagogical knowledge on students' learning of the design process	➢ Questionnaires ➢ Online observations ➢ Semi structured interviews	➢ TPACK framework ➢ Connectivism
RQ3 How do e-tutors' content knowledge influence effective teaching and learning of design process?	To determine the influence of the e-tutors' content knowledge on effective teaching and learning of design process.	➢ Questionnaires ➢ Online observations ➢ Connectivism	➢ TPACK framework ➢ Transactional Distance Theory ➢ Connectivism

Elaborate discussions on the study's theoretical perspectives and framework unfold in Chapter 2 of this study.

1.10 SYNOPSIS OF THE RESEARCH DESIGN AND METHODS

1.10.1 Study Population and Sample

This study employed a pragmatic research approach and an exploratory mixed method design approach (Bryman 2012; Creswell 2008; Creswell & Plano Clark 2007; Greene 2007) to collect and analyse data. Pragmatists hold a view that truth is 'what works' and that the researcher plays a larger role in the interpretation of the results (Plano Clark & Creswell 2008:214). The results for the study were obtained from a population.

1.10.2 Population

A population is a group of elements or cases that conform to specific criteria (McMillan & Schumacher 2010:129) such as undergraduate students of a university from which sample elements were selected by the researcher for her study. The study's population comprised all the e-tutors and students of Technology Education who registered the modules of Learning Area Didactics (LADTECX) and Economic Literacy and Entrepreneurship (PFC101S) for the Bachelor of Education (B.Ed.) programme. The total number of e-tutors was six and 1435 students who were registered for the two modules during the time when this study was conducted.

Generating an understanding towards concepts is significant because not one person sees the concept as similar. The same understanding is given to the concept of a population. For example, a population refers to a group of elements or cases that conform to specific criteria from which the results of a study can become generalized McMillan and Schumacher (2014:5). While a population is a universe of units from which the sample is to be selected Bryman (2012:187). Overall, the meanings assigned to the concept agree on the notion of elements or units which suggests that the idea of a reference to the concept of population can generate common but multiple definitions. As indicated in Chapter 1, section 1.10.1.1 the population in this study comprised two groups. First were the e-tutors who were employed to facilitate two modules Learning Area Didactics (LADTECX) and Economic Literacy and Entrepreneurship (PFC103S) from

Technology Education discipline. Second were the students who by the commencement of this study registered the two modules as mentioned above. The use of e-tutors in this study suggests some sampling procedures were followed.

1.10.3 Sampling

Qualitative purposive sampling is a crucial stage in research process because it assists in informing the quality of deductions which the researcher derives from the underlying things (Onwuegbuzie & Collins 2007:281). Sampling involves the selection of units of analysis for a mixed method study through both probability and purposive sampling strategies (Clark & Creswell 2008:212). A major reason for such a selection is that the sample is studied intensively (Kothari 2004:17). Sampling denotes a statistical procedure of finding cases to study wherein estimation for the cases is made (Silverman 2014:455). Looking across the understanding created around sampling (Silverman 2014; Clark & Creswell 2008), the authors' common position about sampling is that there must be a quantitative aspect in the sampling process. However, the qualitative aspect does not receive an underscore since purposive strategies are also considered during the selection of the units for analysis. Given the situation and for the purposes of this study, both the quantifying and the qualifying sampling aspects emerge as important to consider. As a result, given that the study employed a mixed method approach, purposeful and convenience sampling were used to select the participants in this study.

Purposive sampling is a feature in qualitative research whereby researchers handpick the cases to include as samples based on the possession of characteristics the researchers pursue (Cohen, Manion & Morrison 2007:114). The value of purposive sampling is that the researcher knows the population and also has the knowledge about the population which has an understanding of the research field (Bless & Higson-Smith 1995:95). In light of the above, purposeful sampling was appropriate to hand pick five e-tutors from the Technology Education discipline. The rationale was that the selected participants will best help to understand the research problem (Creswell 2014:246). In support of the above, Babbie and Mouton (2001:166) opined that the sample is based on the researcher's knowledge of the discipline and a good knowledge of the available population. In this

regard, the sample units were subjectively selected by the researcher Nachmias-Frankfort and Nachmias (1992:175) in the study. A researcher got to select the cases from which the issues of the study could be learned (Merriam 2009:77). This was a possibility since qualitative interviews are possible from a relatively small number of participants because they are able to generate in-depth information in response to queries and probes of the interviewer Bikgman and Rock (2009:299). The number was as a result of the participants who were active in the delivery of the curriculum during when this study was conducted.

At the same time, the researcher needed convenience as it is seen to provide structure. Convenience sampling strategy on the other hand, involves the selection of subjects which are available or accessible for study McMillan and Schumacher (2014:246). The strategy involves the choosing of nearest individuals to the researcher as respondents also on the basis that they are available and accessible (Cohen, Manion & Morrison 2007:113). In this study, convenience sampling involved the collection of a quantitative data whereby the selection of 145 students was based from their availability and willingness to participation (Creswell 2008: 239). The researcher in this regard, benefitted from the situated convenience of being an insider since she was in the employment where the study was conducted.

1.10.4 Data Collection

It has been explained in Section 1.10.1 that the study employed a mixed method approach. In this study, quantitative and qualitative data were collected concurrently. The objective of using two methods was to triangulate the findings from the two data sets for the purpose of conducting the study (Gall et al 2007:298). In this regard, three data sets were used to collect data, with an aim to provide methodological rigour (Bergman 2008:55). Firstly, it was a survey designed and adapted from TPACK framework as proposed by Mishra and Koehler (2006). A closed structured online questionnaire was employed in this regard to collect quantitative data from students. Before a questionnaire could be administered, it was sent to the course coordinators in the field of Technology Education for quality assurance. After the approval, student list was created on Google

App and the questionnaire was sent to the list of students and their responses resulted in data was collected through graphs.

Secondly, online observations were collected from the e-tutor sites of the institution's learning management system (LMS). In this regard, the researcher observed the daily interactions of e-tutors and students that occurred online.

Thirdly, next was the collection of qualitative data. From the purpose of this study, the face-to-face semi-structured interviews were conducted with e-tutors in the research sites. A set of basic rules was observed in developing the questions (Harrel & Bradley 2009). These rules include among others the avoidance of long explanations of the study that assisted the researcher not to deviate from the purpose of the study. A set of predetermined questions guided the interviews. All the five participants were asked the same set of questions in sequence. The collected data was recorded and typed by the researcher.

1.10.5 Data analyses

For the analysis, the survey data were scored using the Google form free survey (GFFS) application and presented in the form of tables.

The qualitative data from the interviews were coded and explored in thematic responses. In order to ensure for validity which became the evidence which supported the interpretations which were made on the results of the study Moskal and Leydens (2001:1). The researcher ensured that those participants in the sampling frame were given an equal chance of being selected (Lancaster 2005:149). On completion of the data analysis process, the qualitative data were made available to participants for member checking and to confirm authenticity (McMillan & Schumacher 2012; Creswell 2014). In order to ensure reliability Shuttleworth (2008) the face interviews were pre-tested through piloting so as to test an extent to which a method gives consistent results across a range of settings (Wellington 2000:200).

1.11. ETHICAL ISSUES

Professional organisations adhere to ethical issues in research from which employee needs for research become safeguarded. According to Bryman (2010:130) such professional organisations formulate codes of ethics for conducting research. On sight application clearance certificates are issued from the process involving filling of ethics applications form. The issue of such a certificate means the researcher takes accountability in how the research is conducted. This study was issued with an ethics certificate by the research committee within the College of Education. The certificate appears as (Ref 2018/04/18/07724101/23MC) **APPENDIX: 1** in the study.

The second professional organisation named, Research Permission Subcommittee (RPSC) of the UNISA Senate, Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC), certificate no; Ref #: 2018-RPSC-037); (**APPENDIX: 2)** also provided permission to conduct surveys with the undergraduate and post graduate students (LADTECX and PFC103S) modules and also permission to conduct interviews with the e-tutors.

The issue of an ethics certificate mandated the researcher to conduct research that informed participants about the study purpose, getting their consent and making sure that they are willing to allow the researcher to use the data collected from them to be considered as ethical. This process for this study was orbited with an initial application to participant e-tutors. The permission letter is attached as **APPENDIX: 3.**

Getting consent (Creswell 2014:312 & Maree 2008:208) from the participants is also mandatory. The process followed by the e-tutor participants is to sign a consent form with an undertaking that they are free to withdraw at any stage of data collection without providing reasons appeared as **APPENDIX: 7.** Finally, the data which were collected from the e-tutor participants were in the possession of the researcher and it is not connected to any one of the participants in order to ensure anonymity Buchanan and Bryman (2010:86) to participation.

1.12. DEFINITION OF TERMS

This section grounds the terminology used for the study. The aim is to introduce and provide expositions from literature in order to dispel confusions as the study progresses. In the definition, each concept is followed by a descriptor as reflected below. The terminology includes, e-learning, e-tutor, e-tutoring, design process, Distance Education, Open Education, Open Distance and e-Learning, Technology Education and technology. The way the terminology is presented followed an alphabetical order sequence.

TERM	DESCRIPTOR
E-tutor	Someone who interacts directly with learners to supply their learning process when they are separated from tutor in time and place for some or all direct interactions (Denis, Watland, Sebastien & Verday 2004:3)
E-tutoring	E-tutoring or electronic tutoring refers to individualised learning support provided via the Internet and includes on-going communication between e-tutor and e-tutee (Johnson & Bratt 2009:38; Flowers 2007:98).
Design process	Design process is a creative and interactive approach used to develop solutions to identified problems or human needs with associated skills of investigating, designing, making, evaluating and communicating (Department of Education 2002:8, Department of Basic Education 2011:11)
Distance Education	Distance education is teaching and planned learning in which teaching normally occurs in a different place from learning, requiring communication through technologies as well as special instructional organisation (Moore & Kearsley 2012).

Open Distance and E-learning	Forms of education provision that use contemporary technologies to enable varied combinations of synchronous and asynchronous communication among students and lecturers who are physically separated from one another for part or all learning (Alfanso 2012: 38).
Technology	The use of knowledge, skills, values and resources to meet people's needs and wants by developing practical solutions to problems, taking social factors into consideration (Department of Education 2002:8 Department of Basic Education 2011: 11)
Technological Knowledge	Technological Knowledge is considered developmental, a type of knowledge that is generated and adapted over time through new and varying interactions and experiences (Harris, Mishra & Koehler 2009:98; Koehler & Mishra 2008:74; Harris 2008:16)
Pedagogical Knowledge	Pedagogical knowledge refers to processes, practices or methods of teaching and learning with an intention to help the teachers to use technology in their subject teaching (Lumat 2015:14).
Content Knowledge	The concept of Content Knowledge refers to the amount actual knowledge, organization of knowledge in the mind of the teacher and how the nature of that knowledge is different for various content areas (Chang, Hsu and Ciou 2016:137

1.13 PLAN OF THE STUDY

CHAPTER 1

This Chapter set the tone for the study. It incorporated the introduction, context, problem statement, purpose and the objectives of the study. These were followed by the study's main research question, the significance of the study together with the rationale for the study. The theoretical perspective focused on the theory of transactional distance together with aspects of discussed dialogue, structure and learner autonomy. Connectivism together with the Technological Pedagogical Framework (TPACK) were next focus for discussions. The synopsis of the research design and methods was next for discussion. This section elaborated on the population, sampling technique, data collection and the data analyses in the study. The ethical issues concerning the study were also discussed and the definition of terms was explained for the study. The next section is the plan of the study.

CHAPTER 2

The first focus for Chapter 2 was based on literature which grounded an understanding on the concept of the design process. The different understandings of the design process were discussed. These were the design process as problem solving and the design process as procedural steps: investigation, design, make, evaluate and communicate were discussed. The next section of focus was on e-tutoring. The Roles and competencies of the e-tutors were discussed together with e-Learning in Distance Education. The next section of focus was on student support in Open and Distance eLearning (ODeL). The theoretical and conceptual frameworks of the study were also focussed on. A specific focus became the Transactional distance theory where dialogue, structure and learner autonomy were discussed. The discussion on connectivism as a theoretical aspect targeted *cognitive presence* in connectivist pedagogy, social presence in connectivist pedagogy and teacher presence in connectivist pedagogy. The next focus was on the Technological Pedagogical and Content Knowledge (TPACK) framework whereby the Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Knowledge, Technological

Content Knowledge were discussed. *The next section deals with the* justification for TPACK framework in the study. The study was rounded with a conclusion.

CHAPTER 3

This Chapter of the study started with the research design and methods. The study philosophy and the research methodology were next in discussion. Within the research methodology, mixed methodology paradigm, triangulation design and the sequential explanatory design were discussed. The next discussion focused on the population and the sampling techniques. The section on data collection focused on the designing of the questionnaire and piloting the draft of final questionnaire. The next focus became designing of the individual semi-structured face to face interviews for the study. Furthermore, concepts of validity, external validity, face validity, content validity and reliability were discussed. The next focus was on a section about designing for the online questionnaire.

In terms of the data analysis, three analyses were observed. Those of analysing the quantitative data (questionnaires), analysis of quantitative data (online observations) and the analysing of the qualitative data (face to face interviews). The next section for discussion was the ethical considerations which focused on the following variables: harm to participants informed consent, anonymity and confidentiality. The section preceding the summary section was based on explaining the position of the researcher. The next Chapter dealt with chapter 4 were the analyses of the study's results.

CHAPTER 4

This Chapter presented the analyses and results of both the quantitative and the qualitative data. The first presentation was on students' quantitative data results. The analysis focused on the e-tutors' Technological Knowledge (TK) of the design process. The results were presented in four item questions in relation to the research question 1 of the study. The next analysis focused on the Pedagogical Knowledge of Technology Education design process of the students. In this section four question items were asked to students regarding their views on the influence of the learning of the design process by e-tutors acquired pedagogical knowledge. Furthermore, the Content Knowledge of the

design process for Technology Education content were presented. This section related to the nine question items asked to students regarding the influence of e-tutors content knowledge on effective teaching and learning of the design process.

The next section of results which were analysed were the results from the online observations for the e-tutors' Technological Knowledge (TK) of the design process. This section was presented in three items based on the research question about the extent to which the e-tutors have acquired technological skills for online content delivery. The online Pedagogical Knowledge (PK) skills for e-tutors of the design process in an online environment were also analysed. This section's results were presented in three observation items about the extent to which the e-tutors have acquired pedagogical knowledge skills for the delivery of online content for the design process.

An analysis on the semi-structured interviews was also presented. This was based on three RQ's. RQ1- *What is the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process in Technology Education?*

From the RQ1, three themes emerged of theme 1: E-tutors used online tools to deliver the design process content; theme 2: the e-tutors familiarised themselves with the technology tools and theme 3: the e-tutors' experience of teaching the design process.

The RQ2 was based on: how do the e-tutors' acquired pedagogical knowledge influence the students' learning of design process? Two themes emerged during the analysis of data. Theme 1: e-tutor qualifications influence the teaching of the design process and theme 2: e-tutor training influences the teaching of the design process.

The RQ3 focused on: How do e-tutors' content knowledge influence effective teaching and learning of the design process? From the *RQ3,* there were three themes which emerged from the given research question. These themes were practical activities that influence e-tutors' content knowledge of the design process, problem solving influences e-tutors' content knowledge and content knowledge influences the teaching of the design process. The Chapter ended with a conclusion.

CHAPTER 5

Chapter five was the final chapter of the study. It presented discussions of findings, conclusions and recommendations. The summary of all the chapters were presented. This was followed by the discussions of the main results which were discussed in relation to the objectives which were set for the study. The focus of the discussions was based on all the three subsidiary research questions of the study. A section on the study's limitations was also presented. This was followed by the recommendations which were made for the study. The reflection of the study was also a topic in this study which was followed by a conclusion. The next section presents Chapter 2 of the study.

CHAPTER 2

THE CONCEPTUALISATION OF THE DESIGN PROCESS IN AN OPEN DISTANCE e-LEARNING SPACE

2.1. INTRODUCTION

The aim of the study was to determine the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process within Technology Education specialisation. The focus in this chapter is to review the existing and related literature, in order to identify matters known in relation to the study. Thus, the chapter will review literature related to the design process as problem solving and design process as procedural steps. This will be followed by e-tutoring with E-learning in an ODeL space. The chapter will further describe the theoretical perspectives grounding the study.

E-tutoring with specific focus on the roles and competencies of the e-tutors formed part of the literature review. The theoretical and conceptual frameworks employed for the study, the transactional distance theory's strands of dialogue, structure and learner autonomy became subtopics for discussions. A mention was made earlier that the transactional theory will be coined with connectivism and this is the platform where it was discussed in detail. Within connectivism, the cognitive social and teacher presence tenets were presented.

The TPACK framework was also focused on in this section of the study. Sections of technological knowledge, pedagogical knowledge and the content knowledge strands were discussed. Subsidiary tenets of pedagogical content knowledge, technological pedagogical knowledge and the technological content knowledge were also in focus. This was curtailed by a section which concluded the chapter.

The process of the literature which was obtained used the Google search engine which followed a process of typing key words.

2.2. THE DESIGN PROCESS

The concept of design process is well established as a dominant discursive regime within the subject, Technology Education (Mawson 2010:119). As a result, a growing number of leaders (Hill 2006; Wicklein 2006; Daughtery 2005) advocated that the implementation of the subject in classrooms should be treated as a 'technological process'. This process is given an added importance in the national curriculum because it has become a common element in the teaching of the subject (McCormick, Murphy & Hennesy 1994:5). In a case where those who are tasked to implement the process of design as recommended think otherwise, Parker (2003:7) cautions that:

> Teaching of the design process leads to a fragmented and a disjointed approach in which the exploration of materials to inform designing is absent and the useful procedures are not utilized. The range of teaching and learning styles employed is limited leading to a situation where the students are complaint rather than enthusiastic.

Parker (2003) first statement refers to a challenge of procedure which can be interpreted as a warning and a lack of specific teaching styles is needed to create learning which is within the aims of the curriculum. Parker (2003) is supported by Barlex & Welch (2004:17) that specified teaching styles might inform best practices and development for the subject. Some distinguishing attributes of teaching styles for the design process were described in order to provide a sufficient foundation for a properly functioning technological process. (Hope 2005; Hill & Anning 2001; Hope 2000; Mymon, Harel & Barak 1999) mentioned portfolio creation teaching strategies for various phases of communication stage.

The pedagogy of the design process also became a central focus in other studies. These studies (Howard-Jones 2002; Turnbull 2002; Hill & Anning 2001; Murphy & Hennessy 2001; Atkinson 2000) investigated various learning styles and strategies to teach the design process. In this regard, Howard-Jones (2002) established that the teaching strategies became a challenge since teachers could not support the use of such strategies and the learning styles in classes. This concurs with other studies (Walmsley

2003; McNaair, Daliat & Clarke 2003; Molwane 2001) regarding the teaching strategies of teachers which were decided upon in order to teach aspects of the design process. Molwane (2001) analysed teaching styles and observed that teachers' strategies and styles encouraged passive overactive learning. In support of this observation, researchers (Mawson, 2003; Fatt & Joo 2001) indicated a detrimental impact on students learning of the subject based on the continued adherence to such strategies.

Other studies (Brophy, Klein, Portmore & Rogers 2008; Shields 2007; Yasar, Baker, Robinson-Kurpius, Krause & Roberts 2006; Creighton 2002) have been conducted into identifying barriers for successful implementation of the design process during teaching. One of the studies (Brophy, et. al. 2008) identified problems with the way teachers implement the procedural steps within the design process. Related studies (Bailey 2013; Pool, Reitsma & Mentz 2013; Atkinson 2011) were concerned about moving teachers away from the linear approach which emphasised the product and not the processes during the design of the product process. These studies revealed and further confirmed that there is a contrast and an unconnected relationship of how teachers implement the procedure to the relevant outcomes of products. In the same vein, Pool, Reitsma & Mentz (2013) study on Technology Education teachers reported that in South Africa it indicated a lack of appropriate skills to drive the preferred reiterative than the linear approach of the design process. Pool, Reitsma & Mentz (2013) study indicated a demand for strategies aimed to reform the implementation of the technological steps within the design process.

As things stand from the literature, a suggestion is that all these findings may be best improved with an approach that engages the e-tutors around their insights about the design process. In the study's context, in order to capitalise fully upon the potential that the design process holds, the integration of formal qualifications of the e-tutors, their formal training (Continuing Professional Teacher Development (CPTD) and their experience maybe sought. The relevance of formal qualifications, experience and the initial e-tutor training might enable e-tutors to become motivated to engage adequately with the delivery of the design process

Operating under an ODeL conditions, there is a need for well-prepared e-tutors. During the appointment processes, there are decisions to be made about who qualifies for such an appointment. Such decisions can be built into what might be called Continuing Professional Teacher Development (CPTD) which for purposes in this study became known as ‘e-tutor training registered as a special need for preparing e-tutors’. CPTD, Desimone, Smith, Hayes and Frisvold (2005:16), over many decades focused more on improving teacher professional development for their face to face classroom activities. The purpose of CPDT is the development of content knowledge, instructional methodology and skills (Steyl 1998:92; Craft 1996:6; Hunsaker & Johnston 1992:350). Steyl (1998:114) further guided that CPTD empowers unqualified teachers and also further development of qualified teachers for a specific content area. This commitment of professionalising e-tutors through training was aimed to provide a considerable support network and also an improvement in the facilitation of the design process in an ODeL space.

In the light of the above, several studies were conducted in order to provide insights into how teacher training develop for teachers to professionalise the teaching of the design process in the classrooms (Troxell, Siller & Iversen 2008; Burghardt & Hacker 2007; Burke & Meande 2007; DeMiranda, Ross & Bayle 2007). Consistent with the studies mentioned, a study by Ross & Bayle (2007) identified a number of challenges facing the Technology Education teachers as they sought to make changes during the teaching of the design process. Further studies, (Balchin 2005; Rutland 2004) also identified teachers who were not able to support the execution of the design process even after CPTD initiatives.

CPTD in this study is focused only in an ODeL environment. As a result, some studies were conducted in this context. For an example, studies of engagements in educative online environments (Wayne, Yoon, Zhu, Cronen & Garet 2008; Ingarson, Meiers & Beavis 2005; Guskey 2000) enlightened that there is no sufficient evidence to indicate which features of professional development are effective for eliciting improvements in student learning. Other studies (Wayne, Yoon, Zhu, Cronen & Garet 2008; Ingarson, Meiers & Beavis 2005; Guskey 2000) highlighted the positive value of online activities

including (Desimone, Porter, Garet, Yoon & Birman 2002; Garet, Porter, Desimone, Birman & Yoon 2001) studies. The studies mentioned, (Wayne et al. 2008; Ingarson, et al. 2005; Guskey 2000) identified CPTD as a critical feature of focus, but in these mentioned studies it does not often translate the complex learning opportunities of the design process for the students. These findings are useful to know when considering enquiring into the experience from the e-tutors who implement the design process.

Experience features within CPTD and as a unit of focus from the e-tutors who implement the design process. In this study, an assumption is that all the e-tutors who were appointed to implement the design process have gained some form of experience. Bencze (2010:45) indicated that from the teachers who implement the design process, one teacher out of ten was experienced in promoting the technological process steps. However, Canales & Maldonado (2018:35) argue that experience has been identified as the most important human capital in studies. Studies on experience (Harris & Sass 2011; Goldhaber 2008; Kane, Rockoff & Staiger 2008; Ladd 2008; Clotfelter, Ladd & Vigdor 2007, 2006; Rivkin, Hanushek & Kain 2005; Rockoff 2004) showed positive effects of experience on students' academic outcomes. On the other hand, (Harris & Sass 2011; Goldhaber 2008) completed studies on the impact to the number of years which accumulated as experience and found that experience has a positive effect during the first five years of teaching career. Rivkin et al. (2005) study concluded that improvements in teaching proficiency as a result of experience occur during the first three to five years.

A main role player for developing and improving the design process is an e-tutor who is suitably qualified. A well - qualified teacher helps students to develop creative ideas and confidence (Brown 2008:89). Teacher qualification is a well sought asset of strength towards understanding the dynamics of content (Martin 2009:209). This would mean Martin (2009) that e-tutors in this context are capable to convey the design process content based on their qualifications to students that they teach. In the light of this, teacher qualification is also another feature of CPTD.

Studies in teacher qualifications (Clotfelter, Ladd & Vigdor 2007; Rivkin, et al. 2005; Nye, Kostantopoulos & Hedges 2004; Rice 2003; Goldhaber & Brewer 2000) were conducted

in relation to teacher education. Goldhaber & brewer (2000) found little rigorous evidence that teacher qualification is systematically related to students' achievement. Also, Rice (2003) study found that by having a masters' degree is unrelated to teachers' classroom performances on students' achievement.

Three lenses, formal qualifications, experience and the initial e-tutor training were proposed to establish their association and their potential for the delivery of the design process and its implementation. The three lenses might influence how e-tutors perceive the design process during their instructional activities. The following aspects were suggested as those that might direct the flow of teaching the design process. The flow is modelled against design process as problem solving and design process as procedural steps. The next section's focus is on the design process as problem solving.

2.2.1 Design process as problem solving

For the design process to qualify as problem solving, it must contain the procedural steps (Hillmola & Lindfors 2016:17). A mention was made earlier that the design process itself is recommended to be implemented in procedural steps which include the investigation, design, make, evaluate and communicate, Department of Basic Education (2011:11). Based on this understanding, learning the design process as problem solving is a well-established enquiry (Walker, Recker, Robertshaw, Osen & Leary 2011:33; Park & Etmer 2008:18; Parkinson 2001:45). Problem solving is an instructional method used in formal settings in which learners in small groups acquire knowledge through engagements with authentic and challenging real life problems (Walker, Recker, Robertshaw, Osen & Leary 2011:73). These problems often pose uncertainties about which processes are necessary to follow for best solutions (Jonassen 1997:65). A solution is to regard problem solving as a teaching method from which students acquire skills through investigating and solving problems, Park & Etmer (2008:632). It is a critical thinking skill necessary for the subject and a necessary tool for developing effective solutions to practical problems (Makgatho 2011:3). In the light of Makgatho (2011), that would mean for the successful implementation of the design process as problem solving, e-tutors would require a set of skills that the curriculum requires from the students that they teach.

Keeping in mind with the challenge set for the e-tutors above, an array of scholars (Kangas, Seitamaa-Hakkarainen & Hakkarainen 2011; Pudi 2007; Gustafson & Rowell 1998; Hill 1998) proposed to have problem solving connected to critical thinking and creativity and also that they become key aspects for the design process. Consequently, a significant study, Pudi (2007) observed that the implementation of the design process is skewed and a hurdle for teachers from how they construed problem solving as a skill to be taught for the design process. Some studies also attracted research interest on design process as problem solving (Spendlove 2005; Haffenden 2004; Hardy 2004; Nichol 2004; Rutland 2004; Hammilton 2003 & Kimbell 2000) reported that in Technology Education teachers still lack abilities to help learner in thinking creatively and also how to use problem solving so as to become creative problem solvers.

In a growing recognition for design process as problem solving, related studies (Davis 2011; Asunda, 2007; Vandeleur, Ankiewicz, Swart & Gross 2001; McCormick 2004; McCormick 1997 & Wakefield 1992) linked creativity as a skill within problem solving of the design process. McCormick (1997) study advised that the basis for design process to be treated as problem solving accounts for few and at most no empirical research of what happens in classrooms. In addition, a later study, McCormick (2004) claimed that there is little evidence that problem solving capabilities developed in one area will transfer to another in a similar context. In the light of this understanding, some of the e-tutors were appointed from a face to face interaction setting into a distance learning context. This would mean that in the time of adjusting to the context, students might still lack support for the skills needed in the design process to be taught as problem solving. Context is important to problem solving for the design process since the activities given to the students are shaped by the tools and resources available (McCormick, Murphy & Hennesy 1994:6). From the use of such tools of for an example, basic hand tools, equipment and materials develops psychomotor skills necessary for practical tasks and activities for the design process as problem solving Johnson (1997: 167).

Along the same vein, Asunda (2007) study pointed out to a range of absent skills to practice and ground the design process as problem solving from teachers who implement the design process. These were freedom to generate ideas, flexible use of time and

space, availability of appropriate materials and the ability to see a solution. The absent skills mentioned, Asunda (2007) would mean that there will be a lack of understanding by e-tutors to incorporate the skills in order to complement the instructional objective of teaching the design process as problem solving. In summary, two authors mentioned, it is important to note that such skills as cognitive, practical (motor) and other technology related skills are essential for problem solving related skills, Reddy (2003:30) while skills of cognition, practical work, creative and critical problem solving skills which are imperative for problem solving activities, Johnson (1997:161).

2.2.2 Design process as procedural steps

The successful implementation of the design process is dependent on teachers having a solidly established related content for the subject that they teach (Appiah This section presents the results from the quantitative results 2015:98). This means these teachers have become experts of the subjects and as a result they have different conceptions about how to implement the procedural steps of the design process. A common view amongst teachers is to understand the design process as a linear process (Williams 2014: 356; Mawson 2003:120). In other words, the design process is construed as a series of steps outlined by the teachers and learners are expected to follow these steps sequentially and diligently in their projects (Singh-Pillay & Appiah 2016:217). The linear process model does not provide enough room for developing the creative skills of the learner (Lewis 2006:265) nor does it allow for learner autonomy (Rowel 2004:50).

An alternative view to the linear approach is to conceptualise the design process in procedural steps. In this context, procedural steps are creative and iterative steps of possible solutions which come from the refinement of the identified problem and the ever-changing ideas (Hill 1998:203). Design process as procedural steps has creative aspects whereby students can generate ideas, have room for experimentation, non-conformity and the generation of new ideas (Asunda 2007:56; Davis 1999:13; & Wakefields 1996:64).

The two views held about how to conceptualise the design process generated debates from proponents who hold opposing views about the procedural steps to be followed

during the teaching of the design process. The proponents for the linear approach were (Williams 1995; Johnsey 1990; Rowland 1989; Kelly 1987) whose common advocacy for the linear process was that this provides a structure for the teachers to teach the design process. On the other hand, (Ritchie & Hampton 1996; Roth 1996; Fleer & Sukroo 1995; Jane & Smith 1995; Anning 1994; Jones & Carr 1993; were proponents who described a view for the procedural steps. While these debates were progressing, this study was planned in accordance within a South African context university whose role was to supply Technology Education teachers. Such teachers were prepared to have a solid foundation of how to teach the content knowledge, the necessary pedagogical knowledge and the knowledge for technologies. In the light of this, this study opted to follow a non-linear approach as suggested by Department of Basic Education (2011:7) where a non-linear process is consistent with teacher knowledge (Department of Basic Education 2011:9).

Technology subject also recommended that it should be used to structure the delivery of the design process, Department of Basic Education (2011:11). In the light of such developments, some studies were conducted on the both the linear and the non-linear process of the design process. Studies on linear approach, (McRobbie, Stein, Stein & Gins, 2001; Parkinson 2001; Fleer & Sukroo 1995; Jones & Carr 1993; Roth 1998) became subjects for investigation. In this regard, Parkinson (2001) study established that there was a lack of fit between the specific step by step approach which followed a linear process whereby the teachers were unable to show how the design process can be taught in procedural steps. An earlier study Kimbell et al (1991) noted that the non-linear approach provides opportunities for students to replicate how the professional engineers work. Also, in Roth's (1998) study, he reported that in instances where students followed a linear approach of drawing their ideas prior to the construction, there was a considerable discontinuity between the drawings and what the students produced during construction. The relevance of this finding to the study is that it offers a benchmark for the results with those which were obtained from this section of the study. At the same time some scholars (Williams 2014; Mioduser & Dagan 2007; Aspelund 2006; Rowel 2004; Mawson 2003; Peto 1999 & Kimbell, Stables, Wheeler, Wosniak & Kelly 1991, conducted studies on the non-linear approach to design process as problem solving. Out of a study conducted by

(Williams 2014) it was reported that when students use the non-linear approach, they are able to start generating ideas then later develop these ideas into products. The possibility of generating ideas which later develop into products provide potentials of using procedural steps by students to engage positively with the design process. The procedural steps are summarised in Figure 2.1.

Figure 2.1: IDMEC process (adapted from the Department of Basic Education 2011:11)

In the light of the scholarly debates, the Department of Basic Education (2011) was committed to the course of teaching the design process so that the set aims of its curriculum can be achieved. In response, it provided considerable frame to the non-linear iterative steps towards teaching the design process as procedural steps (Figure 2.1: IDMEC process). Its policy document, Curriculum Assessment Policy Statement (CAPS) is an official document for the Technology subject where the Design Process procedural steps of (Investigate, Design, Make, Evaluate, and Communicate [IDMEC]) are to be taught in a non-linear fashion. Detailed descriptions of the procedural steps follow below.

2.2.3 Investigation

Investigation is the first step of the design process. A positive gain from understanding the investigation stage of the design process is that children should be able to ask questions which will lead to finding solutions about the problems under investigation (McLaren 1997:12 & Fry 1994:34). This view of asking questions encourages learners to interrogate the design process in order to effectively analyse the actual problem (Lawson 1980:40). The investigation stage provides important skills that need to be developed in order to find effective solutions to problems (Sedio & Potgieter 2020:19). The investigation of problems must become dynamically constructed, reconstructed, resolved and abandoned (Roth 1995:372). Within the step, problem investigation and analysis is the first activity for the investigation step of the design process (Rennie, Treagust & Kinnear 1992:204). Problem investigation requires moving from a broad statement of need to a specific problem that students might solve (Berland, Steingut & Ko 2014:705). It is in this stage that students become more aware of real-world problems and through investigation and analysis processes, the relevance of this stage motivates them to become more engaged (Bell 2016:63). The relevance of this stage in the study is that it provides a general overview so that the e-tutor activities are in line with the expectations around this stage of the design process.

Several studies (Lindfors & Hilmola 2015; Lewis 2009; Kelly 2008; Roth 1995) were conducted on this stage of the design. A study by Kelly (2008) discovered that many problems in the investigation stage are ill defined. An earlier study by Lewis (2009) highlighted that the problems presented in the investigation stage at the different Technology Education classrooms are mostly inappropriate. The results from these studies (Lewis 2009; Kelly 2008) are an indication that teachers are challenged to provide for more authentic instructional activities for the investigation stage of the design process.

2.2.4 Design

In this design stage, generally children do not appear to have a clear idea of what the design stage looked like (Rogers 1999:7). The design step allows students to bring their ideas into the real world where they may use drawings to develop, clarify, evaluate and communicated ideas to others (Welch 1998:243). A deeper understanding of the design step is crucial for teachers if they are to provide students with skills required for the design step (Atkinson 2013:19).

The design step is the second most complicated step of the design process which involves the generation and evaluation of alternative solutions (Rennie et al 1992:204). Once multiple solutions have been identified, students must work to select one (Berland, Steingut & Ko 2014:706). Alternative and multiple solutions are depicted in the form of drawings which have become a critical medium of core necessity (Macdonald, Gustafason & Gentilini 2007: 60). Drawings for students means serving a wide range of purposes that includes visualising the whole components, improving the form of a product, identifying the properties and the working constraints of materials (Murray 1992:39).

These drawings differ in their characteristics of 2-dimensional and 3-dimensional modelling (MacDonald & Gustafson 2004:8). The design step concerns itself with only two dimensional (2-D) and three dimensional (3-D) diagrams (Barlex 1994:16; Sparkes 1993:10); Evans 1992:23; Harrison 1992:29). In the actual drawing process of the 2-D model, planning is divided into three phases which include an analysis, synthesis and assessment (Lawson 1983:84). 2-D drawings involve making representations of design ideas on paper and more with techniques of including rough sketches (Johnsey 1995:40). In contrast, the 3-D diagrams involve the use of construction techniques leading to the fabrication of a form occupying space (Harrison 1992:33).

Architect Renzo Piano declared that, ‘design step is like having a quiet sort of game and that game is played through drawing’ (Robinsons 1994, p.127).

Studies, (Fleer 2000; Rogers 1999) were conducted on the design step of the design process. Rogers (1999) study reported that generally students do not appear to have a clear idea of what the design step process looked like. Several studies were also connected to genuine design step activities (Atkinson 2012; Lawler, McTaminey, de-Brett & Lord 2012; Atkinson 2011; Atkinson 2009; Ellis, Steed, Applebee 2006). In Atkinson's (2012) study, she noted that students experienced the incorrect design step instructions which led to entrenched misconceptions about this stage from the students. In an earlier study Ellis et al. (2006) ascertained that many misconceptions dominate the university students because of the approaches to the drawings used by their e-tutors while teaching the design step.

Further studies (Druin & Fast 2002; Hutchnson 2002; France & Davies 2001; Gustafson, Rowell & Rose 2001; Hill & Anning 2001; Rogers & Wallace 2000; Welch 1999; Anning 1997) were conducted on drawing pictures for the design step for the design process. Rogers and Wallace (2000) found that students confused the differences between drawing a picture and making a design drawing.

Druin and Fast (2002) study noted that not only do teachers never knew about the different genres of 2D diagrams, but they were unable to offer guidance to children on how to use drawings. Further studies (Fleer 2000; Hope 2000; Anning 1997) reported on 2-D diagrams that teachers do not place much importance on teaching students to learn about a 2D diagram. Another study's conclusion on the design step by Fleer (2000) suggested that teachers have inadequate understanding of how to draw 3D diagrams. Hope's (2000) study cautioned that teachers seldom model different drawing methods and little specific teaching of 3-D diagrams occurring at present in many classrooms.

2.2.5 Make

Make is the third stage of the design process which involves the construction of models (Rennie et al. 1992:204). Make and modelling are fundamental aspects in the make stage (Berland et al. 2014:707). This stage focuses on students making the product (Mawson 2010:10). Making and doing is an evident part of the design process stage (Hill, 1998:210 & Mawson 2010:10). The make stage may be an age-old task of innovations and

adaptations of processes from which students develop and produce ready to use products (Lee 2011:42). Making of the project indicates that the manipulation of materials succeeded which ended with a product from a school design process (Autio, Hietanoro & Ruismaki 2011:351). This stage of the design process prepares students who will be able to recognise the relationship between technological products (Hallstrom & Gyberg 2011:9).

Some studies (Hilmola 2011 & Carr, Jones, Lee, Smith & Duncan 2010) were conducted on the make stage of the design process. Results, Hilmola's (2011) study indicated that learners in rural areas get better results in the making tasks of the process. Carr et al. (2010) indicated that the learners' experiences during making stage were influenced by the experiences which children bring from their different homes experiences which they bring during the make stage of the design process.

2.2.6 Evaluate

The evaluate age is the fourth practical skill section of evaluating artefacts which were provided during the making stage. Evaluate is the trial and modification stage of solutions for the design process (Rennie et al 1992:204). During the process, students collect data regarding the efficacy of various solutions (Crismond & Adams 2012:755). Solutions are evaluated which must be appropriate, correct, useful or valuable (Barak 2010:78). Solutions must satisfy task specification by being relevant and capable of fulfilling some practical purpose of effectiveness (Cropley & Cropley 2010:101). The success of the evaluate stage depends upon the usability and the functionality of an object. Usability is a combination of the users' needs and demands of various possibilities about solutions for products (Lindfors 2010:47). On the other hand, functionality is the relationship between the solution and the user.

Some studies (Bjorkholm 2014; Galbraith 2012; Lindfors 2010; Assink 2006 & Skogen 2006) were conducted on the evaluate stage for the design process. Bjorkholm (2014) reported that, students experienced difficulties in evaluating solutions. This was the case since students were not able to establish the appropriate purpose for the product. In addition, students were also unable to grasp the effectiveness of possible solutions so

that products can function. At the same time, Galbraith's (2012) study commented that students struggle with engaging in an evaluate based reasoning around the evaluate stage.

2.2.7 Communicate

Communicate is the final stage within the design process. In this stage, students use language to communicate about their projects. Language is a medium which is used to communicate and present the design step and explain the procedure of the production for a project (Sedio & Potgieter 2020:79). Language makes it possible for students to communicate about a product (Lebahar 2007:59). Through language, students make persuasive presentations by using language to explain charts with both 2D and 3D diagrams which were drawn to explain the design stage of the design process (Hutchinson 2002:18). Final products are communicated by students through language to convey their understanding of the procedural steps of how products were developed (Roth & Pozzer- Ardenghi 2006:788). A study on students' team use of language by Stempfle & Badke-Schaube (2002) discovered that the student team spent only 10% of their time using language to communicate and the remaining 90% investigating and planning for solutions. The study findings differ from those observed by McNeill, Gero and Warren (2007) who reported that students spent most of their time using language to communicate and plan for all the stages of the design process.

In the light of the complexities around the procedural steps of the design process, e – tutoring is imperative for Technology Education students in an ODeL context. The concept of e-tutoring is discussed next.

2.3 E-TUTORING

The concept of e-tutoring develops from the word ‘electronic tutoring’ or ‘Internet tutoring’ which refers to individualised learning support provided via the internet (Johnson & Bratt 2009:33; Carreno 2011:311). In order to drive e-tutoring, it needs the services of e-tutors. An e-tutor is someone who directly interacts with students to support their learning process when they are separated in time and place for some or all these direct interactions (Denis, Watland, Pirotte & Verday 2004:2). E-tutors are very different in terms of their roles, attributes and expertise, the ways and how they interact with students is key (White, Murphy, Shelley & Baumann 2005:83). The unique roles require a tutor who has new range of skills which cater for the dynamic online world (Cox, Clark, Heath & Plumton 2002:2). Tutoring in ODeL encompasses a broad range of teaching, coaching, mentoring and monitoring activities that guide students through their course, mediating the packaged learning materials and facilitating the learning process (UNISA 2008:16). The relevance of e-tutoring for the design process is that it is describing what is important to consider of what the students need so as to progress with the procedural steps within the process.

That said, the study engaged here seeks to explore the type of an e-tutor who engages with the design process being separated in time and place. In the light of the above, it means this e-tutor holds some expertise in order to be known as facilitator Klimova & Poulova (2011:1486); a leader (Hotte & Pierre 2002:47); e-moderator, Salmon (2000:496); facilitator, Collinson, Elbaum, Haavind and Tinker (2000:39). In becoming known to be a facilitator Klimova and Poulova (2011), an e-tutor carries an important responsibility of student support. The process of e-tutoring is viewed as a possible approach for addressing student support.

E-tutoring differs from face to face as a result in the involvement of technology, Ramorola (2018:20). Technology therefore plays a crucial part during e-tutoring activities. Gerrard (2002 :) noted the dissimilarities and identified several ways in which e-tutoring is characterised, it:

- Places a greater emphasis on written skills.
- Produces a more formal tone.
- Does not follow a linear conversation but instead promotes multiple conversations.
- Does not confine teaching to specific times.
- Places greater emphasis on student-student learning.
- Requires teachers to develop new ways of encouraging participation.
- Requires teachers to assess worth of online contributions.

Having said that e-tutors place greater emphasis on student-student learning, e-tutoring reflect instructional practices that range from highly structured individualised support to occasional response of specific homework questions Denard (2003:13). In support, Asterhan (2011:450) mentioned that e-tutors provide pedagogical support managerial support and lastly the technical support which focusses on detecting operational and technical difficulties. Additionally, Chatta (2006:38) echoed that the e-tutoring services often reflect a remedial paradigm that includes: (1) initial assessment to determine specific academic deficiencies; (2) tutoring sessions that target those deficiencies; (3) on-going assessment following tutoring sessions; and (4) frequent reporting of tutee progress. In the context of this study, it is against this background, Chatta (2006) that the assessment process is of high priority so that students who engage with the design process assessment achieve the intended outcomes.

For these reasons, eLearning will only succeed with a tutoring team that has appropriate online tutoring skills necessary to explore and maximise the designed environments (McPherson & Nunes 2004:347). To meet these requirements, the tutoring team requires a careful selection process. This does not simply mean selecting a tutoring team with subject matter expertise and or technical skills, but ‘choosing educationalists with pedagogical, information and communication literacy skills that required to manage and facilitate online learning’ (McPherson and Nunes 2004, p.347). To Duke (2002:61) this approach calls for more in terms of pedagogy than simply putting lecturers and tutors onto the web. Thus, the academic roles must change focus since face-to-face teaching

solutions may not work in an online learning environment. Given the scale of task facing e-tutoring, the next section discusses the roles and competencies of the e-tutors.

2.3.1 The roles and competencies of the e-tutor

E-tutors are very different in terms of their roles, attributes and how they interact with students is also key (White, Murphy, Shelley & Baumann 2005:83). The unique roles require a tutor who has new range of skills which cater for the dynamic online world (Cox, Clark, Heath & Plumton 2002:2). Tutoring in ODeL encompasses a broad range of teaching, coaching, mentoring and monitoring activities that guide students through their course, mediating the packaged learning materials and facilitating the learning process (UNISA 2008:16). In order to be considered as an e-tutor who is a subject expert, it depends on the carried-out functions and the competencies (Bianchino, Marinensi, Medaglia & Rouzzi 2012:25). Denis, Watland, Pirrote and Verday (2004:78) highlighted on roles or functions (Llorente 2017:197) and competencies of the e-tutors. The authors explain the reasons for the importance of tutor support in a technology-mediated learning environment. These reasons range from practical reasons such as reduction of dropout rates, theoretical reasons such as mitigating student isolation, and moral reasons such as the obligation to help students succeed (Ibid). In reviewing literature on the roles and competencies of the e-tutor, the same terms as described in section 2.3 above, are interchangeably used to illustrate the same or similar roles. Barker (2002:7) and Ryan Scott, Freeman and Patel (2007:7) see e-tutors as serving the roles of 'pastoral care of students in terms of advising them about careers and course choices, marking student's assignments and coursework and providing feedback on submitted material'. Ryan, Scott, Freeman and Patel (2000:110) also advocate

> 'the main role of the online tutor is that of educational facilitator who,

contributes specialist knowledge and insight, focus the discussion on the critical points, to ask questions and respond to student's contributions, weave together disparate comments and synthesise the points made to foster emerging themes. Tutors also need skills for nurturing online collaboration, creating an atmosphere of openness, assuring all participants their contributions are valued and welcome, building rapport within the group

to help members to explore ideas, different perspectives and to take ownership of their learning'. These ideas Ryan Scott, Freeman and Patel (2007); Barker (2002) & Ryan, Scott, Freeman and Patel (2000) would suggest that there is need for the e-tutors to make adjustments for these roles which will gradually lead to a broader understanding of the design process good practice.

Another study (Bianchino et al. (2012:25) on e-tutor roles established e-tutor roles such as:

- Moderator and promoter of discussions between users in the forum.
- Facilitator of the formative path, especially from the point of view of time management and support of learners' motivation.
- Technical helpdesk, which enables users to exploit the instruments at their disposal.
- Middleman between lecturers and students.

Similar study (Lentell 2003:67) perceived tutors as facilitators who guide the students' learning in a way such that students gain knowledge and understanding. For the purpose of this study, these roles would suggest that a design process distance education e-tutor should ensure that students have grounding in the subject and provide students with academic support in the subject matter. Furthermore, e-tutors' roles in this regard include assisting students in exploring the links between different course modules and integrating work experience with academic knowledge. To achieve these, tutors develop and practice a 'multitude of skills and strategies' (Lentell 2003, p.67).

In support to Lentell's (2003) views, is Simpson (2002: 7) who described two broad areas of tutor support: academic and non-academic. Academic (or tutorial) support deals with supporting students with the cognitive, intellectual and knowledge issues of specific courses or sets of courses that include, developing general learning skills, numeracy and literacy. Non-academic or counselling support involves the support of students in the affective and organisational aspects of their studies. Reports, Lentell (2003) & Simpson (2002) have stressed in common that academic support for knowledge and non-academic support remain key factors in the progress made by students in relation to their

understanding of the subject matter. Such reports in this study, describes how the delivery of the design process can be helped with both academic and non-academic support from the e-tutors.

From the given list of e-tutors' roles, one discovers a vast range of duplication. To condense these flaws, researchers (Denis et al 2004:46; Jimenez, Rodriquez & Vidal 2017:197) made a distinction between central and peripheral roles and linked them between the e-tutor and learner interaction. The central roles as linked to tutor-learner interaction highlight six classifications that identify the e-tutor. These classifications are discussed in the next section.

Firstly, the e-tutor serves as a content facilitator (academic function) who intervenes as subject expert, sometimes as interpreter, and guide through the study concepts.

Secondly and thirdly, the e-tutor plays a role of a facilitator. These take a form of metacognition facilitator where the tutor supports reflection on learning activities and outcomes as well as study skills development. The e-tutor also becomes a process facilitator who supports learners' learning strategies, and their time management.

Fourthly, the e-tutor serves as an advisor or counsellor (social function) who provides pastoral support doorway to institutional and or local support systems.

Fifthly, the e-tutor serves as an assessor (formative and summative) who gives feedback on task achievement and performance, assignment development, and sometimes he or she is also an examiner. The e-tutor is also a technologist who guides first-post support with technologies and tools for learning.

Lastly, the e-tutor is a resource provider who identifies and locates, develops and produces resources to provide 'just in case' or 'just in time' learning support.

Considering the above, tutor support is considered critical to the educational process and the students learning experience Denis et al. (2004). To provide adequate support, e-tutors need to adopt several unique roles depending on the epistemological framework and the tasks the learners must manage (ibid). The authors further established that the tutors' roles have transformed from a mere transmitter of knowledge to a facilitator of

learning. A lesson from Denis et al. (2004) in relation to this study is that there is a creation of awareness which connects these roles to help e-tutors so that they can offer useful support when guiding students through the design process.

In support, Berge (1995:15) further identified four main e-tutor roles namely, pedagogical or intellectual roles, social roles, managerial or organisational roles, and technological roles. For the purpose of this study, these roles are further discussed in the next section.

Pedagogical or intellectual roles

These roles include several tasks such as opening the discussions, focusing on relevant content and issues, intervening in order to promote interest and productive conversation, guiding and maintaining students' involvement in discussions, and summarising debates (Berge 1995:25). Pedagogical roles may also encompass directing and focusing discussions on vital points, synthesising points made by the participants and providing summaries and interpreting on-line discussions. According to Zafeiriou (2000:67), the e-tutor uses questions and probes for students' responses that focus discussions on critical concepts, principles and skills. Perraton (2005:89) further elaborates on pedagogical roles and contends that,

> The pedagogical and the logistical elements of instruction include motivating students, promoting relevant learning and facilitating access to course content, engaging the learner in activities and discussions through communication, monitoring learners' progress and adjusting learning opportunities to support learners in areas of difficulty.

In line with Berge (1995), it would suggest that there should be a priority focus which ensures that e-tutors implement and put in best practice of their pedagogical roles. In return, these pedagogical roles will direct how the design process is approached for supporting students who are at a distance.

Social roles

Social roles involve the creation of friendly and comfortable social environments in which students feel that learning is possible (McPherson & Nunes 2004:348). In this context, e-tutors McPherson & Nunes (2004:350) are responsible for guaranteeing opportunities for participants to:

- introduce themselves,
- identify and deal with lurkers who are reticent and sometimes reluctant to participate,
- ensure that appropriate communications take place,
- take into consideration cultural and ethnic backgrounds by minimising humoristic, offensive and disruptive behaviour, promoting interactivity between students, and finally
- deal with flaming, should this occur, by reminding participants of the appropriate netiquette.

In the light of the emphasis placed on the social roles, it reflects on the experience of the e-tutors who are able identify multiple ways to address social problems. These social problems might not be in the list of concerns but rather they have become those that might delay the actual support given for implementation of the design process.

Managerial or organisational roles

According to Berge (1995:56) these roles involve setting learning objectives; establishing agendas for the learning activities; timetabling learning activities and tasks; clarifying procedural rules and decision-making norms. Additionally, the roles also include ‘encouraging participants to be clear, responding to the participants’ contributions, being patient, following the flow of the conversation and encouraging comments, synchronising, handling overload of information, encouraging participants, and ending the sessions’ (Zafeiriou 2000, p.67). In not so many words, Berge (1995) might suggest that e-tutors should perceive their managerial roles to be compatible with the teaching schedule of the

design process. This understanding might probably be sufficient to perform managerial roles with some easiness and for the total required support of students at a distance.

Technical roles

These involve becoming familiar, comfortable and competent with the information and communication systems and software that compose the eLearning environment (McPherson & Nunes 2004:349). These roles include supporting the students in becoming competent and comfortable themselves (McCreary 1990:16) by providing technical guidance such as offering study guides, directions and feedback on technical problems, ensuring that time to harness the ICT systems is made available and encouraging peer learning. To address this role, the e-tutor would be competent in both the pedagogy and (communication) technology, which are very important in learner support.

The technological competencies can be related to the use of ICT tools, the resources production, and the platform management. For e-tutors to interact at a distance learning environment requires one to use correctly the tools available in the eLearning campus, as well as to advise students to use the didactical resources, chats and forums. Further than that, the e-tutor should be able to understand the proposed contents as well as to provide relevant resources to the learners (Lentell 2003:34). Rogers (1951:11) confirms this idea and states that the teacher will make learning resources available, relying on continuing experience and recognises that any course is a beginning and not the end of learning (p.427). (Lentell 2003 & McCreary 1990) advocate for an interdisciplinary approach of pedagogy and communication technology for e-tutor technical roles. The relevance of the two is a possible gain for e-tutors who become more aware of real-world technologies. Through this relevance, the e-tutors become further motivated to engage students with technological competencies during the delivery of the design process.

This section on e-tutoring pointed to the roles and competencies of e-tutors as, pedagogical or intellectual, technical, managerial or organisational and social roles. It is assumed that the practical application of these roles created a purposeful learning distance environment. The distance context enabled students to engage with the design

process. When delivered effectively, e-learning is an option for the design process curriculum. The process of e-learning in an ODeL context is next for discussion.

2.3.2 e-Learning in Distance Education

The successful implementation of e-tutor roles and competencies are dependent on e-Learning since they both rely on technology. Technology allows students even though they may be geographically separated, to interact and engage in a meaningful real time learning (Arah 2012:841). During the process of e-tutoring, e-learning activities benefit from the many rapid developments taking place from the use of such technologies Barker (2002:3). In the last decade, it has been noticed that the face of distance education has changed drastically (Simonson, Smaldono, Albright & Zvacek 2000:46). These changes arise from the integration of technologies that have allowed institutions to implement course programmes for students. Students in this study benefited from such a course programme known as Technology Education. In the light of this, technology has played a key role in changing the dynamics of course delivery as well as pedagogy behind e-Learning Beldarrain (2006:139). It is from this technology that it has become a fundamental and an essential tool for driving the pedagogy. This is the case since without such technology, the teaching and learning processes cannot be enhanced (Merisotis & Phipps (1999:17). The teaching and learning processes have known to become e-Learning. E-Learning is known as a mode of learning in which the educational process is supported by information and communication technology Sulčič & Sulčič (2007:36). This type of learning encompasses supported learning; blended learning and learning that is delivered entirely online (Kabanda 2014:74).

E-Learning is gaining ground in different forms of teaching as a result of the emphasis placed on improving teaching and learning process (Llorente 2006:64). The accorded status makes e-Learning to be known differently by various names such as ‘technology mediated interactive learning’ (Dede 1990:254). The technology mediated active learning separates the teacher in time and place from the student, but the educational outcomes can be achieved, Keegan (2003:34). From the realities of improving teaching and learning, e-Learning policies at various institutions went through an evolutionary process

with a desire to achieve the educational outcomes, Kabanda (2014:39). The response of some tertiary institutions was to adopt multimedia policies for technologies in order to deliver tuition since technology has become an indispensable part of acquiring educational outcomes, Klimova and Poulova (2010:1485). In view of this development by tertiary institutions, some faculty staff started to perceive e-Learning differently. Some viewed the e-Learning environment as a useful platform for engaging with different levels of individual student's learning progress, Chen, Huang, Shih and Chang (2013:67). Given these descriptions, e-Learning became an important pillar in ODeL, Ainsworth, Bibby and Wood (2002:90) since students take positions of becoming active participants. Within this pedagogical model, the students acquire special importance towards the use of information and communication technologies, Jimenez, Rodriquez and Vidal (2016:197). This notion is supported in a study, Gavanaugh, Gillian et al. (2004) that students who received online instruction performed well or better than students in regular schools.

Literature (Valle & Duffy 2009; Lim, Kim, Chen & Ryder 2008; Robinson & Hullinger 2008; Connolly, MacArthur, Stansfield & McLellan 2007; Maki & Maki 2007; Robertson, Grant & Jackson 2005) have highlighted the benefits of e-Learning. Many students are attracted to online learning because of the freedom and flexibility in organising their learning activities and the opportunity to work from any place (Valle & Duffy 2009:130). Online students outperform their counter students in a traditional classroom (Maki & Maki 2007:67). Online students learn more and spend more time on task and are more engaged than traditional students (Robertson et al. 2005) perform on average (Robinson & Hullinger 2008); have higher achievement and perform better (Connolly et al. 2007; Lin, et al. 2008).

In this section of the study, the design process was an important aspect for discussion. The application of the design process takes place in the form of e-tutoring whose potential is seen in e-tutor roles and competencies. From a teaching point of view, the emphasis should be on student support which is to become a cornerstone for the benefit of students

in an ODeL space. In the light of the descriptions, student support in ODeL space is next for discussion.

2.4 Student support in Open and Distance eLearning (ODeL)

Student support is a critical component for students in ODeL spaces. For the purpose of this study, student support would mean, providing students with a sense of self-esteem which allows them to avoid feelings of isolation but feelings of self-direction and management Paniagua and Simpson (2018:1). However, the management of self-esteem is never simple and never settled; its state is affected powerfully by the availability of support provided from the outside Jerome and Bruner (1996:37). As a result, student support is recognized and supported in ODeL institutions of higher learning Ghosh, Nath and Agarwal (2012:53). In the words of Mitra (2009:257), “Lack of student support can lead to lack of motivation, feelings of isolation and high levels of anxieties in students, all compounding to dissatisfaction and attrition”. In the light of student support as a key component in ODeL structures, its effectiveness during learning has resulted in demand for e-tutors who will support the students online Denard (2003:97).

Given the importance of e-tutors who serve as key components towards student support, central support roles are needed from the e-tutors. In this regard, student support services of a didactic, administrative and technical kind are needed with varying degrees of attention for the students Palmerio (2003:109). E-tutors also monitor, sustain and track fruition of the learners Bianchino et.al (2012:25). Paechter and Maier (2010:54) also established that e-tutors provide structure for the content, stimulate students’ motivation to process and reflect on content. E-tutors provide academic support benefits (Johnson 2011:74; Johnson & Johnson 2006:89). Such academic support benefits, Johnson and Bratt (2009:32) are assumed to arise from a knowledgeable and skilled individual whose responsibility is to provide support.

Since student support in this study occurs online, there is a need for instructor presence. Literature (Aragon 2003; Rouke, Anderson, Garrison & Archer 2001; McCroskey, Sallinen, Fayer, Richmond & Brrclough 1996 & Gorham & Zakahi 1990) highlighted that

high instructor presence produces greater affective and cognitive learning skills. The notion from literature above is critical in that instructor presence is a basic human need where students are not only looking for information but are also looking for support and affirmation (Sproul & Faraj 1997:38). Instructor presence needs intimacy, immediacy and interactivity which have shown to have a mutual relationship with social presence. (Collins, Murphy 1997:126; Gunawardena & Zittle 1997:34). Social presence is a phenomenon that helps translate virtual activities into impressions of real people (Dixson 2010:48). Also, social presence is a necessary component to effective online instruction (Hughes 2008; Kehrwald 2008; Dennen, Darabi & Smith 2007; Goertzen & Kristjansson 2007; Shea, Li, & Pickett 2006). A key opportunity to model instructor presence is when students feel connected to the instructor and in the content being studied (Lewis & Abdul-Hamid 2006:79). A suggestion may be that an outcome from such support might lessen the risk of students feeling isolated.

In order to lessen the risk of students feeling isolated, the instructor needs to be actively involved in the learning of their students Gayton & McEwen (2007:45). Active means, 'performative' which is demonstrated by activities, posting of messages and responding to other messages Kehrwald (2008:45). Some instructors respond to being performative by being minimally active in discussions. Therefore, it means that effective online instruction requires strong methodology and opportunities for students to interact with each other and the instructor Maki & Maki (2007:68). This would suggest that the instructor and the students should be socially present and engaged in the teaching and learning activities (Levy 2008; Dennen et al; 2007; Shea et al, 2006; Young 2006). This notion is expressed differently by Akcaoglu and Lee (2016:2) that students in online settings also need social connections. Too much instructor participation in discussion can decrease student social connections (Dennen et al. 2007:98). In brief, instructors should not dominate the social discussions in fact they should open the discussions and guide the students where necessary.

2.5 THEORETICAL AND CONCEPTUAL FRAMEWORKS OF THE STUDY

This section presents the theoretical and conceptual framework employed for the study. The transactional distance theory is the first for discussion followed by the conceptual frameworks for the study.

2.5.1 THEORETICAL FRAMEWORK FOR THIS STUDY

Theories and models to support the integration of technology in teaching and learning and those to support the connecting of people physically separated in geographic location are considered in this study.

This study seeks to determine the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process within Technology Education specialisation. Taking this aim into consideration, the theories of connectivism and transactional distance were found vital to the study. The two theories are described in the following sections.

2.5.1.1 Transactional distance theory

Given that the study context is Open Distance Learning, and that distance is a matter of psychology, which can be manipulated by instructional design (Moore 1991:13; 1973:19), championed the transactional distance theory. The theory purported that, separation between the teacher and students can lead to communication gaps, a psychological space of potential misunderstandings between the behaviours of instructors and those of the learners' (Moore & Kersley1996:200). Distance in this regard is not determined by geography but by the way and to what extend instructors, learners and the learning environment interact with one another (Chen 2001:460). The relevance of transactional distance theory in this study is that an important goal set for the design process is to be realized in a distance learning space. The instructional design (Moore 1991:13; 1973:19)

suggests that the design process stands to benefit students who rely on their technical abilities in order to close the communication gaps.

To address the learning gap, Moore (1989:28) proposed three types of essential interactions in distance education.

In order to achieve what the theory was intended for, these include learner-instructor, learner-content interaction and learner-learner interaction. The three essential interaction types in distance education are further discussed in the next section.

Dialogue

Dialogue is a communication medium that determines whether the medium can be manipulated to increase dialogue (Stein, Wanstreet, Calvin, Overtoom & Wheaton 2005:107). In teaching and learning context, dialogue describes the exchange of words, actions and ideas between the teacher and learner (Kang & Gyorke 2008:204).

Since the focus of this study is open distance learning, the quality and effectiveness of dialogue are important in the resolution of problems the distance learner may be experiencing (Fallon 2011:189). It has been explained in the previous sections that distance learning succeeds through the integration of technology, in this milieu, synchronous systems would improve learners' attitudes, performance in tests, encourage earlier completion of coursework, and builds learning communities (Schullo, Hilbelink, Venable and Barron (2007:2). Furthermore, instructors could strive to optimise interaction between learner-instructor, learner-learner, and learner-content through effective modes of communication (Cheng & Willits 1999:12; Jung 2001:18, Moore 1993:34). This suggests that a two-way communication has power to increase more dialogue than in a one-way communication (McBrien, Jones & Cheng 2009:4). It seems dialogue which is about the exchange of words Kang and Gyorke (2008) is based on views that will guide and lead students to discussions that would reflect how they express their thinking about the design process. Often, such thinking process requires structure which follows in the next discussion.

Structure

Structure is a measure of the extent to which a course' elements change to meet the specific needs of individual learners (Kang & Gyorke 2008:204). It is concerned with the elements of the course design in the form of learning objectives, activities, assignments, planned interaction and evaluation (Kanuka, Collett & Caswell 2002:153; Stein, Wanstreet, Overtoom & Wheaton 2005:106). Additionally, structure expresses the rigidity or flexibility of the program's educational objectives, teaching strategies and evaluation methods (Moore1991:4). Structure and dialogue do not function in isolation; they balance one another especially in the dialogue between the instructor and learners (Cifuentes 2001:298). It has been noted that high structure and high dialogue could reduce the transactional distance and allow greater adaptability of content (Wikeley & Muschamp 2004:125). The role of the e-tutors in this study is to guide students in a systematic manner in order to achieve objectives (Kanuka, Collett & Caswell 2002; Stein, Wanstreet, Overtoom & Wheaton 2005) of the design process. The objectives are reflected in the activities which are generated to prepare students for the demands of the design process. By so doing, students become more prepared to engage and grow to make their own design process decisions. Such growth from the students is a sign of high dialogue and high structure which lessens the transactional distance which might be experienced by the students. What is illustrated above reflects some learner autonomy which is discussed in the next section.

Learner autonomy

Learner autonomy relates to the learner's control over learning activities and processes (Kang & Gyorke 2008:204). Learner autonomy is intimately tied with the learner's sense of self-direction and the extent to which the learner exerts control over learning procedures (Fullan 2011:190). Learner autonomy is noticed in students who temporarily surrenders autonomy and only turn to a teacher temporarily when in need of help from the teacher (Moore 2013:81). The autonomy of students is important as it relates to their ability to work within virtual environments (Benson & Barak 2009:74). The orientation towards being autonomous dictates for learners to cope under conditions of distance

during teaching and learning (Moore 2013:84). Learner autonomy is a crucial characteristic of student engagement for their learning process since it naturally reduces their experiences of distance (Moore 1993:43). It might be seen (that the idea behind learner autonomy is to develop and increase students' independence (Moore 2013). From this point of view, students will realise the significance of autonomy since it will help them to realise the significance of individual and collective responsibility when dealing with the design process.

2.5.1.2 Connectivism

Goerge Siemens and Stephen Downes coined Connectivism to be a learning theory for digital age (Duke, Harper & Johnston 2013:4; Tschofen & Macknes 2012:124). In the authors' views, the theory makes great demands on those trying to seize opportunities presented by emerging technologies in contexts for learning and education Bell (2011:1). In this environment, the use of technology becomes a central point for an on-going learning process in which the student seeks new developments and connections (Jarche, cited in Stranack 2012). Not with-standing the situation mentioned, the level of teacher presence and student presence cannot be disregarded (Siemens 2012:27). Teacher presence includes three pedagogies: the connective presence in connectivist pedagogy; social presence in connectivist pedagogy; and teaching presence in connectivist pedagogy. These pedagogies are discussed in the next section.

Cognitive Presence in Connectivist Pedagogy

Cognitive presence is the 'extend to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication (Garrison, Anderson & Archer 2001:11). It also ensures that a particular level of depth in the educational interaction is realised (Kop 2011:22). Interactions on networks enrich the connective cognitive presence and the perceptual interactions to some devices embedded in social communication media (Lombard & Ditton 1997:9). It is in this context that learners develop networks of their own and increase their cognitive presence during learning (Davies 2003; Phillips 2002). Cognitive presence is relevant to this study because for the students to engage with the design process, it needs the students to use

their communication and cognitive abilities that will help them to think. In so doing, these students express autonomy in networks and turn to a teacher temporarily for advice to filter the connective networks for knowledge of the design process to develop.

Social Presence in Connectivist Pedagogy

Social presence was originally developed in order to differentiate communications media according to their capabilities for conveying media users' sense of engagement with other users in a different time and space (Short, Williams & Christie 1976:167). The capabilities of the media users have a direct impact on the learning goals of the users whereby activities and choices left by previous users are mined through network analytics which later serve as guideposts to knowledge that new users can follow (Dron 2006:17). There is a connection between the cognitive presence and the social presence. In the study's context, the cognitive presence employs the social presence networks to sustain networks communication which engage the cognitive aspect of the design process. This happens because students in these spaces exercise independence as to how to share knowledge since the extent of such independence is autonomous. In becoming autonomous, the sequencing of the students' activities for the design process depends on the teaching methods organised by the e-tutors.

Teacher Presence in Connectivist Pedagogy

Teacher presence are the methods that instructors use to create quality online instructional experiences that support and sustain productive communities of inquiry (Lombard & Ditton 1997:9). A teacher would not necessarily be present but is present by the connectivist presence from which knowledgeable others on the Web communicate and collaborate with feedback from others (Kop 2011:22). An advantage from the high level of presence is that it enhances the depth of learning and subsequently the learning experience of the students online (Reeve 2015:7). Given this idea (Kop 2011) it can be established that the personal knowledge and the understanding of that knowledge links e-tutors to other network users who are supported to explore ways in which to independently explore ways of becoming independent users. A mutual reciprocal

arrangement between cognitive presence, *social presence and teacher presence combine to show that the design process delivery benefits from such an arrangement.*

Earlier, it was indicated in figure 1.1 about the research theories matrix of the study. This section highlighted how the theories will be combined in order to achieve the objectives of the study. This understanding become applicable in how the data was presented and analysed for the study.

2.5.2 Technological Pedagogical and Content Knowledge (TPACK) framework

Given the importance of the theories of online learning at an open distance context, I deduce that the two theories still fall short of articulating the broader spectrum of possible knowledge that is required for teaching online. I therefore blended Mooore and Siemens theories with the 'knowledge for teaching' framework of Mishra and Koehler (2006) which among other things identifies TPACK as a critical component of the teachers' knowledge for the design process. Linking the two with a conceptual framework concerning e-tutors' knowledge made sense especially for examining the relationship between the e-tutors' TK, PK and CK and the resulting changes in teaching practice.

2.5.2.1 Technological pedagogical and Content Knowledge (TPACK)

TPACK is an increasingly utilised framework which has allowed researches to reshape contemporary understandings of knowledge forms required by expert teachers (Phillips, Koehler & Rosenberg 2016:154). The framework defines the competencies and skills needed by teachers to integrate ICTs and how they teach content using technology (Shulman 1987:12; 1986:8). Shulman (1986) first introduced the concept of Pedagogical Content Knowledge (PCK) which was extended by other authors (Koehler & Mishra 2008:10; Mishra & Koehler 2006:16) to include technology. Given this, the framework is known as TPACK (Benson & Ward 2013:154; Schmidt, Baran, Thompson, Mishra, Koehler & Shin 2009:123).

Literature, Benson and Ward (2013: 156) highlighted the importance of TPACK that it is a lens through which to conceptualise excellence during teaching and

learning with technology in HE institutions of learning. Furthermore, Can, Erokten and Bahtiyar (2017:52) attest that to the successful HE institutions are those that use and improve technology to train individuals who can survive, decide alone and solve problems. In this light, TPACK framework functions as a conceptual lens which views educational technology by drawing attention to specific aspects of the teaching and learning process Koehler, Shin and Mishra (2012:17).

Having given the importance of TPACK in HE institutions, it is worth employing the framework in this study, because e-tutoring cannot progress effectively without the integration of technology Ramorola (2018:340). For this reason, e-tutors must become significant experts who integrate technology effectively in supporting the ODeL students. In the same tone, e-tutors as experts need to acquire relevant knowledge that will enhance them so as to use technologies into their teaching in ways that connect to deep subject matter learning Kereluik, Mishra and Koehler (2010: 3892).

In conceptualising TPACK, Mishra and Koehler (2009; 2006) pioneered three knowledge domains to describe the nature of knowledge needed by teachers to effectively use ICT in pedagogy. These domains include Pedagogical Knowledge (PK), Technological Knowledge (TK) and Content Knowledge (CK) as illustrated in figure 2.1. The interactions of the three core knowledge domains interact to formulate secondary knowledge domains of Pedagogical Content Knowledge (PCK), the Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK) (Drummond & Sweeney 2017:969). When the three secondary domains interact, they convoluted a triad of what was mentioned earlier to be a TPACK framework. The following diagram 2.1 encapsulates the different forms of knowledge domains within TPACK framework.

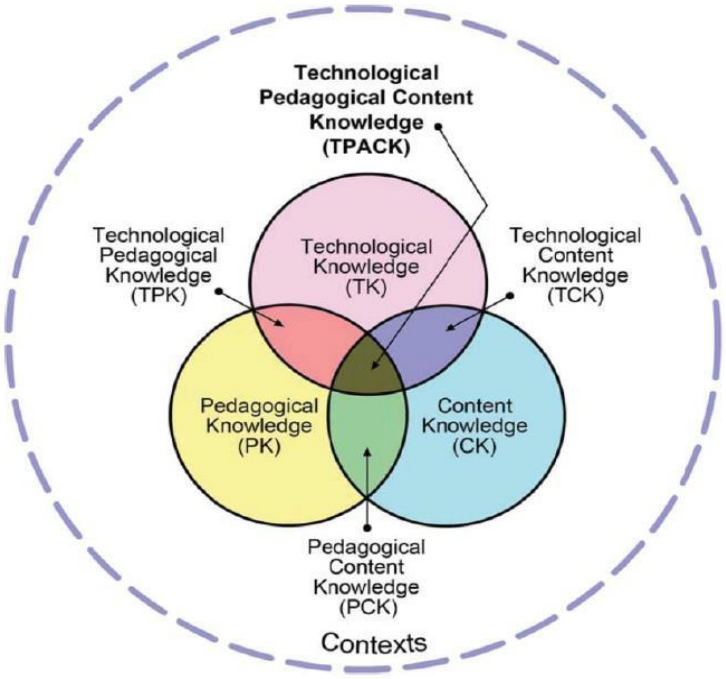

Figure 2.2: TPACK Framework and its knowledge domains (Adapted from Mishra and Koehler 2006:1023)

- **Technological Knowledge**

As stated earlier, the purpose of this study is to establish whether e-tutors have acquired technological knowledge to support students. In line with this purpose, certain demands are expected from e-tutors who must teach this construct to the students. Literature, Altun and Akyildiz (2017:468) warned that teaching technological knowledge has become a more complex area as students of current generation are exposed to digital technologies and are highly competent users of technologies. The importance that is accorded to the technological knowledge as understood from the purpose of this study has the potential to change the nature of classrooms Mishra and Koehler (2006:1023). The reason for this may be that technological knowledge engages students in real world problem solving through effective exploitation of ICT's Koh, Chai and Lim (2017:172).

As a result, those who teach technological knowledge will have to do more than simply learn how to use currently available tools but must also learn new techniques and skills as current technologies become obsolete Goold et al (2010:59). That is the reason why technological knowledge is considered developmental, a type of knowledge that is generated and adapted over time through new and varying interactions and experiences (Harris, Mishra & Koehler 2009:98; Koehler & Mishra 2008:74; Harris 2008:16). The concept, technological knowledge is represented as the first circle at the top in figure 2.1 with content knowledge and pedagogical knowledge at the bottom and their combination forming a triad. Technological knowledge encompasses the knowledge and skills required to effectively learn, master and utilise various technologies for information processing, communication and problem solving (Harris, Mishra & Koehler 2007:218). According to Schmidt et al (2009:131) technological knowledge refers to an understanding of how to use various technologies while Lumat (2015:14) advised that technological knowledge is knowledge about technologies.

Following the explanations given to the concept of technological knowledge (Lumat (2015); Schmidt et al (2009) & Harris, Mishra & Koehler 2007) it is noted that there is no single common definition to the concept from the authors. However, it suffices to say that those who know about the concept have become another category of people who are concerned with applications of technical problems in practice Rapohl (1997:65). In the light of the above, this section stands to benefit the design process delivery. It will focus on learning to do something with technologies and the knowledge for the different technologies which have become important commodities in ODeL spaces. A second domain deemed central in further developing the TPACK framework is the pedagogical knowledge construct. The domain is next in line for discussion.

- **Pedagogical Knowledge**

Pedagogical knowledge is represented as one of the two circles situated on the left of CK and the two are situated at the bottom of the triad in figure 2.1 above. As a recap, an objective which was mentioned earlier for this section of the study was to determine the influence of the e-tutors' pedagogical knowledge on students' learning of design process.

One way to meet this objective was to formulate an understanding of how the concept is conceptualized in literature. Pedagogical knowledge refers to processes, practices or methods of teaching and learning with an intention to help the teachers to use technology in their subject teaching (Lumat 2015:14). Also, pedagogical knowledge involves strategies and methods of classroom management (Harris et al 2009). The concept of pedagogical knowledge includes knowledge of knowing what teaching approaches or methods of teaching fit the content (Mishra & Koehler 2006:1027). On the other hand, Schmidt et.al (2009:132) advocacy for pedagogical knowledge is that it encompasses methods and processes of teaching fundamental knowledge in areas such as classroom management and student learning. A central point made here (Lumat 2015) is that pedagogical knowledge requires even e-tutors in the case of this study to become experts in the teaching approaches or strategies which they employ. These sophisticated skills in the form of teaching strategies or approaches bring the idea of teaching the design process in fruition.

Pedagogical knowledge has real and strong influence by technologies. This is the case since these methods of teaching or even teaching approaches prefer technology (Lumat 2015:215; Mishra & Koehler 2006:36; Schmidt. et.al 2009:17) in areas of classroom management. This is especially true if pedagogical approaches from the e-tutors are to become effectively deployed for the efficient transfer of skills for their student clientele (Barker 2002:2). The deployment of pedagogical approaches by the e-tutors does not restrict the type of technologies to use during teaching but those preferred technologies to teach a topic in the design process. This echoes well with the e-tutors who meet with students at micro level of teaching the design process. It is for this reason that the pedagogical strategies which they have employed to implement the design process reflect their teaching strategies that made them become professional Heitink, Voogt, Fisser and van Braak (2017:7). In addition, it may be that the pedagogical approaches are in action so much that e-tutors present a broad sphere of power in pedagogical strategies that they employ Talanquer, Novodvorsky and Tomanek (2010:1391). It may seem that the pedagogical knowledge guides the behavior of e-tutors in the classroom (broad sphere of power in pedagogical strategies Talanquer, Novodvorsky and Tomanek (2010).

Insights into the pedagogical knowledge of the e-tutors could be useful for the teaching of the design process. The design process is the subject matter content knowledge which is another important component in the TPCK framework. The content knowledge domain is discussed next.

- **Content Knowledge**

The concept of CK refers to the amount actual knowledge, organization of knowledge in the mind of the teacher and how the nature of that knowledge is different for various content areas (Chang, Hsu and Ciou 2016:137; Lumat 2015:14; Mishra and Koehler 2006:1026; Schmidt et.al 2009:132; Shulman 1986:9). The content knowledge is presented at the bottom of the circle with the pedagogical knowledge and the technological knowledge at the top of figure 2.1 above. This domain represents teachers' knowledge and understanding of the subject matter or course being taught to students (Mishra & Koehler 2006:1026). In this study, the subject matter which is studied is within the design process. The success of content knowledge together with the pedagogical knowledge is an entry into an important foundation for e-tutors to develop since they relate to how teaching and learning into specific fields progresses Koehler & Mishra 2008:98). In the light of the above (Koehler & Mishra 2008) it may be taken that it would be useful to investigate linking the learning of content knowledge to the pedagogical approaches. This might be happening in trying to resolve design process specific issues of content knowledge which are important foundation for e-tutors to develop.

Teachers have special responsibilities in relation to content knowledge as they serve as the primary source of student understanding of the subject matter (Shulman 1986:9). Content knowledge is not in isolation with other knowledge domains. There is a relationship between the content knowledge and the technological knowledge. Content knowledge is important to understand especially when one manages technologies in the continuously changing technologies (Chang, Hsu & Ciou 2016:139). Lessons were based on modern technologies that combined application of craft technologies (Autio 2016:78).

The area of content knowledge is expected to have concepts and field-specific practices which develop the content knowledge of the Shulman (1986:10). In this study, the content domain tent knowledge discusses the design process which is taught in an ODeL environment. As a result, it is important that e-tutors must know and understand the subject that they teach including the knowledge of central facts, concepts and procedures within their given field Archambault and Crippen (2009:72). From this point of view (Archambault & Crippen 2009) may help to realize the significance of individual e-tutors' responsibility for procedural knowledge of the design process. Furthermore, it is a considerable idea to consider the pedagogical content knowledge since it formulates an understanding of topics taught in courses. The pedagogical content knowledge is next for discussion.

- **Pedagogical Content Knowledge**

The concept of pedagogical content knowledge became a brainchild of Shulman (1986) who conceptualized a theoretical framework which speaks to what teachers should be able to know and be able to do (Archambault & Crippen 2009:72). Pedagogical content knowledge appears at the intersection of pedagogical knowledge and content knowledge of figure 2.1. The pedagogical content knowledge domain exists at the intersection of content and pedagogy which were in isolation from one another (Mishra & Koehler 2006:1021). A rationale for teaching the pedagogical content knowledge is that it constructs the pedagogical skills and content that should be learned and in what order and why it should be learned (Grossman 1999:10). The relevance of PCK in relation to teaching and learning is that it represents the most regularly taught topic or topics in one's subject area (Mishra & Koehler 2006:1021). In this study, the most regular taught topic is of the design process where the e-tutors were provided opportunities to deliver the design process procedural steps. Along with the responsibility of delivering the most regular topics for the design process, a pertinent question from the teachers who teach the content emerge. 'But how are the content knowledge and general pedagogical knowledge supposed to be taught?' (Shulman 1986:9). It appears based on the question the teachers were pondering upon this type of a question is looking for an answer which may formalise the teaching of the design process especially in ODeL spaces which this study pursued.

As a result of the pertinent question asked, the pedagogical content knowledge goes beyond content or subject matter knowledge to include knowledge about how to teach content Shulman (1986:9). Pedagogical content knowledge is about an understanding of what makes the learning of specific topics easy or difficult which mostly become conceptions and misconceptions that students bring in their different ages and backgrounds (Shulman 1996:9). The domain of pedagogical content knowledge elucidates on how particular topics, problems or issues are organized, presented and adapted to the diverse interests and abilities of the learners. De Miranda (2008:18). A lesson De Miranda (2008) is that within the domain, a greater responsibility is taken by e-tutors towards providing for multiple solutions for the design process students who are uniquely diverse. Ideally, this aim may be possible with the infusion of technological pedagogical knowledge domain into the design process daily teaching. The technological pedagogical knowledge is next for focus.

- **Technological Pedagogical Knowledge**

In diagram 2.1 TPK is as a result of an intersections between technology and pedagogy. The technological pedagogical knowledge explains the teachers' knowledge about the existence, components and the capabilities of various technologies that are used in teaching (Lee & Tsai 2010:3). The knowledge about the existence of the components and capabilities of various technologies as they are used in teaching and learning settings refers to the technological pedagogical knowledge (Mishra & Koehler 2006:1028). The technological pedagogical knowledge focuses on how various technologies can be used in teaching and also to understand that using technology can change the way teachers teach (Schmidt et.al 2009:125).

While considering that using technology can change the way teachers teach, some academics suggested two broad groupings. Harris et al (2009) suggested knowing which technologies are suitably aligned with teaching and learning strategies as well as which technologies lend themselves best to educational contexts. The same authors Harris et al (2009) suggested that the ability to think creatively about how to integrate technology for teaching and learning is particularly an important aspect of TPK in that most

technology is not specifically intended for educational purposes. What is given are two understandings about the expectations around the technological pedagogical content knowledge (Harris et al (2009). It seemed the authors argued for making use of technology important to understand how teachers engage in the selection of technology and to go about using relevant strategies for such technologies. Therefore, the knowledge and insights that underlie teachers' use of pedagogical strategies in conjunction with technology can be aggregated to in their specific best educational practices in the subjects that they teach Heitink, Voogt and Van Braak (2017:96). In the light of the above, technologies that match the content of the design process becomes imperative. The next section discusses the technological pedagogical content knowledge domain of the TPACK framework.

- **Technological Content Knowledge**

Technological content knowledge exists as a domain between technological knowledge and content knowledge in the figure 2.1 above. Researchers (Lee & Tsai 2010; Harris et al 2009; Schmidt et.al 2009; Mishra & Koehler 2006) proclaimed what they believed to be underlining assumptions about the technological content knowledge concept.

Technological content knowledge illustrates a teacher's knowledge about the manner to take the features and the advantages of technology into the content subject matter (Lee & Tsai 2010:3). It engages the knowledge of how technology can create new representations for specific content (Schmidt et.al 2009:125). The concept includes the knowledge that the use of technology may either impede or enhance the representations of content (Harris et al 2009:17; Mishra & Koehler 2006:1026).

Technological content knowledge is about the manner in which technology and content are reciprocally related where in the case of teachers they need to know the manner in which their different subjects matter can be changed by the application of technology (Mishra & Koehler 2006:1028). The relevance of these construct by the authors to the objective which was developed for this section of the study is that e-tutors need technologies that may map the implementation of the design process. Such a perception

can mean that the technological content knowledge influences how e-tutors match technologies with the procedural steps of the design process. Having noted the discussions around the technological content knowledge, this study was in a pursuit for developing some knowledge around the construction of the design process from e-tutors. The TPACK framework provided the interactive domains to pursue such knowledge. Then, this study needed this potential promise from using TPACK as a framework in order to achieve the outcomes from teaching the design process. This supports the section which follows on the justification of why TPACK was employed in the study.

2.6 Justification for TPACK framework in the study

We have recognized from literature (Phillips, Koehler & Rosenberg 2016; Lee & Tsai 2010; Harris et al 2009; Schmidt et.al 2009; Koehler & Mishra 2008; Mishra & Koehler 2006) that TPACK describes the kinds of knowledge needed by teachers for effective technology integration. The efficacy of these claims is evident in the growing of considerable interest in many studies (see Drummond & Sweeney 2017; Batiibwe & Bakkabulindi 2016; Di Blas 2016; Mai & Hamza 2016; Millen & Gable 2016; Benson & Ward 2013; Koehler, Shin & Mishra 2012; Kafyulilo 2010; Schmidt, et. al 2009; Mishra & Koehler 2006) which used the framework. In the light of the above, the TPACK framework provided a potential for this study to be leveraged to a maximum level in order to achieve the objectives which were set for the study.

The results presented in this study were based on the specific domains of TPACK. In the face of the growing and diverse research into the many aspects of TPACK, it appears that TPACK domain specific within the design process would benefit from such a framework. In essence, it means the TPACK framework created an opportunity to formulate an understanding of the design process knowledge. In doing so, it means this study benefitted from domain specific TPACK rather than the general as seen by (Wu 2013; Mesina & Tabone 2012).

It might also be difficult to make strong claims about TPACK without considering the context. Context for TPACK is an essential feature of education as it affects teaching and

learning (Phillips, Koehler & Rosenberg 2016:155; Mishra & Koehler 2006:1029). Central to this study is the idea that this study takes place in an ODeL context. In the light of the above, it is important to understand that by generating knowledge from this context, TPACK might benefit from the different perspectives which can lead to better understanding of the domains within the framework.

2.7 CONCLUSION

This section presented a review of literature which provided grounding for the theoretical and conceptual framework perspectives for the study. The theories which supported this study were identified and discussed in detail. In doing so, the discussion was first based on the pragmatic stance of the study followed by the transactional distance theory. A specific focus was on dialogue, structure and learner autonomy as tents with the theory. A discussion also focused on connectivism theoretical framework where cognitive presence, social presence and teacher presence in connectivist pedagogies became points of focus. TPACK as a framework employed for the study was also discussed. The focus was on the justification for TPACK as a framework for the study, the concept of TPACK and the TK, PK, CK together with PCK, TPK and the TCK as tenets within TPACK framework. Chapter 3 follows as the research design and methods.

CHAPTER 3

RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

The previous chapter discussed the related literature which grounded the study. The purpose of this chapter is to present and discuss the study philosophy, research methods, research design, and data collection strategies employed for this study. The different aspects of how the analysis of the collected data was done is also discussed. The concepts of validity, reliability and other constructs relevant to this study were also described.

3.2 STUDY PHILOSOPHY

It is crucial to understand the various philosophical worldviews that researchers employ to conduct and shape their research studies. In this regard, the philosophy adopted in this study is pragmatism. In order to gain ontological insights into what exists in an ODeL environment in terms of how e-tutors construct the design process thoughts, the researcher adopted pragmatism. Based on the comment on the relevance of pragmatism in this study, there is an accurate representation of ontology that it is the reality which addresses what is there to know Willig (2001:13). It might be assumed that in order to address such a question, pluralist approach to discover such new insights Creswell (2014:213) could not be ignored. Such an understanding is likely to connect with a notion that pragmatist researchers place emphasis on the research problem and employ all approaches available to figure out the problem Creswell (2009:10). In order to aid in achieving this control on approaches, an advice is to employ pragmatism since it emphasises ‘what works’ to be the truth and is best for understanding a particular research problem (Maree 2007:263; Tashakkori & Teddle 2008:17). The emphasis on what works might also imply that it is important for researchers to study what they think is important to study.

In the light of this understanding, methodological pragmatism is proposed in view that it can become a method of inquiry with an assumption that that it will work for the studies which were pursued (Tashakkori & Teddle 2008:17). As a result, pragmatists use mixed methods in their enquiries Ihuah and Eaton (2013:940. In this regard, the sense of using mixed method procedures to investigate how e-tutors construct the teaching and learning of the design process in an ODeL context became what works for the study. The next section deals with the research methodology employed for the study.

3.3 RESEARCH METHODOLOGY

This section deals with the research methodology of the study. Methodological issues in research help to shed some light on the types of research approaches in social sciences (Bryman 2012:35). In social science research, there are three main research methods: qualitative, quantitative and mixed method (Creswell 2009:15; Plowright 2011:3). In this study, the mixed method was explored to learn about how e-tutors construct best practice of the design process in an ODeL space. The mixed methodology is described in the next section.

3.3.1 Mixed Methodology

This study employed mixed method approach (Tashakkori & Teddle 2010:51) since it allowed the researcher to blend both qualitative and quantitative data. The process of data collection happened simultaneously. In this study, the researcher was mindful of Creswell (2009:67) that mixed method can be divided into three parts where 75% is the quantitative data and 25% is the qualitative data. This was how the data was structured in the study.

Benefits for using mixed methods in educational research are well documented (Bryman 2012:647; Creswell 2008:552; Gray 2009:212). The possible gains achieved by mixing methods in evaluation are great (Green, Benjamin & Goodyear 2001:4. It allows for

compensating for the weaknesses or blind spots of the other however the different methods remaining autonomous and operating side by side (Bryman 2012:647). The mixed method is the most preferable methodology which covers a big scope of investigation (Creswell 2014:33).

Mixed method research is the type of research in which the researcher, or a group of researches merge elements of qualitative and quantitative data for the wide objective of scope and depth of understanding and confirmation (Bryman, 2012:37; Johnson, Onwuegbuzie & Turner 2007:123. Against this background, the mixed method approach Tashakkori and Teddle (2010:51) was adopted to gather data from the use of closed ended questions.

Mixed methods broaden methodological repertoire which enhances the methodological rigour (Bergman 2008:55). That said, there was much to gain from the inductive qualitative approach which provided the e-tutor voices with different views on e-tutoring about the design process activities. Also, the qualitative aspect prompted a need to facilitate an in-depth study of the phenomenon as well as to explore the individuals' perceptions and meanings they assign to their actions (Merriam 2002:3). The methodological rigour was also given an expression by the numeric data from the quantitative aspect. The importance of each approach was designed to elicit what Bergman (2008:54) noted as situated pragmatic reasons.

3.4 RESEARCH DESIGN

The choice of a research design dictates for the data collection strategies (Gray 2009:580; Creswell 2014:33; Bryman 2012:37). In addition, the aim of research designs is to provide credible answers for questions towards the extent to which the findings approximate reality and are judged to be trustworthy and reasonable McMillan & Schumacher (2001:199). The overlapping third purpose of a research design is to show which variables were measured at what time and intervals and how these measures (nominal, ordinal, interval and ratio) were related to the external events Morrison (2009:9). Following the

aim and the purpose of the research design mentioned above, the researcher's purpose was to use the questionnaires' data to better understand the interviews responses. In so doing, it is assumed that this was an arranged plan.

This line of thinking agrees with some explanations given to the concept of research design. From which, a research design is a plan which describes the conditions and procedures for collecting and analysing data McMillan & Schumacher (2014:6). A research design is a type of enquiry within mixed method which provides a specific direction for procedures in research (Creswell 2014:12). The research design refers to a basic plan or strategy of the research and the logic behind it which makes the drawing of more general conclusions possible and valid (Oppenheim 2001:6). Each of the above authors (Creswell 2014; McMillan & Schumacher 2014; Oppenheim 2001) provided an opportunity for agreement when there was an agreement based on the idea of a plan and some form of direction. For this plan to achieve its set goals, it needed a triangulation design which is discussed in the next section.

3.4.1 Triangulation Design

The concept means, 'converging operations' (Leary 2007:57). The aim of triangulation is to blend the results of two or more rigorous investigations conducted to generate a more comprehensive representation of the results than either study on its own (Tashakkori & Teddle 2003:125). The purpose of triangulation design is to use more than one method or source of data in the study of a social phenomenon so that findings may be cross checked (Bryman 2008:700). Triangulation compares several sources of evidence in order to establish the accuracy of information in a phenomenon (Briggs & Coleman 2007:68). Since this study was assigned to merge operations, it considered both the qualitative and the quantitative data sets during the time of checking the interpretations of each data source. In other words, according to Patten (2005:123) this initiative is termed method triangulation where different methods such as questionnaires, interviews and online observations are used to gather data.

In line with this study, method triangulation was claimed when the researcher conducted face to face interviews with e-tutors concerning how they construct the design process during their e-tutoring activities. The qualitative responses from the e-tutors were reviewed in a survey questionnaire given to online students about their e-tutor practices of the design process. The two data sets were supported by online observations which resulted from the interactions between the e-tutors and their online students. Either way, triangulation be it data or method, is a quality control measure adopted to enhance credibility, validity and reliability of research data (Briggs & Coleman 2007:203; Patte, 2005:567; Tashakkori & Teddle 2003:99). The quality control in this study was presented based on the simultaneous collection of the quantitative and the qualitative data. Through this process, the researcher was mindful of the necessary research design needed in order to provide a specific direction. The direction aimed towards the procedure to be followed for data collection, analysis and the writing of the study's report. Taking the mentioned into consideration, the sequential explanatory design is discussed next.

3.4.2 Sequential explanatory design

A sequential explanatory Maree (2007:264) embedded design was employed for this study. The sequential explanatory design strategy is characterized by the collection and analysis of the quantitative data followed by a collection and analysis of qualitative data (Maree 2007:265). During the data collection, methods for gathering data vary and also the purpose for which the information is being gathered (Creswell 2009:15). The use of an effective method is critical as it determines the nature and quality of the results (Creswell 2009:15).

Methods and instruments used for studies inform which would be most effective in providing the data required (Maxwell 1996:92). In this study, the process of data collection was aligned with the methodological pragmatism which could only be achieved from multiple sources of information. An earlier discussion (Section 3.3.1) in this study detailed a mixed method approach. Mixed methods data collection was used as a subset of multi

method research in which what is learned from one method is integrated in the application of another method Axim and Pearce (2007:1).

Within a mixed method, both quantitative and qualitative tents exist within the approach. In note of the independence of the two, data for the study was collected simultaneously and at different stages. Quantitative data were collected in two distinct ways. The online observations data were collected through the researcher's developed instrument. Their collection commenced from the time there were first online postings in the form of two-way interactions between the e-tutors and the online students began. Secondly, the questionnaires data were collected through the researcher developed TPACK instrument. Lastly, the qualitative data were also collected through the researcher developed instrument. All the processes of data collection needed instruments which are next for discussion.

For the process of data collection within the design to become successfully implemented, it required particular instruments in order to provide direction. The next discussion is based on how data was collected for the study together with how the designing of instruments progressed.

3.5 DATA COLLECTION

This section presents the data collection procedures. It has been illustrated in figure 1.1 of study's research matrix that data was collected through questionnaires, observations and semi-structured interviews. In the next section, the data collection instruments are discussed.

3.5.1 Questionnaire

Based on the mixed method design, appropriate and corresponding procedures for data collection became imperative. From the study's quantitative aspect, data were collected by means of a structured questionnaire. Quantitative data permits for different analyses including statistical reports (Babbie & Mouton 2001:81). For a questionnaire to serve the intended purpose of an acceptable tool for data collection, the process of data collection was imperative.

Data collection for the questionnaires

A structured questionnaire was one of the two instruments together with online questionnaires used to collect the quantitative data comprising of 30 closed questions with levels in a Likert Scale of agree, strongly agree, neutral, strongly disagree and disagree. The questionnaires were distributed online for the Technology Education students to complete. The data collection commenced on the first the February 1st to the 1st of December 2019 where data was collected as soon as a student completes and sends the questionnaire back to the researcher.

Overall, a total number of 145 responded to the questionnaire. A total of 155 opted not to respond to the questionnaire and the return rate response translated to 90.6% which by far was above the 70% standard credence of the response rate. At the same time, the process of designing the online questionnaire was also important as it appears in the next discussion.

Designing the online questionnaire for the study

The aim of using questionnaires in studies is to use them as instruments within surveys to collect information about a well- defined population (Czaja & Blair 1996:3). The purpose of questionnaires is to serve as a methodology in research which permits for significant collection in amounts of data from a sizeable population (Gray 2009:219). The following were cited as benefits of using questionnaires:

- Low cost in terms of time and money.
- The inflow of data is quick and for many people.
- Respondents can complete the questionnaires at a time and place that suites them.
- Data analysis of closed questions is relatively simple, and questions can be coded quickly.

- Respondents' anonymity can be assured (Gray 2009:338).

On the contrary, the following were indicated the following disadvantages in questionnaires:

- Low response rate.
- Restricted to online population who must be literate.
- Confidentiality and anonymity issues.
- Multiple replies.
- Respondents can give the questionnaires to someone else to complete.
- The conditions under which the questionnaires are completed cannot be controlled (Bryman 2012:677; Maree 2007:156).

The questionnaire instrument in this study was developed to serve the purpose of an instrument. The questionnaire was developed to have four parts (APPENDIX 5). Closed ended questions were adopted since they require a respondent to choose from a variety of stated answers David and Sutton (2004:162). A Likert scale item comprising of five items inventory was used as measurement. Likert scales are a convenient means of gathering data on a construct form a range of different approaches (Harris, Brown & Hong 2010:1). In a Likert scale, the respondent is asked the extent to which they agree or disagree about a topic. The responses may be provided in the form of a mostly 5-point scale of for an example, Strongly Agree (SA); Agree (A); Neutral (N); Strongly Disagree (SD) and Disagree (D) (Williams 2003:246; David and Sutton 2004:168). For purposes in this study, the questionnaire instrument was divided into six sections.

Section 1 was an introductory part which explained the rationale for the study and it also established the need for the respondents to maintain their anonymity. It also provided instructions to the respondents on how to respond to the questions.

Section 2 addressed the biographical section of the study. The section contained an aspect of gender and age.

Section 3 addressed the Technological Knowledge (TK) aspect within the TPACK. It contained 6 aspects which were close ended.

Section 4 focused on the Pedagogical knowledge (PK) domain within the TPACK framework. It comprised 6 aspects which were close ended.

Section 5 dealt with the Content Knowledge (CK) tenet of the framework. It contained 8 aspects which were close ended.

The design of an instrument follows some procedural steps. In this study, the design and procedure followed six steps. Firstly, the researcher reviewed literature with an aim of a selection for an instrument and the assessment of a previously used TPACK instruments (Alrwaished, Alkandari & Alhashem 2017:6131; Chee, Mariani, Othman & Mashita 2017:133; Kopcha & Ozden, 2016:763; Karadag & Acat 2015:106; Koh, Chai & Tsai 2014:188; Yurdakul et. al 2012:975; Baser, Chai, Koh, Tsai & Tan 2011:1189; Graham 2011:346; Archambault & Barnett 2010:1659; Archambault & Crippen 2009:87; Schmidt et al. 2009:144.

The second step was to adapt a previously made scale Schmidt et al. (2009:144) to include three domains within TPACK. Thirdly, the researcher modified the previously made scale to cover 18 items. The fourth step to the process was to compose an item pool for design process within the instrument. In the fifth step, the researcher involved specialists of Technology Education for assessment for content validity. The final sixth step was to pilot the draft questionnaire for reliability and validity.

Piloting the questionnaires

Piloting questionnaires are trial runs which are done in preparation for the major study (Polit, Beck & Hungler 2001:467). Having systematic questionnaire testing procedures in place is vital for data quality particularly for a minimization of the measurement error

(Brancato, Macchia, Murgia, Signore & Simeone 2006:1). This study took cognizance on the importance of aiming to piloting the draft questionnaires. The aim was to obtain an advance warning about where the main research question could fail, or whether the proposed instrument was inappropriate or even too complex for the respondents to answer (Teijlingen & Hundley 2001:36; Roberts 2004:24). In the current study, the draft TPACK questionnaire consisted of 47 scale items which included the demographic information.

Potential difficulties exist during the piloting of the draft questionnaires. In order to avert such potential difficulties, a sample questionnaire should be given to the prospective respondents Roberts (2004:24). In this study, a sample questionnaire was given to ten (10) online students from the two modules to respond. The ten pilot respondents were asked to indicate any procedural difficulties they might have encountered Lancaster (2005:138). The format of the pilot questionnaire was designed with the aim of allowing prospective respondents an easy understanding of the introductory instruction. Their responses informed the final study questionnaire design which was given to 135 online students conveniently to provide feedback Roberts (2004:139). The final version of the study TPACK questionnaire was reduced to 18 items from the original 47.

At the same time of administering the pilot questionnaires, 2 colleagues were interviewed in face to face settings. The aim was to check whether the responses from the online students' questionnaires were in consonance with their actual opinions (Williams 2003:249). The two colleagues were chosen on the basis that they happened to be in the same department and in the same Technology Education specialization with the researcher. During the analysis of the results, the online students indicated that the questions were generally clear and understandable. Some attention was however drawn to the discrepancies in the responses option for some answers. The researcher action was to correct some wording on some of the response categories. From the two colleagues, their responses were adequate. The respondents did not appear to have difficulty in responding to the face to face interviews (Teijlingen & Hundley 2005:35; Woolfitt 2005:4). In the light that this study opted for a methodological pragmatism, the design of a tool was important to achieve the process of data collection.

3.5.2 Individual semi-structured face to face interviews

Individual semi- structured interviews were also used for qualitative data collection. Since they were employed as instruments for data collection in this study, their designing process became imperative as a point of focus.

Designing for the individual semi-structured face to face interviews

At the same time with the questionnaires, pilot interviews were conducted with the colleagues from the unit of Technology Education. The researcher purposefully selected the two colleagues since they were experts in the field. The aim of the pilot interviews was to test and refine as much as possible the final interview leads and questions. This was to improve the external validity; face validity and content validity of the interview leads and questions.

External validity

External validity is the extent to which the research findings can be generalized to a larger population and be applied to different settings (David & Sutton 2004:173). In order to ensure external validity, all the respondents must have been allowed an equal chance of being selected in the sampling strategies to ensure the generalisation of the results from which the population was selected.

Face validity

The face validity of this study's questionnaire was examined by interviewing 2 colleagues after the students completed the questionnaires. The aim was to check whether the responses that were provided in the questionnaires matched with their real opinions (Williams 2003:249). This agrees with 'weather an instrument appears to be valid on the face of it' (Patten 2007:63; Drost 2004:116). Therefore, it means these are judgements which researchers make when they consider the face validity. The judgement is that it is presumed that the instrument appeared to measure what it sets out to measure.

Content validity

In case the content of an instrument matches an actual phenomenon under scrutiny, then the test has content value. Researchers make judgements on the appropriateness of the contents of an instrument in order to determine content validity (Patten 2007:64). In order to ensure content validity of the questionnaire, the researcher considered the meanings the respondents were likely to attach to specific words in the questions (Patten 2007:65). For an example, a concept, Technology Education (TE) which is not Educational Technology (ET) was explained in the front of the questionnaire (see appendix 5). After careful reviews and refinement together with critical assessment of written responses, an assumption was made that the content of the instrument measured the phenomenon under investigation.

3.5.3 Online Observations

The online observations in this study were used as another set to collect the quantitative data. Non-participatory observation was used to observe the interactions between the online students and the e-tutors. Since the researcher was the primary lecturer in one of the modules, a colleague agreed to assume the primary responsibilities of a lecturer from the start until the end of the research process. As a result, the researcher did not in any form (direct or indirect) intrude in the daily activities the e-tutors.

Since these observations were considered as an important source for the quantitative section, its design was important, and which is discussed in the next section.

Designing the online observations for the study

Online observation refers to the textual exchanges of both synchronous (simultaneous such as chat) and asynchronous (non-simultaneous such as e-mail (Norskov & Rask 2011:5). In order to establish the procedures for observing online, the approach to the observations took a less formal structure. The technique is grounded in interactive internet- based virtual communities and it involves an informal approach of less structure and allows the researcher flexibility and freedom regarding data collection and recording

(Norskov & Rask 2011:5). For purposes of this study, the UNISA's mode of @mylife. unisa's discussion forum exchanges were used for the online observations.

In this study, the online observations started from the first month (February) after the students' registration up to the last month (November) before the final year end exams. The aim was to provide information which could provide insights on the online interactions between the students and the e-tutors. Based on the type of observations, an observer is the one who becomes an investigator which observes how tasks are assigned in by e-tutors for the students online Norskov and Rask (2011:5). As a researcher, my purpose was to establish an understanding about student postings, the frequency of discussions, how e-tutors' responded and finally the nature of their engagements. Put differently, these observations became a possible baseline against which to evaluate the e-tutoring competencies within the design process specification and a programme model within UNISA. As a result, an instrument was necessary in order to explore these issues. The instrument was developed by the researcher. The development of such an instrument was possible since this study was situated with a pragmatic design orientation. (An instrument is attached as Appendix 4).

In developing the instrument, it contained constructs (Technological Knowledge (TK); Pedagogical Knowledge (PK) and Content Knowledge (CK) which were designed by the researcher. The issues of reliability and validity are addressed from the perspective of trustworthiness. The two concepts equate to the concept of trustworthiness (Cohen, et al 1992:285). Trustworthiness was also determined in order to address issues of objectivity and credibility. The two concepts are among the four associated with trustworthiness (Maxwell 1992:285). For purposes of this study, in order to ensure trustworthiness, it initially involved taking the instrument to colleagues. Secondly, the process involved taking the instrument to other specialists in the same field.

The instrument contained three knowledge domains which were identified for the online observations. The first domain covered the TK aspect, the second domain covered the PK aspect, and the final domain involved the CK issues. Each of the three knowledge domains targeted a specified subsidiary research question. Within each domain, a

construct was developed. A total of three constructs were developed for each domain. For an example, it may be seen here that in TK construct number 1: *E-tutors use knowledge which provided online students with enough opportunities to work with different technologies.* It means all the online interactions were classified according to the type a question which was asked and the responses from each of the six e-tutors. All the postings from the five e-tutors were tallied, arranged and mapped in the three constructs which were developed into graphical representations.

In terms of the PK which answered the second subsidiary research question, three constructs were developed. For an example, it may be seen here that in PK construct number 3: *E-tutors use a wide range of teaching approaches in a virtual classroom setting.* Postings were tallied and later represented in the form of graphs.

The same procedure was followed for the development of the third knowledge domain of CK. For an example, it may be noticed here that in CK number 2*: E-tutors help students to understand all the four stages of the design process.* All the postings which matched this tenet were classified, tallied and recorded under this tenet. The tallies were grouped and later represented into pictorial graphs for further analysis.

3.6 TRUSTWORTHINESS, VALIDITY AND RELIABILITY

The researcher noted that this study needed to provide trustworthiness. It was noted also that criteria in deciding which forms of data analysis to undertake would require to become fit for a purpose by considering the terminology. In the context of this study, the following terminology referenced important meanings to the process of data analysis. As a result, four concepts of credibility, conformity, transferability and dependability (Lincoln & Guba 1985:290) are associated with the concept of trustworthiness. This study's approach to addressing credibility and conformability was to make available instruments and data for confirmation, comparison and scrutiny by other colleagues and researchers. This included raw data from the questionnaires, the online observations and the questions

from the semi structured interviews. **Credibility** defines whether findings are worthy to be credited and exemplifies conceptual interpretation of information derived from the participants' original responses (Lincoln & Guba 1985:296). **Confirmability** refers to the extent of how well the findings and observations of the research are accepted (Lincoln & Guba 1985:297).

Additionally, in this study, dependability is linked to credibility and conformability. Direct transcriptions of the audio-recorded interviews and the raw data from the survey are available. Also, the reference list and web links are available so that the authenticity of the study and findings can be checked. All these constitute an audit trail of evidence collected during the study.

Since this study employed a mixed method approach, the analysis of the qualitative data was to assign codes to the data under the relevant themes and categories. In so doing, the purpose was to describe specific characteristics related to the main research question.

Trustworthiness, validity and reliability are some of the important concepts for the qualitative aspect in a research. The concepts are discussed in the next sections.

3.6.1 Trustworthiness

Four important elements of credibility, transferability, dependability and conformability feature as important elements within trustworthiness are distinguished in any qualitative project that warrant attention (Lincoln & Guba 1985:290).

Transferability is the extent to which the findings of the research are applicable and can overlap beyond the limits of the research (Lincoln & Guba 1985:297).

Dependability refers to the evaluation of the quality of the interrelated processes of information as are backed by the data collected (Lincoln & Guba 1985:297).

3.6.2 Validity

As a researcher, in a quest to ensure validity in this study, a questionnaire, online observations and semi structured interviews became three main data sources of data collection. This agrees with Cohen (2005:113) that each of the three data sources used to collect evidence of the same phenomenon is indicative of triangulation which increases the validity of the study. Methodological triangulation was used were both the qualitative and quantitative methods were employed where the quantitative data was used to support where relevant and to look for the emerging trends. The notion is further known to be employed to judge the accuracy of the description of the phenomenon that a research sets to describe (Briggs & Coleman 2007:65). This suggests the extent to which the evidence supports the interpretations a researcher makes on the results of the study (Moskal & Leydens 2001:1). Validity makes ascertains that interpretations are correct and how they are used are also correct (Singleton & Straits 2004:131). Critical components of the research design, the methodology and the emerging conclusions all require taking the validity of the process into cognizance (David & Sutton 2004:171). This study adopted purposive sampling strategies and then used the entire population of two modules (LADTECX and PFC103S) who were conversant with design process. In this regard, the researcher ensured that all the cases in the sampling frame were given an equal chance of being selected Lancaster (2005:149).

3.6.3 Reliability

In this study, it was important for the researcher that the instruments could be used with the different participants in the different contexts with a possibility of obtaining the same results from the different contexts. If this could be done, then the instrument and the methodology of application would indicate reliability.

In order to ensure reliability in this study, the questionnaires and the face to face interviews were pre-tested through piloting. The purpose of reliability in research is to test an extent which a test, a method or a tool gives consistent results across a range of settings (Wellington 2000:200). In other words, an essential principle underlying reliability is that any significant results must be more than a unique finding and must also be

intrinsically repeatable. This will augment the results and ensure that the acceptability of the hypothesis by the wider research community (Shuttleworth 2008:87). In augmenting the results, other researchers must be able to perform the same study under the same conditions and produce the same results.

3.7 DATA ANALYSES

This study's data was collected using a mixed method tenet and ended with two quantitative data sets and one qualitative data set. This was seen by Bryman (2012:13) as voluminous raw data. In order to manage the voluminous data, it was separated according to the approach within the mixed method approach. Each of the two approaches is self-possessed by its own unique data analysis procedures. Data analysis stage is fundamentally about data reduction whereby the large copus of information the researcher gathered begins to make sense (Bryman 2012:13). This section provides the data analyses methods employed for the different instruments. The focus of the quantitative data analysis was based on an instrument which was developed for the study. The qualitative data was separately discussed from the quantitative data. The quantitative data analysis was done by focusing on each instrument. The next analysis focuses on the analysis of the questionnaire as one of the instruments in the quantitative data.

3.7.1 Quantitative data analysis

This section presents a section on how quantitative data was analysed for the questionnaires and observations which were formulated for the study. The quantitative data were analysed using the frequency distribution and percentages.

3.7.1.1 Questionnaires

Earlier, it was mentioned that in a Likert scale, the respondent is asked the extent to which they agree or disagree about a topic. Their responses were provided in the form of a 5-point scale of for an example, Strongly Agree (SA); Agree (A); Neutral (N); Strongly Disagree (SD) and Disagree (D). In the light of this information, the initial process involved assigning value labels to each point in a scale. For an example, the value score of SA =

1; A = 2; N = 3; SD = 4 and D = 5). The next process was to enter value scores as inputs. In a case where the student's response became SA, then the input value score is 1. The process was followed until all the three (TK; PK and CK) knowledge construct were completed. In order to ensure that the data entry is error free, meticulous attention must be paid during the entry process (Lancaster 2005:204; Hellerstein & Berkeley 2008:2). To correct the errors, the researcher refers to the affected section and effects the appropriate changes (David & Sutton 2004:260). After cleaning the entries, data were analysed, and the results were described and presented by using tables.

3.7.1.2 Observations

Conducting content analysis on websites has become increasingly significant. These are postings that are made to discussion forum which are construed as a form of document (Bryman 2012:656). Such data in turn would be descriptive and analytically exploited (Jick 2008:110).

This section' focus is on postings between e-tutors and the Technology Education LADTECX and PFC103S modules. Like interviews, online observations can be highly structured and vary in terms of length ranging from rapid to prolonged repeated observations (Nastasi & Hitccock 2016:64). Observations styles vary for different reasons and a particular observation style can be informed by the degree of focus (Patton 2014:228). In this study, the researcher adopted a position of counting the number of times postings happened. This process involves the reading and analyses of the various postings without any participation (Bryman 2012:657).

The analyses of various posting were framed from the research questions which were formulated for the study. Three subsidiary research questions were formulated for the study. In each research question, constructs about each knowledge domain were formulated. For an example it may be seen here that for CK: *The construct needed an indication whether e-tutors have abilities to help students to understand all the stages of the design process.*

From all the five e-tutors, their postings were read, analysed, counted and prepared for entry of analysis using tables. For an example, Table 5.6.1: E-tutor skills for different technologies (TK); Table 5.7.1: E-tutor varied strategies to explain concepts for Technology Education (PK) and Table 5.8.1 E-tutor abilities to help students to conceptualize the first stage of the design process (CK).

The issue of trustworthiness was addresses by printing the posting for verification purposes. The documents were given to two colleagues for verifications and for further verifications.

3.7.2 Qualitative data analysis

This section presents the analysis of the qualitative data which was obtained from the structured interviews.

3.7.2.1 Individual semi structured interviews

The aim of data analysis in qualitative research is to seek for relationships and patterns (Neuman 1997:420). Data analysis involves strategies and techniques used to facilitate discovery for interim analysis (McMillan & Schumacher 2012:463). Qualitative method of data analysis includes organising, accounting for and explaining data (Cohen, Manion, & Morrison 2008:461). The process of data analysis in a qualitative approach is useful as it has connections with research questions (Creswell 2014:14). In this study, a major research question together with three subsidiary research questions were formulated in mind for the process of data analysis as signalled by Creswell (2014).

There is no one neat and a tidy approach to qualitative data analysis nor even one approach (Babbie & Mouton 2001:490). This notion does not reflect a need for standardisation. For some, the first step is to establish units of analysis of the data which are ascribed as codes to the data Cohen, et al (2005:148). Also, data first goes for transcription and then followed by a thematic analysis process which is used to find patterns or themes within the data (Bryman 2012:13). This study followed a thematic analysis Bryman (2012) which generated large volumes of data. In order to guard against losing the important data, which was generated from the analysis, the researcher

recorded the interviews using a voice recorder and a Samsung Galaxy 10. The purpose of using such devices is that it provides for an opportunity to concentrate on the process of listening and refocusing the interview Gray (2009:385). In the light of the above, the researcher analysed the qualitative data obtained from the five e-tutors. The aim was to obtain in-depth answers about the procedural steps of the design process. In so doing, some ethical considerations were important to consider for ethics in research. The next section deals with ethical considerations in research.

3.8 ETHICAL CONSIDERATIONS

Ethical considerations place an important value that respondents have a right to privacy (Gregory 2003:35). Even though respondents may freely and knowingly provide information to the researcher, they are not obliged to disclose the information to others unless the identities of the respondents are sealed (Rudestam & Newton 2001:291).

Questions about ethics in research bring in the role of professional organisations which formulate codes of ethics (Bryman 2010:130). During the period of conducting this study, I was an employee in the College of Education at UNISA and my needs as a researcher were safe guarded by a professional organisation which adhered to ethical issues in research. A professional organisation named UNISA College of Education Research Ethics Committee offered on sight application clearance certificate towards this study (Ref 2018/04/18/07724101/23MC (Appendix 1). The aim for the application was to access sites and participants who were targeted as knowledgeable for this study.

The second professional organisation named, Research Permission Subcommittee (RPSC) of the UNISA Senate, Research, Innovation, Postgraduate Degrees and Commercialization Committee (SRIPCC), certificate Ref #2018-RPSC-037) also provided permission to conduct surveys with the undergraduate and post graduate students (LADTECX and PFC103S) modules. The same permission also covered to conduct face to face interviews with the e-tutors (Appendix 2). In compliance with the two certificates, it was important to ensure issues that relate to ethical principles in research were followed. The following principles relate to good research practices.

3.8.1 Harm to participants

Research that is likely to harm participants is regarded as unacceptable based from a question of exactly what harm is (Bryman 2012:135). Harm entails several facets which include physical harm to participants, harm to participants' development, loss of self-esteem, stress and inducing participants to perform reprehensible acts (Gray 2009:74). Bryman (2012:110) identified the following features that might result as harmful to participants: research which causes a participant to be embarrassed or generally a subject to mental distress and if it produces anxiety or stress and negative emotional reactions. This study posed no such a threads and great care was taken to conduct the interviews in a setting that was nowhere near of a possible trigger to such emotions.

3.8.2 Informed consent

Informed consent has always been an issue in research especially more so when groups are considered as vulnerable (Gray 2009:75). Informed consent means knowing what a reasonable person in the same situation would want to know before giving consent (Buchanan & Bryman 2010:110). The principle of informed consent means the research participants are provided with sufficient and accessible information about a project so that they can make informed decision as to whether to become involved or not (Gray 2009:75). Consent is contingent and situated in that it varies according to whom one is dealing with (Buchanan & Bryman 2010:85). Since informed consent is aligned to reasonable people Buchanan and Bryman (2010) it can be assumed that the process which involves informed consent cannot be adequately addressed by merely signing a form. In line with this understanding, as a researcher, I supplied motivations on why the study was conducted, explained that there were no incentives for participation in the research project and also that the final data presentations would be guided by accuracy and with no distortions in the final report.

3.8.3 Anonymity

Anonymity is compounded when it comes to ways data was collected, sored and what kind of control measures are in place for storing data (Gray 2009:79). Ethical formalism must result with conventions that any research should be anonymised in publications to protect participants from risk of potential harm (Buchanan & Bryman 2010:86). Besides soliciting the informed consent from the respondents, the returned surveys should be kept in a safe space and should only be seen by people in the research study (Hughes & Tight 2006:65; Niederhauser 2006:213. In this study, the way data was collected and also its analyses and interpretation were organised by using codes and pseudonyms. In order to prevent data from being accessed, as a researcher, I developed an encrypted file with a password in the hardware drive system.

3.8.4 Confidentiality

The issue of confidentiality is addressed by advocating care over maintaining the confidentiality of records (Bryman 2012:136). Confidentiality in research is a respect for personal boundaries since confidentiality refers to access to data and not access to people directly (Bickman & Rock 2009:123). In order to safeguard confidentiality, there should be descriptions of specific terms of confidentiality in the consent statement (Bickman & Rock 2009:123). For instance, a statement that ‘participation was not obligatory but voluntary, at any stage of the research process if one felt to withdraw from the interviews, one can pull out’ is a necessity for the participants. In addition, it means identities, records and that care needs to be taken when findings are published to ensure that individuals are not identified or identifiable. To this effect, the participants’ identities in the study were E-tutor 1 to E-tutor 6 (ET1-ET6) and E-tutor Site 1 (ETS1) to E-tutor Site 6 (ETS6). The next section deals with the position of the researcher.

3.9 POSITION OF THE RESEARCHER

My role as a lecturer influenced the start of the present study since I am responsible for two modules in the teacher education programme within the university where this study was conducted. By virtue of this position as a lecturer, I am an insider since I meet the e-tutors appointed in the two modules.

Through the entire research process, my personal participation was maximal from data collection, conducting the semi structured interviews and the analysis of data; from which I happen not to be neutral or objective. My position as a researcher in this study is to reflect on critical navigation in the field which this study pursues.

3.10 SUMMARY

This chapter exposed the study philosophy which was followed by the research methodology was developed for the study. Triangulation was discussed together with the research design which was followed. Next in line for discussion became the population and sampling followed by data collection. The design of questionnaires, semi structured interviews and the design of online observations was also discussed. Concepts of validity, external validity, face validity and content validity were also engaged. The second quantitative data were collected from the online observations. The final data set was the qualitative data which were collected from the interviews with the e-tutors. The section on data analyses focused on the analysis of the questionnaires, online observations and the qualitative interviews. Issues of ethical considerations were also discussed. Finally, the position of the researcher was presented, and the next section deals with the analyses section of the study.

CHAPTER 4

ANALYSES AND RESULTS

4.1 INTRODUCTION

The preceding chapter dealt with the research methodology of the study. This chapter is the analyses and presents the empirical evidence based on both the quantitative and the qualitative data collected for the study. In presenting the results, the quantitative analyses are presented first and thereafter the qualitative findings follow.

4.2 QUANTITATIVE RESULTS

This section presents the results from the quantitative results. The participating students responded to a forty-question item regarding the design process of Technology Education in an Open and Distance e-Learning. Furthermore, the online observations data is also presented in this section.

4.2.1 Results obtained from the students' questionnaires

It has been mentioned that 18 items were used in the survey. The questions covered several aspects, such as Technological Knowledge (4 items); Pedagogical Knowledge (6 items); Content Knowledge (8 items) of the design process. In each aspect, students rated their responses on a 5-point Likert type scale: 1: Agree (A); 2: Strongly Agree (SA); 3 Neutral (N); 4: Strongly Disagree (SD); 5 Disagree (D). These aspects are discussed in the following section.

4.2.1.1 The e-tutors' TK of the design process

This section presents the four items in relation to the research question with regard to how the e-tutors did have acquired technological knowledge (TK) for online content delivery.

Table 4.1: E-tutors provide students with sufficient opportunities to work with different technologies

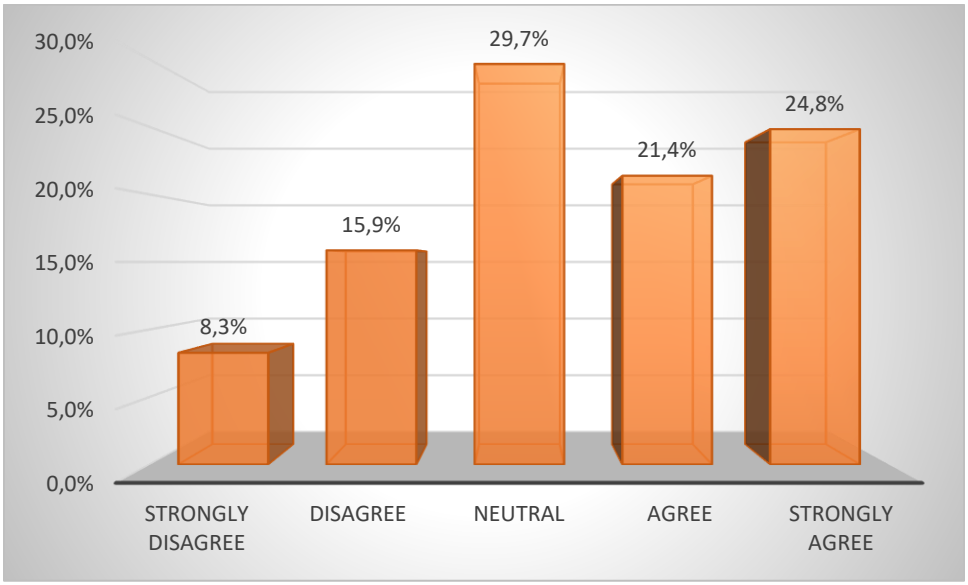

Table 4.1 shows the results in response to an item on e-tutors' abilities to provide students with sufficient opportunities to work with different technologies. It may be observed from the table that 46.2% respondents strongly agreed or agreed with this statement. This result suggests that less than 50% of students believe that their e-tutors could not provide them with sufficient opportunities to work with different technologies in an ODeL context.

Table 4. 2: E- tutors use digital materials that map stages of the design process

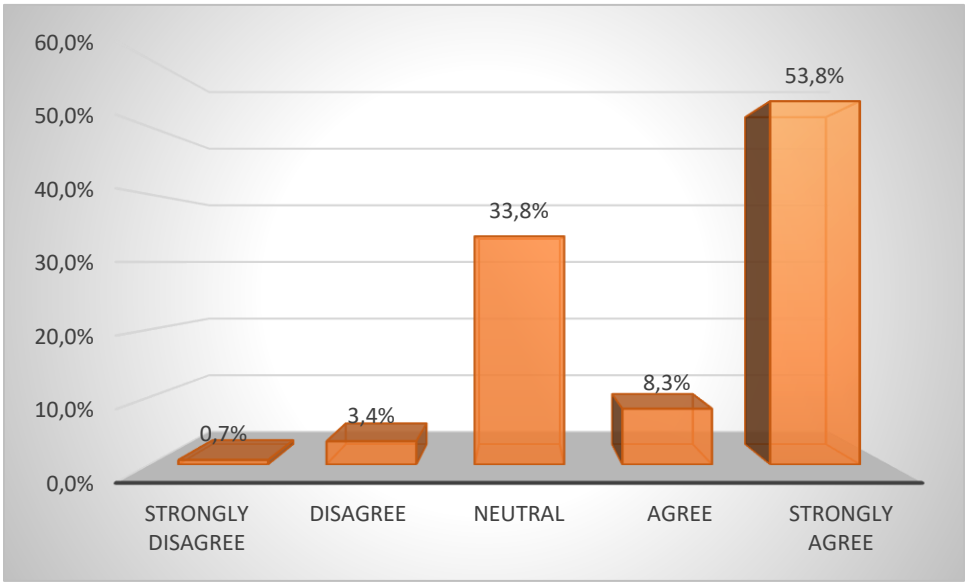

Table 4.2 shows the results in response to an item to rate whether e-tutors were able to use digital materials that map stages of the design process. It is evident from the table that 62,1% of students strongly agreed or agreed that e-tutors were able to use digital materials that map stages of the design process. This would mean that many students believe their e-tutors could use digital materials that map stages of the design process for the Technology Education content in the ODeL context.

Table 4.3: E-tutors' knowledge of the educational technologies

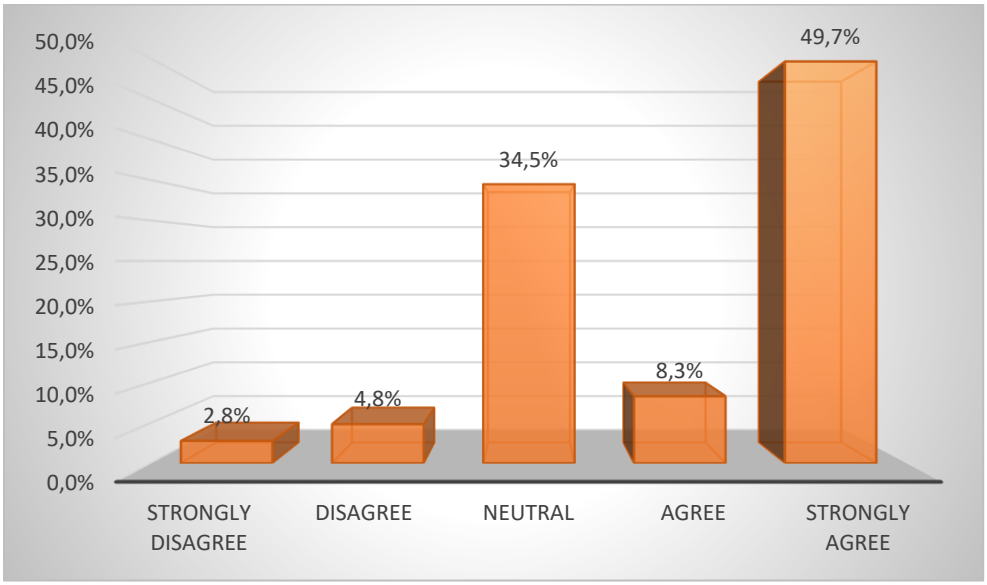

Table 4.3 shows the results in response to whether e-tutors had knowledge of technologies which benefit their studies. It may be observed from the table that 58% of students strongly agreed or agreed that e-tutors possessed knowledge of technologies which benefit their studies. This suggests that the students believe that at an average, their e-tutors had knowledge of technologies which benefit studies in an ODeL space.

Table 4.4: E-tutors choose technologies that enhance the design process content

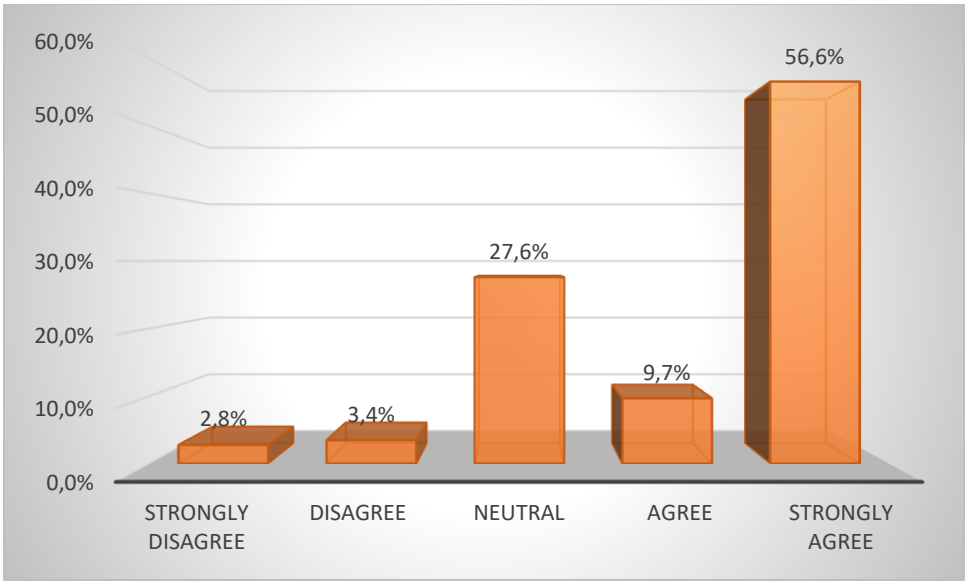

Table 4.4 shows the results in response to whether e-tutors have abilities to choose technologies that enhance the design process content. Many students (66.3%) strongly agreed or agreed that their e-tutors possessed abilities to choose technologies that enhance the design process content. This suggests that an enviable number of students hold the view that their e-tutors can implement the design process lessons for Technology Education in the ODeL context.

The above tables articulated the key aspects which best describes how the students formulated competencies about their e-tutors' technological knowledge. In the light of the above, the same students also responded to the pedagogical knowledge domain which is presented in the next section.

4.2.1.2: Pedagogical Knowledge of the design process

In this section, the four items were asked to students regarding their views on the influence of e-tutors' pedagogical knowledge on the learning of the design process.

Table 4.5: The abilities of e-tutors to assess virtual classroom performances for the stages of the design process.

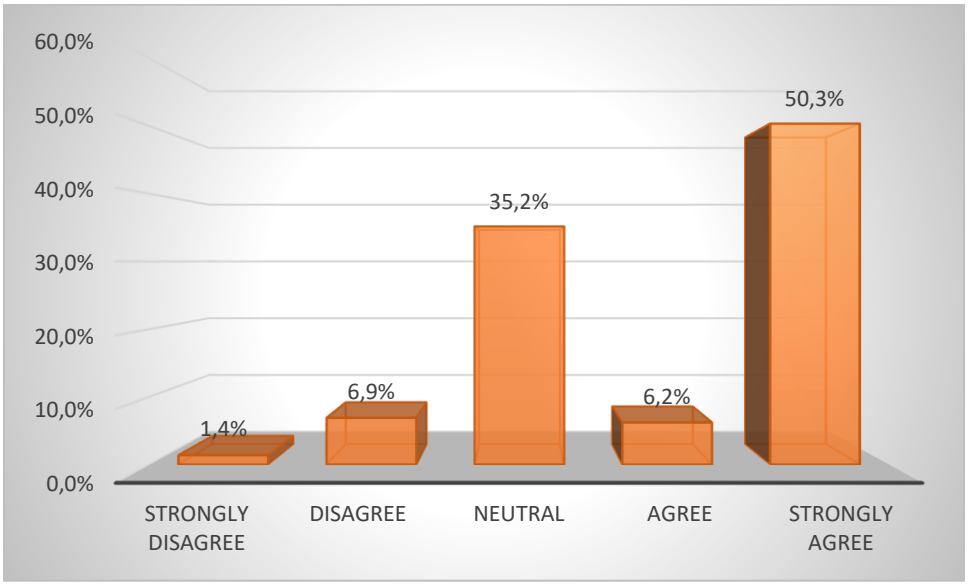

Table 4.5 shows the results in response to an item given to students to indicate whether their e-tutors had abilities to assess virtual classroom performances. It is noted from the table that 56.5% of the students strongly agreed or agreed that their e-tutors possessed abilities to assess performances of the design process in a virtual classroom. This suggests that students believe their e-tutors perform at an average in terms of how they approach their key responsibilities of teaching the design process in an ODeL environment.

Table 4.6: The abilities of e-tutors to adapt their teaching styles to suit the students' learning of the design process

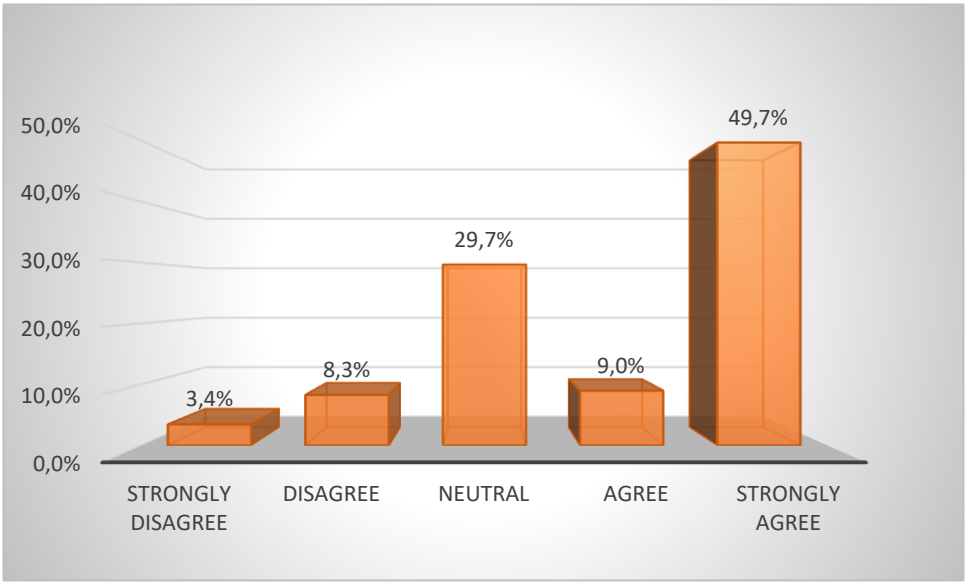

Table 4.6 shows the results in response to an item given to students to indicate whether their e-tutors had abilities to adapt their teaching styles to suit the students' learning. An observation from the table is that 58.7% of the students strongly agreed or agreed that their e-tutors possessed abilities to adapt the teaching styles to suit the learning needs required for the design process content. This suggests average performances by the e-tutors who might leave other students behind when it comes to understanding the core content of the design process.

Table 4.7: The e-tutor abilities to apply different assessment strategies for teaching the design process

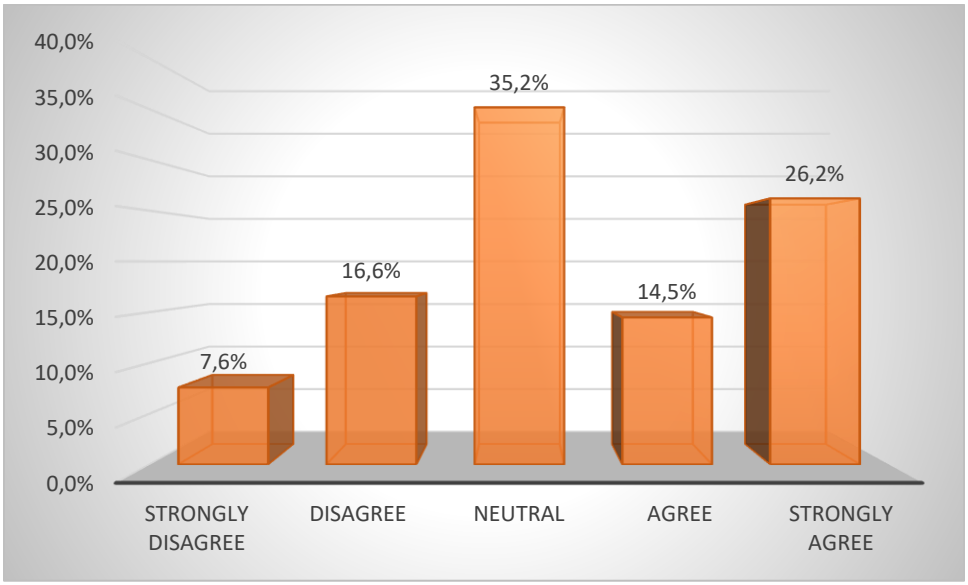

Table 4.7 shows the results in response to an item which was given to students to indicate whether their e-tutors had abilities to apply different assessment strategies during teaching the content for the design process. Upon a closer scrutiny, the table shows that 40.7% of the students strongly agreed or agreed that their e-tutors had abilities to apply different assessment strategies during teaching the content for the design process. This indication suggests that there is probably no creativity from the e-tutors in terms of assessing the cognitive aspect of the design process in an ODeL environment.

Table 4.8: The e-tutor abilities to use a wide range of teaching approaches in a virtual classroom setting for the design process

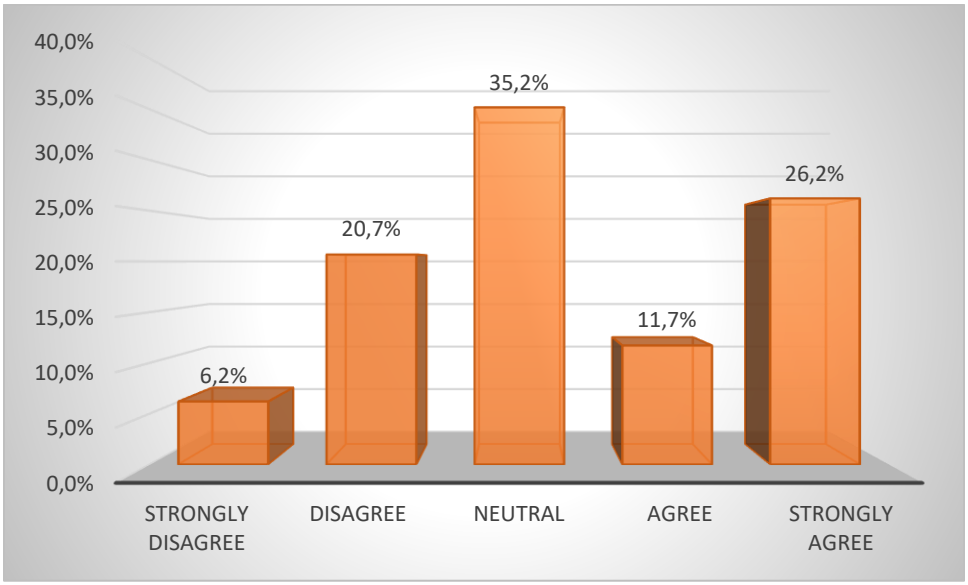

Table 4.8 shows the results in response to an item which was given to students to indicate whether their e-tutors had abilities to use a wide range of teaching approaches in a virtual classroom setting. An observation from the table is that 37.9% of the students strongly agreed or agreed that their e-tutors had abilities to use a wide range of teaching approaches in a virtual classroom setting meant for the design process. From this indication, there is a suggestion that the e-tutors were ill equipped with relevant teaching approaches to deliver the design process in an ODeL environment.

Table 4.9. The familiarity of e-tutors with students' common understandings and misconceptions about the design process

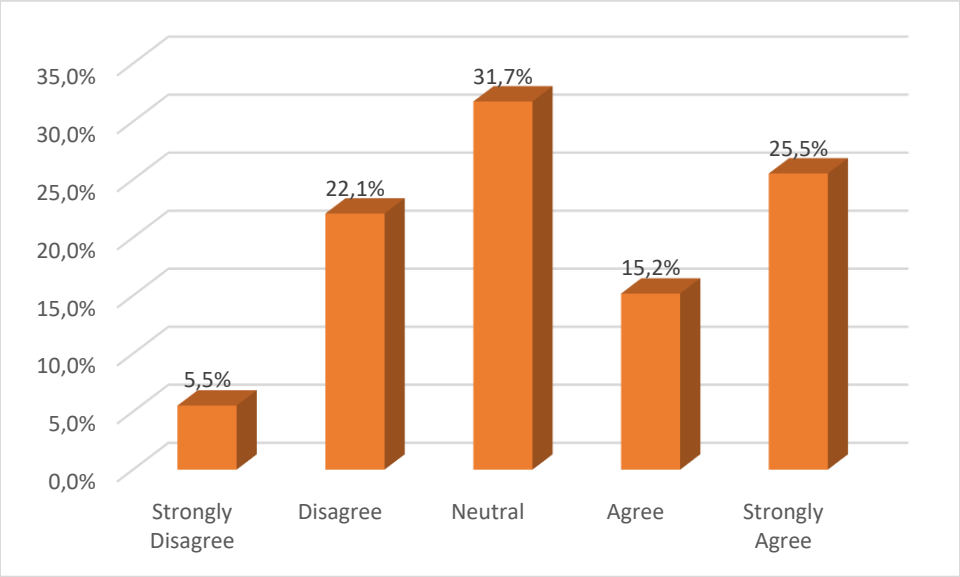

Table 4.9 shows the results in response to an item which was given to students to indicate whether their e-tutors were familiar with the common understandings and misconceptions about the design process. It may be observed from the table that 40.7% of the students strongly agreed or agreed about their e-tutors that they are not familiar about explaining common understandings and misconceptions about the design process. From this indication, there is a suggestion that e-tutors perform at less than average to misspell the misconceptions and to articulate common understandings about the design process especially in an ODeL context.

In the five tables on the descriptions about the pedagogical knowledge from the e-tutors, students provided an elaborate on each of the descriptions. The same descriptions were further needed from the students to locate what they believed as conceivable about their e-tutors' content knowledge of the design process. The section about the e-tutors' content knowledge domain within TPACK is presented in the next section.

4.2.1.3 Content Knowledge of the design process

This section relates to the eight question items which were asked to students regarding the influence of e-tutors content knowledge on effective teaching and learning of the design process.

Table 4.10 The knowledge of e-tutors to facilitate the design process content

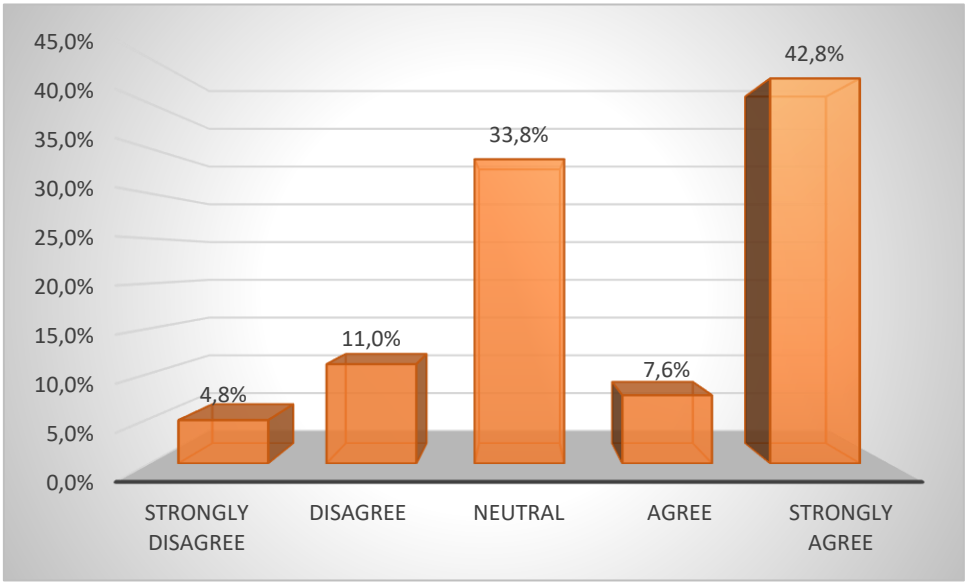

Table 4.10 shows the results in response to an item which was given to students to indicate whether their e-tutors had abilities to facilitate the design process content. In the light of the observations made from the table, it shows that 50.4% of the students strongly agreed or agreed about their e-tutors that they have abilities to facilitate the design process content. From this indication, there is a suggestion that e-tutors perform at an average in terms of their responsibilities towards engaging with the design process that benefit students in an ODeL setup.

Table 4.11 The knowledge of e-tutors to use digital media for the design process

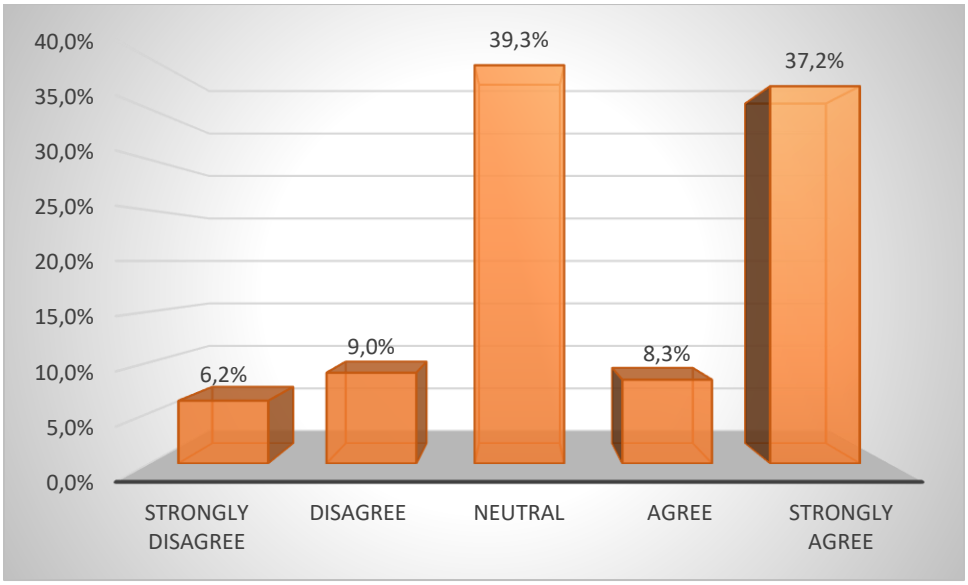

Table 4.11 shows the results in response to an item in which students were requested to indicate whether their e-tutors had abilities to utilise digital media to facilitate the design process content. It may be observed from the table that 45,5 of the students strongly agreed or agreed about their e-tutors use of the digital media to facilitate all the stages of the design process. This suggests that the e-tutors still lacked capacity to facilitate and teach the design process in an ODeL space.

Table 4.12 E-tutors planning knowledge about the sequential stages of the design process.

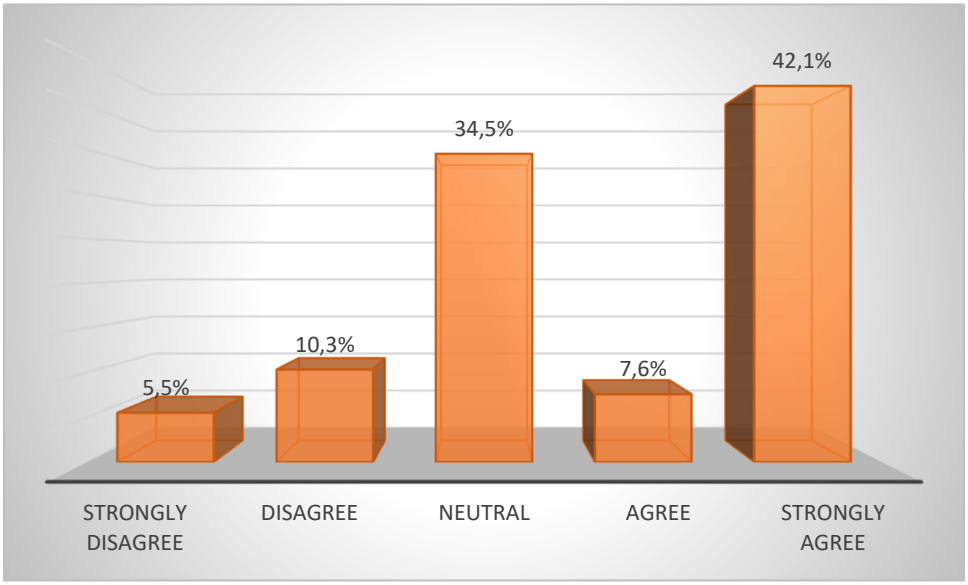

Table 4.12 indicates the results in response to an item that indicate whether e-tutors had abilities to plan the sequence of stages for the design process. It may be observed from the table that 49.7% of the students strongly agreed or agreed about their e-tutors' abilities to plan the sequence of stages for the design process. This indicates that e-tutors struggle on how to sequence the stages of the design process.

Table 4.13 E-tutors' knowledge about the students' conceptualisation of the first stage (investigation) of the design process.

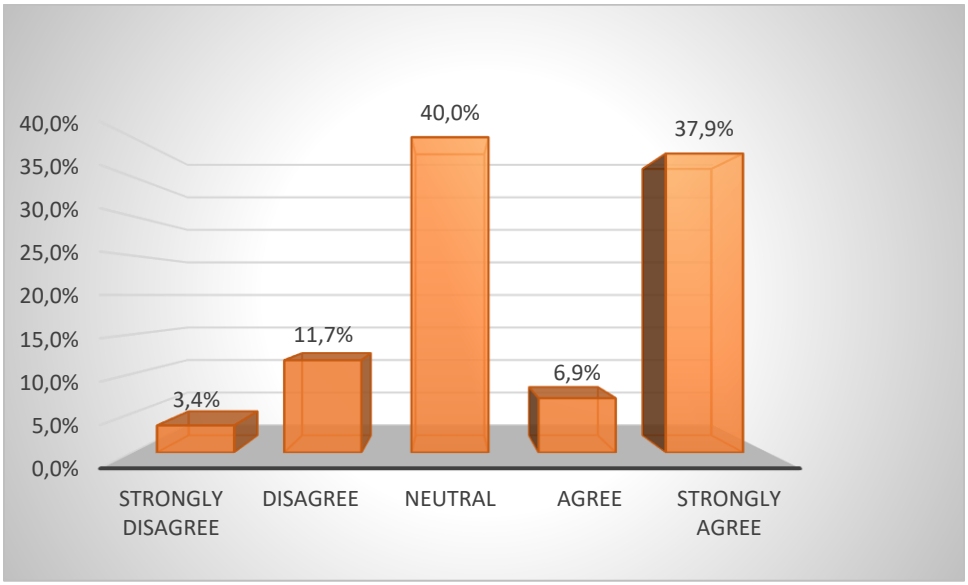

Table 4.13 indicates the results in response to an item which indicate whether e-tutors had abilities to help students to conceptualise the first stage (investigation) of the design process. It may be observed from the table that 44.8% of the students strongly agreed or agreed about their e-tutors' abilities to help them conceptualise the first stage of the design process. This indicates that the e-tutors lack abilities to help the students to conceptualise the first stage of the design process.

Table 4.14 E-tutors' knowledge of helping students to understand the second stage (design) of the design process.

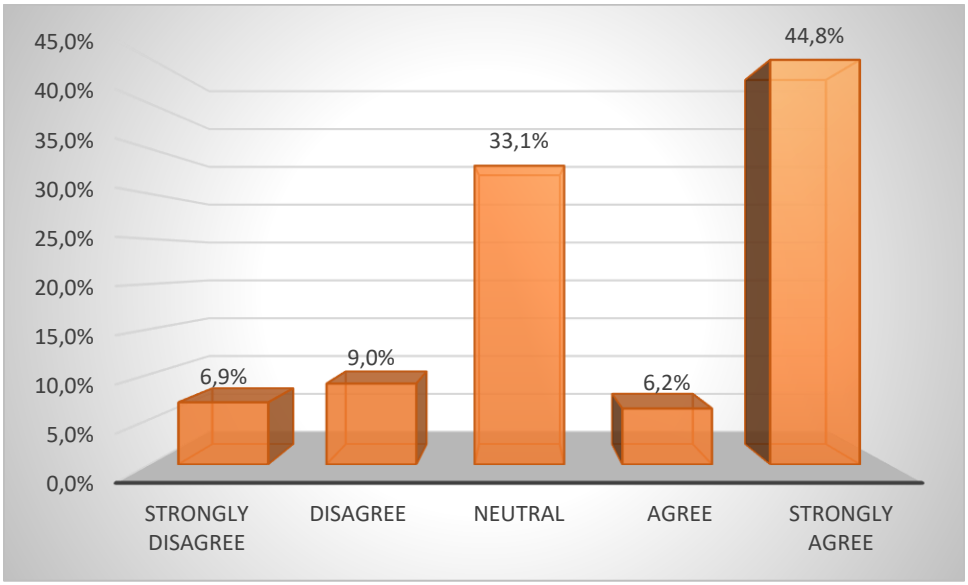

Table 4.14 indicates the results in response to an item which indicate whether e-tutors had abilities to help students understand the design stage of the design process. It may be observed from the table that 51% of the students strongly agreed or agreed about their e-tutors' abilities to help them understand the second stage of the design process. this suggests that some of the e-tutors help the students whereas others do not help them to conceptualise the second stage of the design process.

Table 4.15 E-tutors' knowledge on helping students to understand the third stage (make) of the design process

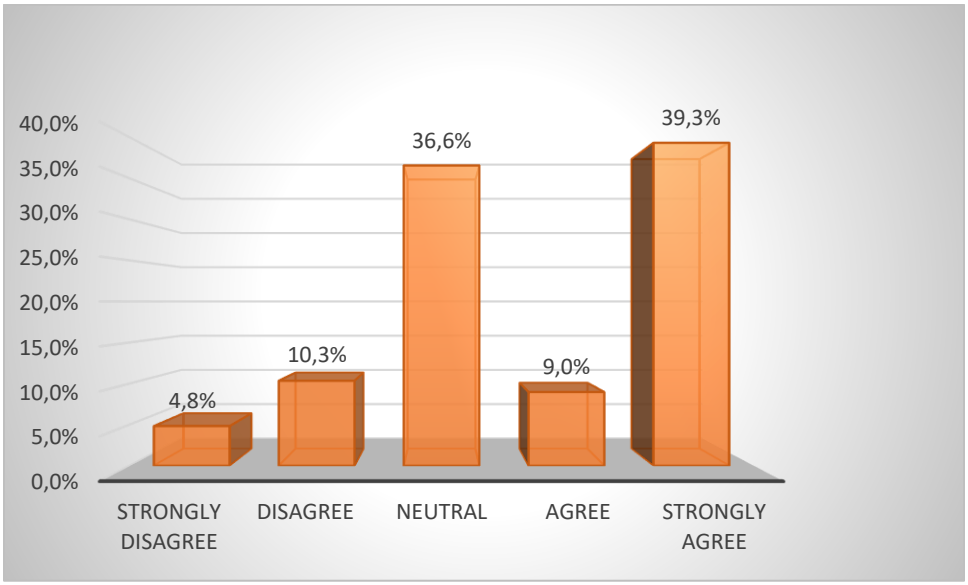

Table 4.15 indicates the results in response to an item which indicate whether e-tutors had abilities to help online students to understand the make stage of the design process. It may be observed from the table that 48.3% of the students strongly agreed or agreed about their e-tutors' abilities to help them understand the third stage of the design process. From this indication, the e-tutors are not able to help the online students to conceptualise the third stage of the design process.

Table 4.16 E-tutors' knowledge to help students to understand the fourth stage (evaluate) of the design process

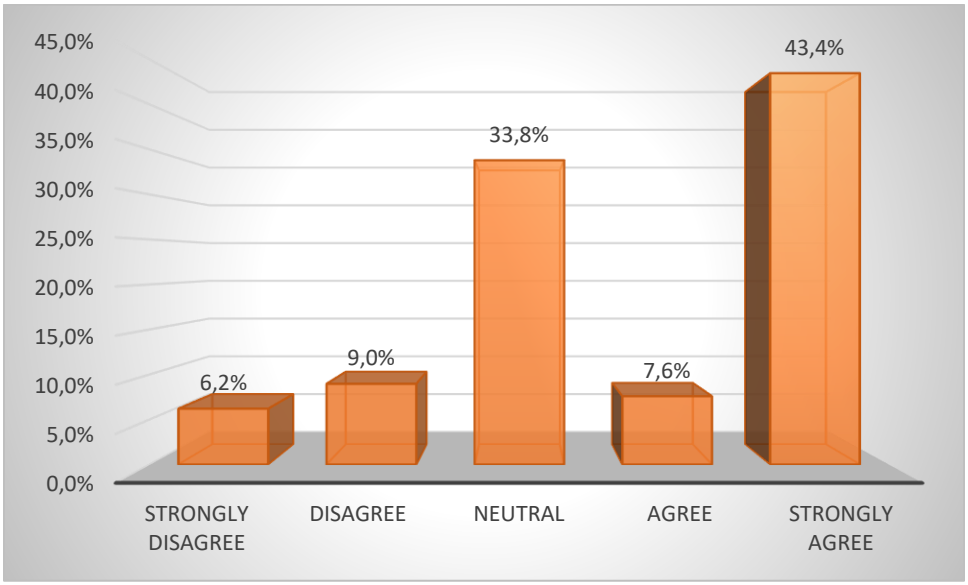

Table 4.16 indicates the results in response to an item which indicate whether e-tutors had abilities to help online students to understand the evaluate stage of the design process. It may be observed from the table that 51% of the students strongly agreed or agreed about their e-tutors' abilities to help online students to understand the fourth stage of the design process. This suggests that the e-tutors perform at an average in as far as helping the students to conceptualise the fourth stage of the design process.

Table 4.17 E-tutors' knowledge to help students to communicate and present best ideas in the final stage (communicate) of the design process

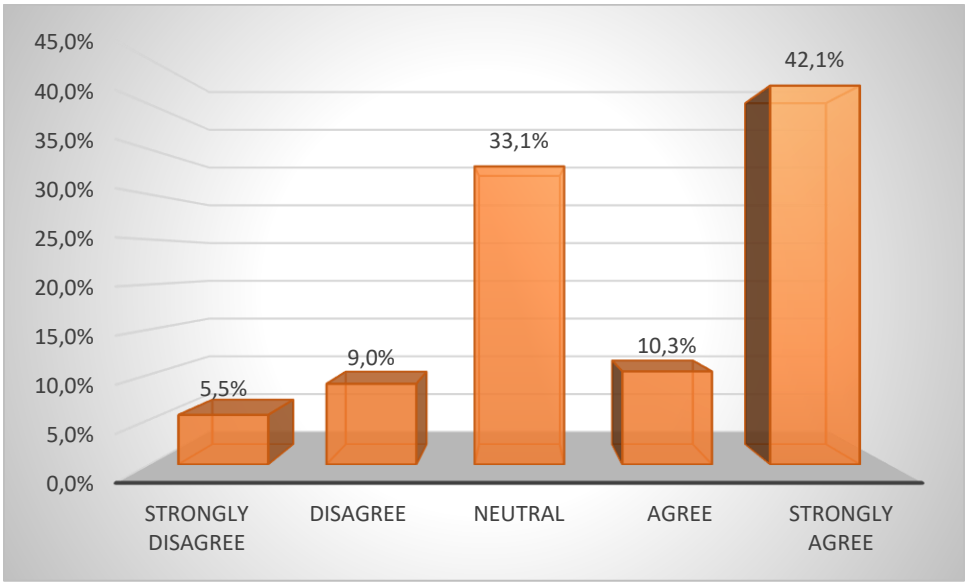

Table 4.17 indicates the results in response to an item which indicate whether e-tutors help online students to communicate and present best ideas in the communicate stage of the design process. It may be observed from the table that 52.4% of the students strongly agreed or agreed about their e-tutors' abilities to help online students to communicate and present best ideas in the final stage of the design process. This indicates that the e-tutors perform at an average in as far as helping the students to communicate and present best ideas in the final stage of the design process.

It can be noticed that a mention was made earlier in section (3.3.2) that two data sets (questionnaires and face to face interviews) were used to check the students' questionnaire responses with the face to face interviews from the e-tutors. These were supported by online observations which aimed to triangulate the results presented in this study. The results which are organised around the online observations were presented in the next Section.

4.2.2 Online observations

As discussed in the above section (see section 3.5.4) the observations were conducted online from the five e-tutor sites. For ethical reasons discussed in section 3.5.4, the code ETS was used to refer to e-tutor sites. These are captured in this section as ETS1 referring to the first e-tutor site and so forth. The following section provides the results of the nine constructs used to cover aspects relating to e-tutors' technological knowledge, pedagogical knowledge and content knowledge of teaching the design process in an ODeL context.

4.2.2.1 E-tutors Technological Knowledge of the design process

This section presents three items in relation to the research question regarding the extent to which the e-tutors have acquired technological knowledge for online content delivery.

Table 4.18: Abilities to use technologies for the design process content

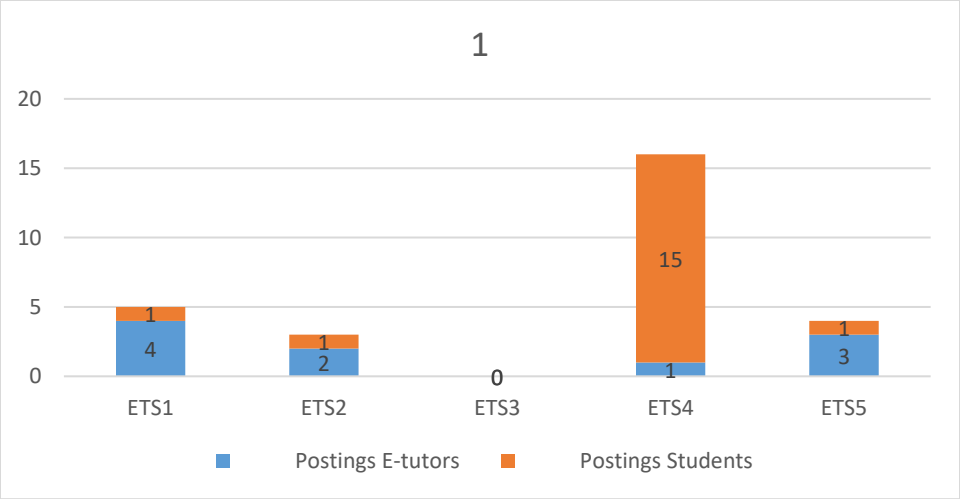

Table 5.18 indicates the results in response to an item developed to indicate whether e-tutors acquired knowledge of using technologies for the design process. The observations evidenced only four e-tutors (ETS1; ETS2; ETS3; and ETS5) postings for the students. There is a further indication of students' responses to the e-tutors. The highest number of e-tutors' postings (4) were evident in ETS1 followed by ETS5 with three postings. Similarly, the highest students' responses (15) to the e-tutor posting were observed in

ETS4. These results would suggest that e-tutors lack the abilities of using technology to support students learning of the design process content in the ODeL settings. An indication from the students' category of postings suggest that the e-tutors' knowledge of technologies is not transferred to students to make the teaching of the design process interesting. This is evident from ETS1; ETS2 and ETS5 with a single potential student posting.

Table 4.19 The ability to choose digital materials for the design process stages

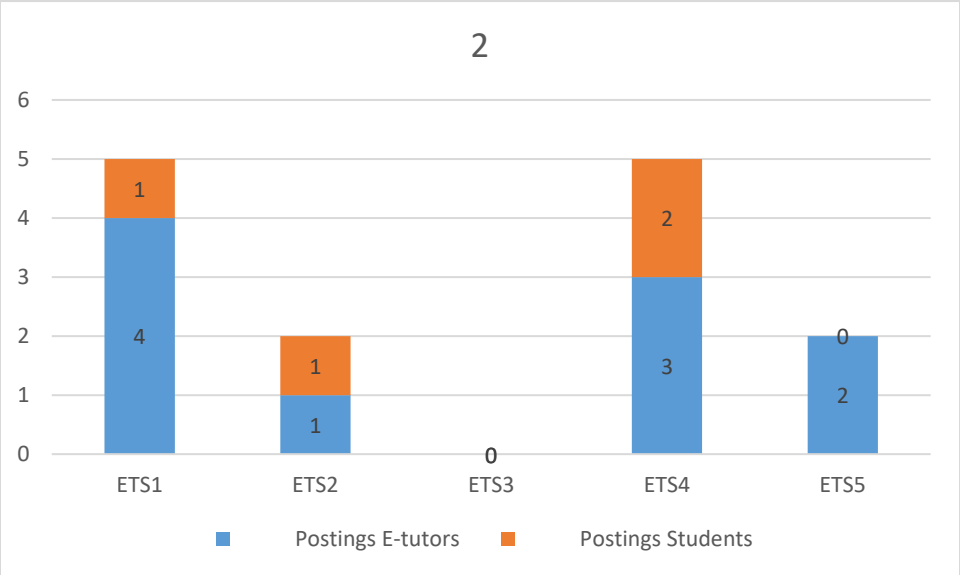

Table 4.19 indicates the results in response to an item developed to indicate whether e-tutors have acquired skills of choosing relevant digital materials for teaching the stages of design process. The observations evidenced only four e-tutors (ETS1; ETS2; ETS4; and ETS5) postings for the students in this regard. There was a further indication of students' response to the e-tutors. The highest number of e-tutors' postings (4) were evident in ETS1 followed by ETS4 with three postings. Similarly, the highest students' responses (2) to e-tutor posting were observed in ETS4. These results would suggest that e-tutors lack the skills of choosing digital materials for the stages of design process which is taught in the ODeL settings. It can be observed in terms of the students' responses that they minimally participate in the e-tutors' postings. For an example in ETS1, the e-tutor posted four times and only one student responded. This is an indication

that teaching is impossible in this way especially as it relates to the important digital skills necessary for the design process.

Table 4.20 The technological knowledge of online technologies for the design process content

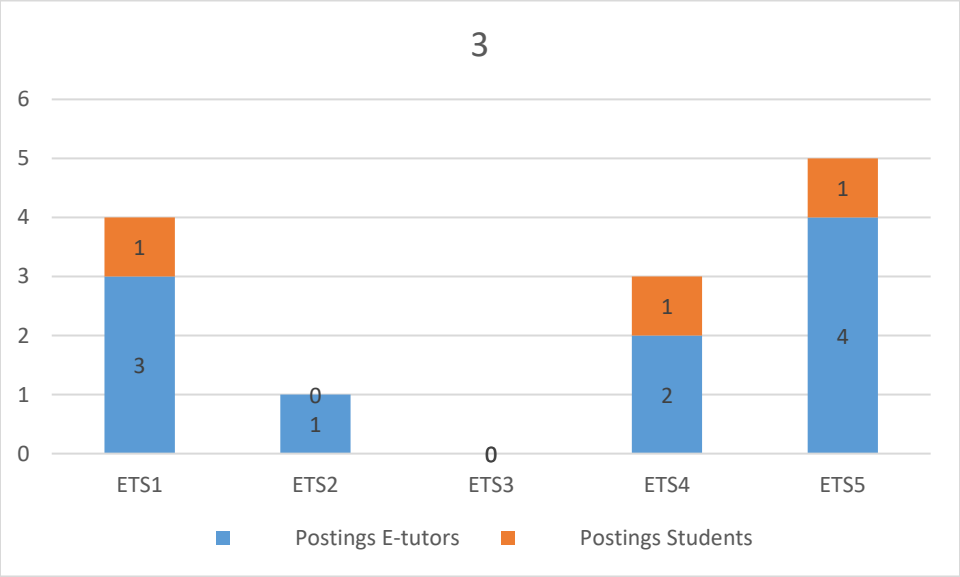

Table 4.20 indicates the results in response to an item developed to indicate whether e-tutors have acquired knowledge and skills for using online technologies for the delivery of the design process content. The observations evidenced only four e-tutors (ETS1; ETS2; ETS4; and ETS5) postings for the online students. There is a further indication of students' responses to the e-tutors. The highest number of e-tutors' postings (4) were evident in ETS5 followed by ETS1 with three postings. Similarly, one posting from students' responses was observed in the three sites (ETS1, ETS4 and ETS5). These results would suggest that e-tutors have not acquired skills for using online technologies for the delivery of the design process for TE content in the ODeL settings. Like the results based on the e-tutors, the students' results indicated that the e-tutors' knowledge of online technologies did not get their technological knowledge learning done which would replicate to their learning of the design process. In the light of the presentations based on the e-tutors' technological knowledge of the design process aspects, the next order required a presentation on the pedagogical content knowledge domain in the framework.

4.2.2.2 Pedagogical Knowledge of the design process

This section presents three observation items about the extent to which the e-tutors have acquired pedagogical knowledge and skills for the delivery of online content for the design process.

Table 4.21 Strategies to explain concepts for the stages of the design process

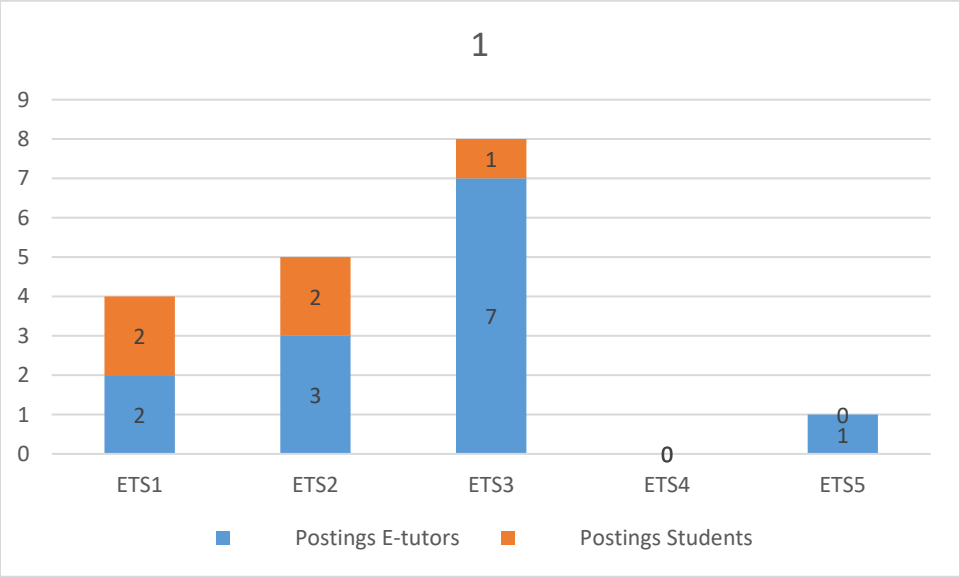

Table 4.21 indicates the results in response to an item developed to indicate whether e-tutors have acquired strategies to explain concepts for the different stages of the design process. The observations evidenced only four e-tutors (ETS1; ETS2; ETS4; and ETS5) postings for the students. There is a further indication of students' responses to the e-tutors. The highest number of e-tutor (seven) postings was evident in ETS3, followed by ETS2 with three postings. Similarly, an equal number (one posting) of online students' responses was observed in ETS1 and ETS2, respectively. The fact that less postings were observed from the e-tutor sites, suggests lack of varied skills that could enhance the explanation of concepts for the different stages of the design process. Inadequate skills in this regard impact negatively on the student participation; hence two postings were visible during the observations.

Table 4.22 Ability to adapt teaching styles to suit students' learning needs for the design process

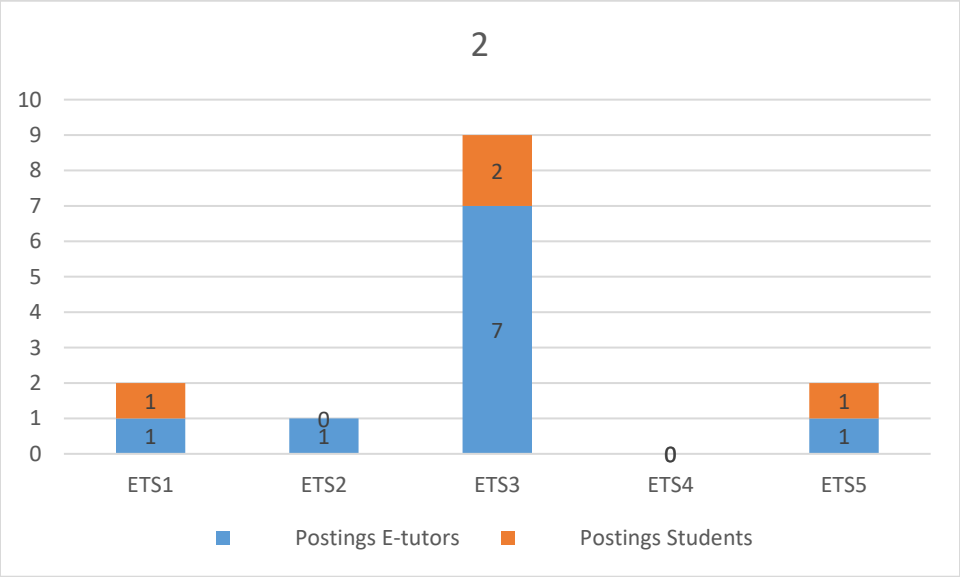

Table 4.22 indicates the results in response to an item developed to indicate whether e-tutors have acquired abilities to adapt their teaching styles to suit their students' learning needs of the design process in an ODeL environment. The observations evidenced only four e-tutors (ETS1; ETS2; ETS3; and ETS5) postings for the students. There is a further indication of students' responses to the e-tutors. The highest number (seven) of e-tutor postings was evident in ETS3. Similarly, an equal number of one posting from online students' responses was observed in ETS1 and ETS5, respectively. These results would suggest that e-tutors have not acquired abilities to adapt their teaching styles to suit students' learning needs of the design process in an ODeL environment. Along the same tone, the results from the students' postings are indicative of no potential fruitfulness of teaching styles to increase their participation towards their learning needs of the design process.

Table 4.23 Ability to use a wide range of online teaching strategies for the design process

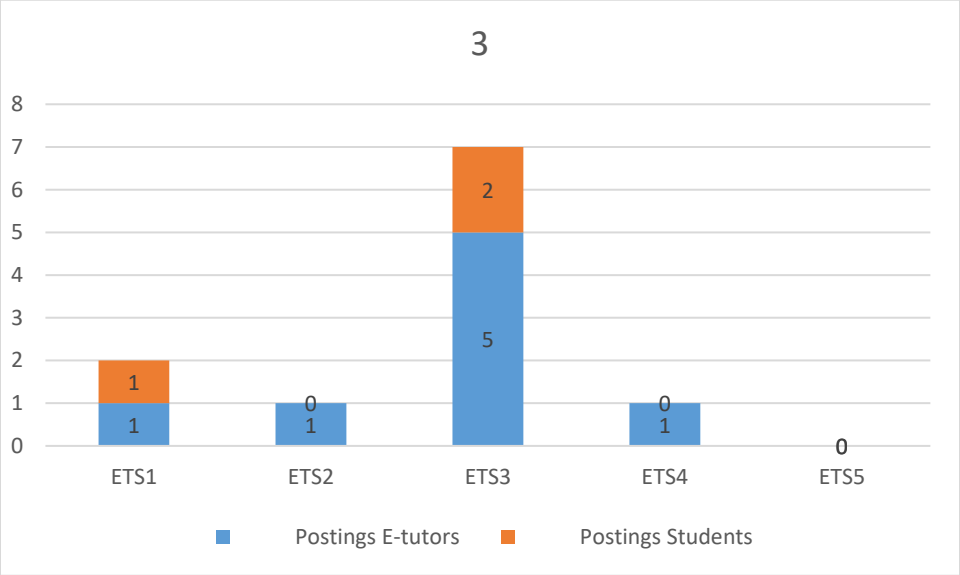

Table 4.23 indicates the results in response to an item developed to indicate whether e-tutors have acquired abilities to use a wide range of online teaching strategies for the design process. The observations evidenced only four e-tutors (ETS1; ETS2; ETS3; and ETS4) postings for the students. There is a further indication of students' responses to the e-tutors. The highest number of e-tutor postings was evident in ETS3 with five postings. Similarly, an equal number of online students' responses were observed in ETS1, ETS2 and ETS5 each with one posting. These results would suggest that e-tutors have not acquired abilities to use a wide range of online teaching strategies for the design process to suit the demands of students' learning needs. Like the results which suggested the lack of e-tutor abilities to use a wide range of online teaching strategies, there are equally congruent findings about the construct. It maybe suggested that students reported here that their e-tutors have not acquired abilities for a wide range of online strategies. The consequence of the results might mean that the e-tutors have minimal engagement with such strategies to further develop how to facilitate student engagement.

These perspectives based on the pedagogical knowledge from both the e-tutor sites and students shed some light as a result of the different constructs. Another category of content knowledge domain is next for discussion.

4.2.2.3 Content knowledge for teaching the design process

This section presents three items section in relation to the research question about the extent of how content knowledge influences e-tutoring skills during the online delivery of design process content.

Table 4.24 The ability to help students conceptualize the first stage of the design process

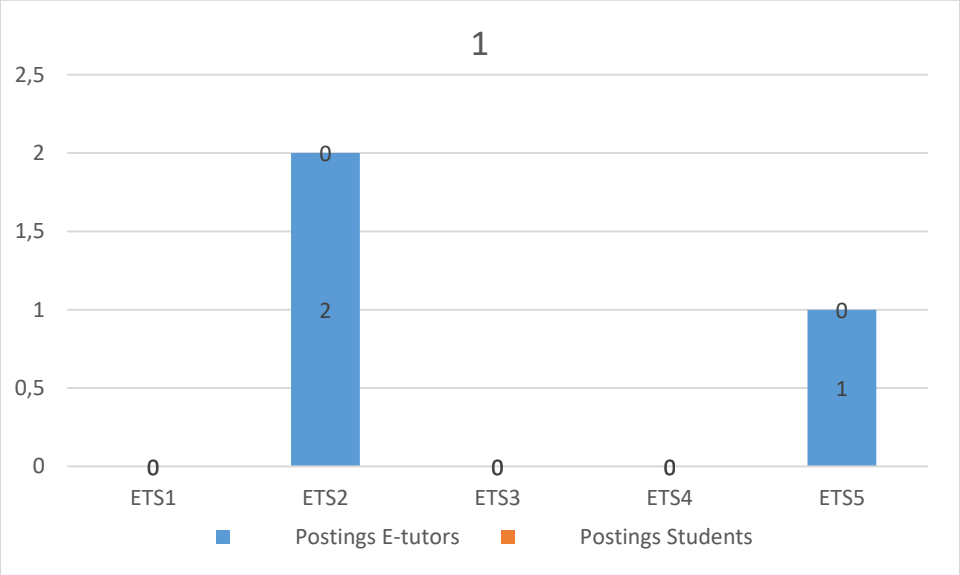

Table 4.24 indicates the results in response to an item developed to indicate whether e-tutors have acquired abilities to help students to conceptualise the first stage of the design process. The observations evidenced only two e-tutors (ETS2 and ETS5) postings for the students. The data revealed no postings in relation to students' responses to the two e-tutors. These results would suggest that e-tutors were not able to help the students conceptualize the first stage of the design process in an ODeL environment. At the same time, when interpreting the students' results, a visible claim was made about the students

that none of them participated towards all the postings. The failure of the students to respond to the postings might suggest a lack of understanding which might negatively impact on their conceptualisation of the investigation stage of the design process.

Table 4.25 Ability to help students understand the four stages of the design process

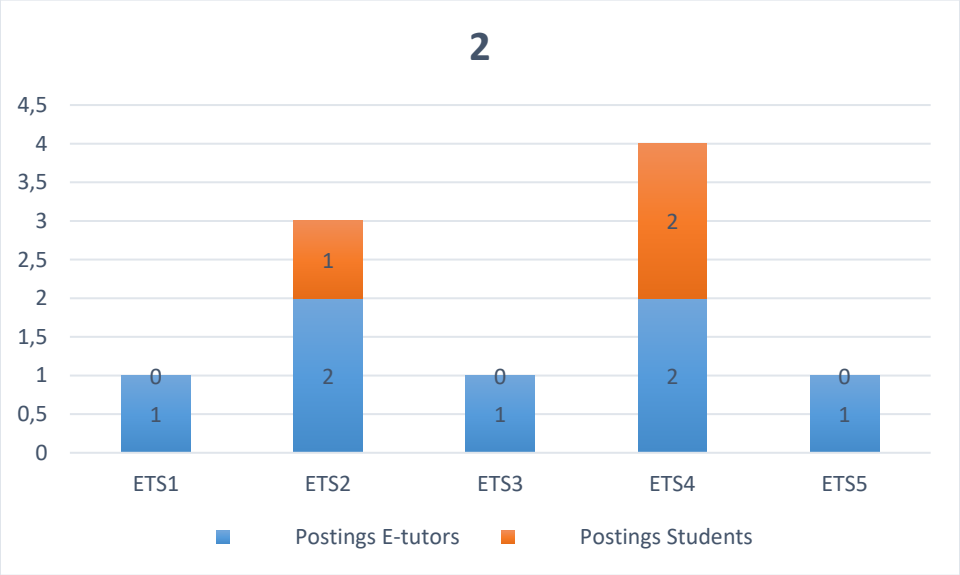

Table 4.25 indicates the results in response to an item developed to indicate whether e-tutors have acquired abilities to help students to understand all the stages of the design process. The observations evidenced all the e-tutors (ETS1; ETS2; ETS3; ETS4 and ETS5) postings for the students. The highest number of e-tutor postings was evident in ETS2 and ETS4 with two postings each. It is also evident that the highest number of online students' responses was from ETS4 with four postings. That said however, the results suggested a different picture about the students' responses towards their e-tutor postings. For an example, ideally students were expected to respond to these postings. However, three e-tutor postings (ETS1; ETS3 and ETS5) were not responded to. This is an indication that the students would not perform as expected in terms of all the stages of the design process.

Table 4.26 Ability to help students present ideas about their projects in the design process

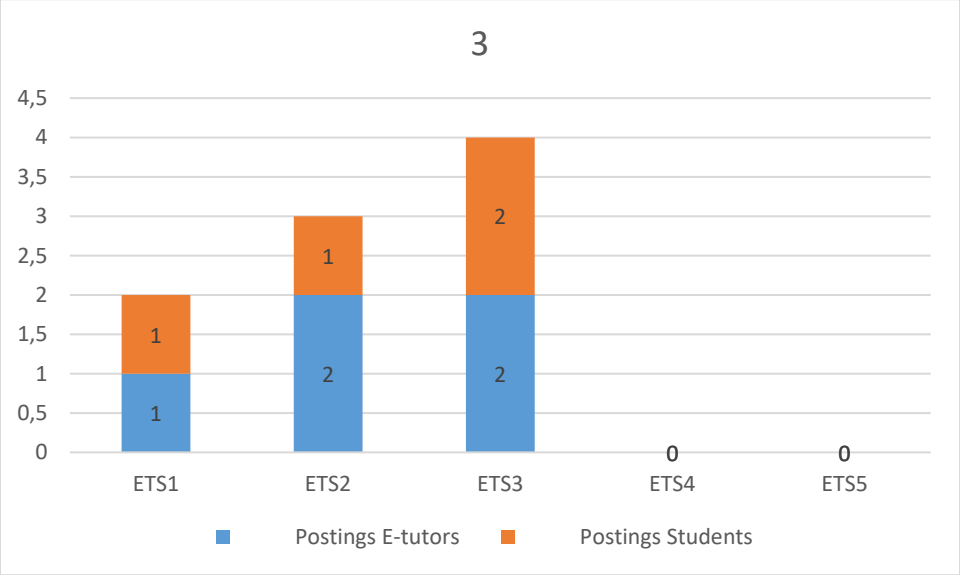

Table 4.26 indicates the results in response to an item developed to indicate whether e-tutors have acquired abilities to help students present best ideas about their final projects of the design process in virtual classrooms. Based on the observations, it was evident that three e-tutors (ETS1; ETS2 and ETS3) posted for the students. The highest number of e-tutor postings was evident in ETS2 and ETS3 with two postings each. It is also evident that the highest number of online students' responses was from ETS3 with two postings. However, these results were negated with what is observed in ETS4 and ETS5. Through this comparison, an evident conclusion is that students were not supported in order to present best ideas about their projects. Central to this comparison is that the students did not benefit from their engagements with such e-tutors.

The next section presents the qualitative findings of the study.

4.3 QUALITATIVE FINDINGS

This section presents the results from the qualitative results. The focus of the presentation was presentation was based on the semi structured interviews.

4.3.2 SEMI STRUCTURED INTERVIEWS

The objective of this Section is to present the findings of the data collected from the semi structured interviews conducted with five e-tutors. The five e-tutors were given identities of ET1-ET5 where ET1 means e-tutor 1 and so forth (see section 3.5.4). In terms of how this section is presented, it focused on each subsidiary research question (RQ) as well as the emerged themes.

The next sections discussed the findings in relation to the first question.

RQ1- *What is the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process in Technology Education?*

It is worth to note that two themes emerged under this research question. These themes are discussed in the next section.

Theme 1: E-tutors used online tools to deliver the design process content

In response to the question asked to e-tutors on the extent to which they have acquired the technological skills for online content delivery. The findings revealed that e-tutors could use technological tools available in the institution's Learning Management System (LMS). These tools include the *discussion forum, the announcements* and the *welcome page*. From the data, it is evident that all the five e-tutors (ET1; ET2; ET3; ET4 and ET5) categorically mentioned a tool which they prefer to use. It was found that the discussion forum and announcements were the main tools used in this regard. The participants indicated,

'*The discussion forum and announcements are the two recommended tools which I use'*(ET1).

'I prefer using announcements and the discussion forum' (ET3; ET4).

'*Discussion forum and welcome page are the tools I use' (*ET2; ET5).

This finding would suggest that the online tools which have been recommended for the e-tutors (discussion forum, the announcements as well as the welcome page) are the main tools used in the ODeL space. The choice of these tools appears to result from the initial e-tutor trainings provided by the institutions. It was noted from the data that the mentioned tools were recommended during their e-tutor training. This notion was further supported by participants as they state,

'During training, these were tools that were recommended, and I have no option but to use them' (ET4).

'*I was left with no other choice but to follow the rules from the university whereby the tools formed part of the recommended tools during training' (*ET5)*.*

This would suggest that e-tutors have no choice of selecting and using other tools but to use those that have been recommended by their trainers. The implication would be that the tools might only be superficially used by the e-tutors. This finding might suggest that the students are only introduced to online tools which do not benefit and support their learning.

It was mentioned by the e-tutors that the students also had their preferred tools. In this view, students indicated to the e-tutors their preferred tools that will assist them to engage more with fellow students. To illustrate more on this notion, the participants mentioned,

'Students always ask for cell phone numbers so that they could form WhatsApp groups… Outside the platform, they continue to use the WhatsApp to communicate about issues that relate to the module' (ET4)*.*

'The next thing you find students who participate asking for cell phone numbers so that they form WhatsApp group for the engagements with the module' (ET2).

This finding is an indication that the students prefer the integration of current technologies in their daily online learning activities.

The following comment from ET3 corroborates what ET4 and ET2 mentioned earlier.

'I always wonder why students prefer to use WhatsApp. Some do not participate in the myUnisa forum and decide to use the forum outside the one prescribed by the university'.

This finding might suggest that the e-tutors are only in compliance to the technological tools which they use to teach the design process content in an online platform. The idea of keeping themselves flexible and open to students' suggestions would reflect as though they operate online tools differently from the normal teaching practices tools.

Theme 2: The e-tutors' familiarity with the technology tools and their experience of teaching the design process

The participants were asked to rate how familiar they were with the technology tools. The data revealed that two participants were respectively at moderate (ET1 and ET5) and very familiar (ET2 and ET3) with the tools. This would suggest an acknowledgement of indirect an also an improved student learning from the use of such tools. As a result, e-tutors might assume that all students could and should participate. For an example, students' challenges to participation were not taken for granted:

'*I receive almost a general complaint from the students about access to the internet. One student remarked that access to the internet is very expensive and therefore they are not able to participate in the e-tutor discussions*'(ET5).

'*The different backgrounds contribute negatively to how the students participate online. Those who are situated in mostly rural areas have major problems of access to the internet because the internet is expensive and the students in the rural areas cannot afford it'* (ET1).

It seems the e-tutors acknowledged that students have difficulties to participate since participation is structured and students are aware what they need to do in order to participate.

The participants were further asked to respond to a question on their teaching experience of the design process in an ODeL environment. From the data which emerged, all the five

e-tutor participants categorically mentioned they have some form of experience of teaching online. For an example, ET4 taught over two years, ET1 over a period of one year, and ET3 a year full. Other participants (ET2 and ET5) had teaching experience of less than a year. It is apparent from the data that the participants have accumulated experience based on a certain period over a year. To attest to the idea of experience participants explained,

'I was able to rely on the experience of digital tools in order to teach the design process. I find YouTube videos and links which I attach for the students to access. The effectiveness of the technological tools is reflected in some of the students' questions about the content' (ET4).

'My prior experience of using technology became useful for me. I also use magna and google scholar for searching scholarly articles which I use for the teaching concepts of the stages of the design process for the students' (ET5).

The data suggest that the participants highly rate their experience as positive in the way they use and integrate different technologies to teach the design process. The next presentation focuses on the second subsidiary research question as well as the themes which emerged from the collected data.

RQ2: How did the e-tutors' acquired pedagogical knowledge influence the students' learning of design process?

It is worth to note that two themes emerged from the analysis of data under RQ2. These themes are discussed in the next section.

Theme 1: E-tutor qualifications influence the learning of the design process

The participants were requested to respond to a question on how their qualifications relate to their pedagogical knowledge. It was noticeable from the data that all the participants have formal qualifications in Technology Education. Four participants (ET2; ET3; ET4 and ET5) indicated that they have Honours degree within Technology Education specialization while, one participant (ET1) possesses a MEd degree in Science and Technology Education. It is evident that the e-tutors have aspired to become

knowledgeable in the design process skills. This would suggest that the e-tutors see qualifications as a positive influence on their pedagogical knowledge. To attest the idea of the influences of e-tutor qualifications positively influence their pedagogical knowledge, the following participants mentioned,

'This qualification helps me to think on my feet since I always try to attract as many online students as possible with creative activities' (ET3).

*'My MEd degree qualification is in Technology Education and it is assisting especially since there are different types of students that I tutor. This qualification helped me to grow by gaining a lot of confidence in order to deal with some of the students who need extra guidance with the teaching of online activities' (*ET1).

In terms of these responses, the data suggests that the participants are reliant on their qualifications to influence the pedagogical knowledge as to how they approach and teach the design process for the Technology Education curriculum in an ODeL context.

Theme 2: e-tutor training influences the teaching of the design process.

In response to the question about the training received prior to e-tutoring services, all the participants (ET1; ET2; ET3; ET4; and ET5) confirmed their training as e-tutors. To attest to the notion of training, the participants had the following to say,

*'My training perfected the activities that I post for the students and these activities are continuously revised as I gain a lot of experience from e-tutoring' (*ET3).

*'Since I became an e-tutor the training assisted especially since there are different types of students that I tutor. The training perfected my approaches of the frequent interactions with the students' (*ET1).

This implication suggests that all the e-tutors regard training as a positive influence on how they approach the teaching of the design process. Participants further responded to question probing on the influence of training on the teaching of the design process. It was found in this regard that three participants (ET2; ET4 and ET5) out of five believed that

their training had a positive influence towards the teaching of the design process. The following notions attest to their advances in relation to their training to become e-tutors:

*'The induction made a difference to how I approach the teaching of content knowledge. It means "I gained a lot of content knowledge and pedagogical knowledge for online teaching of the design process' (*ET4).

*'I rely on the training I received for e-tutoring. The training provided with the necessary skills for me to respond with approaches for different activities which are in line with teaching the design process online' (*ET5).

The e-tutors validate that they were appointed based on their ability to successfully complete the complex training requirements which were initially set before their appointments as e-tutors. The data might suggest that there is a positive influence concerning training the participants received. This notion is attested with the following responses from the participants:

'*With the training I received, I am able to develop approaches which benefitted some of the students. The training makes me to engage with the students at higher cognitive levels especially those who experience problems with the design process steps'* (ET4).

'From the time since I became an e-tutor, I was able to sharpen and use the training to benefit the students with how I approach my design process lessons' (ET1).

A suggestion from these findings is that the e-tutors value the initial training as positive and to benefit towards students learning.

The next section presents the third research question.

RQ3*: How did e-tutors' content knowledge influence effective teaching and learning of the design process?*

In this category, this section found three themes which emerged from the given research question. The first theme is underpinned as practical activities influence e-tutor content knowledge of the design process. In addition, the second theme was suggested as; problem solving influences e-tutors' content knowledge and the last theme as: content knowledge influences the teaching of the design process. The next presentation is based on the first theme in the research question 3.

Theme 1: Practical activities influence e-tutor content knowledge of the design process

The participants were asked to respond to a question which needed their understanding of the concept of design process. Two participants (ET1 and ET4) mentioned that they approached the design process as an activity. This finding suggests that the two respondents held a common understanding about how their knowledge of the design process content centered around their use of activities. This finding can also suggest that the respondents are using different activities of teaching which motivate online students to learn about the design process. Another suggestion from this finding is that the respondents were capacitated in order to achieve the outcomes for the lessons that they teach based on the design process to be an activity. In the light of the above, the following extracts from the participants capture the essence of this finding:

*'…… I have gradually managed on how to focus on activities that help the students to understand the design process for Technology and constantly improved on how I approach the activities for the process of online' (*ET1).

'…… I realise that I have become more creative with how I approach the activities for the design process. I mapped and aimed the activities for online teaching since it is a different environment from face to face teaching' (ET4).

These data suggest that the approach which was used by the e-tutors a to teach the design process as an activity and as practical. It is also apparent from the data that both

ET2 and ET5 regard the design process as a practical activity. Their response conveys an element of change from participants who are willing to adapt their technological knowledge to inform the selection of technology tools to make practical lessons for their online students. The following responses affirm the notion expressed:

'It is important to make design process as practical work with gadgets that make models. It is also possible to video tape the practical work and submit that as a form of evidence since this is important to show that the student was active during the making of the model' (ET2).

'This process is important to show that the student was involved and part of the team during the making of the model. Therefore, the activities in this stage can be best improved by making practical work compulsory for all the students' (ET5).

This data might suggest that both the respondents have developed content knowledge which allows the participants to make suitable content knowledge choices in order to make their virtual classrooms as practical as possible with activities.

Theme 2: Problem solving influences e-tutors' content knowledge.

In answering the question on understanding the design process, two participants (ETS1 and ETS3) understood design process as problem solving. This finding suggests that the two participants were well trained with high cognitive skills which bring the correct pedagogic nature envisaged within the TE curriculum. The data might indicate that the participants have beliefs which expand their problem-solving skills for the online lessons. These skills would ripple on the students' problem-solving activities. The notion was best captured in the following extracts:

'At first, there were some difficult steps that I experienced because of the students struggled with how I approached the design process. I then came up with ways of solving problems. From then on the students started to respond positively with how they understood the design process based on different problems they were exposed to' (ET1).

*'It is very difficult to explain the procedural steps online for the students. I create additional problem-solving activities for the students. For an example, a digital mind map that shows the steps for the design process. The students respond with their steps and the steps where they put words in a particular order to explain a certain step of the design process' (*ET3)

This data might suggest that the participants are influenced to solving online activities that involve complex problems for their students. This might result from the knowledge gained in problem solving approaches for teaching the design process.

It was also found that ETS1 was oriented towards using both practical activities and problem solving to teach the design process. This finding suggests that the participant might have an advanced content knowledge which influences how the participant approach online activities suitable for the design process.

Theme 3: Content knowledge influences the teaching of the design process

In response to a question on how participants understood the design process, the participants (ET1; ET2; ET3 and ET4) regarded knowledge as an important strand for better online activities. The data might indicate that the participants' construction of knowledge is geared towards the first stage of the design process. This finding suggests that the participants in this regard made thorough preparations in to offer lessons relevant for the first stage of the design process. The following extracts sum some of the responses:

*'I start with the first stage of investigation for about three weeks until I am convinced that at least some students respond positively to my postings about the stage. The way I approach this stage is to become a good listener to different students' problems. In this way each student progresses at their own pace to gain knowledge for the other design process stages' (*ET1):

'I was initially disillusioned about the performances of the students in the first stage of the design process. I realized that the students did not understand anything about the stage. I started to provide more creative scenarios which explained and responded to a strand I wanted the students to focus at. Based on the scenario I created for the students, they were able to understand and conceptualize the first stage of the design process' (ET3).

This data suggest that the respondents have a positive approach towards using knowledge to teach the activities for the design process for their online students.

This kind of practice that the content knowledge influences the teaching of the design process also described as having input into learning which took place from working drawings. In this category, working drawings influence the teaching of how the design process unfolds during teaching. This finding suggests that the participants seem to be driven by expertise towards the difficult stage within the design process. The optimistic participants' responses indicated the following:

'Most of the students are not able to present and produce relevant working drawings. I find online activities based on the first stage of the design process and give to the students to attempt' (ET4).

'The most difficult section of the design process is the drawings section. In this section students must draw diagrams which are the most difficult for the students to grasp. The students only draw the 2-dimensional diagrams and are not able to draw 3 dimensional diagrams. I show them how to draw both 2d and 3d diagrams since they are important in order to show how a diagram was first developed' (ET2).

It is suggested here that the e-tutors were rethinking how to teach and how to facilitate working diagrams to students. This suggests that the e-tutors were able to relinquish their roles as experts but working with students to achieve the set goals of the curriculum.

The next section presents the conclusion of the study.

4.4 CONCLUSION

The chapter presented the findings of the study. Three sections were used to present the study's findings based on the types of data sources employed. In the first place, the presentation focused on the questionnaires conducted with the students registered for two modules within the Technology Education discipline. The second presentation entailed the online observations which were obtained from the online postings and responses between the e-tutors and the students. The final section of presentation involved the semi structured interviews which were conducted with the e-tutors. The next Chapter focuses on the discussion of the results, conclusion and recommendations of the study.

CHAPTER 5

DISCUSSIONS OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The focus of this chapter is on three main corner stones of the study: the discussions of the main findings, followed by the conclusions and the recommendations for further research. The process for presenting the discussions involve firstly providing a context which was a recap of the intended study and what the actual findings were. Secondly, the findings are then located within the Technology Education body of knowledge through comparisons and associations of the current findings with those stated in literature.

5.2 SUMMARY OF STUDY CHAPTERS

This section is a presentation of all the chapters for this study.

Chapter 1 served as a road map which guided this research project. Within the roadmap, the description of the background and the context of the study were alluded to. The presentation also covered the main and the subsidiary research questions, the purpose of the study, objectives of the study, the research design and methods. In addition, the significance of the study including the ethical issue which concerned the study was discussed. A tail end covered the definition of terms and the study's plan was focused on.

Chapter 2 the main focal point was the design process as problem solving as well as procedural steps. Furthermore, the chapter examined literature pertaining to e-tutoring with special reference to the roles and competencies of the e-tutors. These roles were coupled with e-Learning in Distance Education. Having discussed previously that the study addresses the phenomenon of student support in ODeL, this chapter shed some light on how student support takes place in an ODeL context. The last sections of the chapter described the theoretical lenses that guided the study. These were mainly theories and models of teaching in an online space.

Chapter 3

This chapter of the study started with the research design and methods. The study philosophy and the research methodology were next in discussion. Within the research methodology, mixed methodology paradigm, triangulation design and the sequential explanatory design were discussed. The next discussion focused on the population and the sampling techniques. The section on data collection focused on the designing of the questionnaire and piloting the draft of final questionnaire. The next focus became designing of the individual semi-structured face to face interviews for the study. Furthermore, concepts of validity, external validity, face validity, content validity and reliability were discussed. The next focus was on a section about designing for the online questionnaire.

In terms of the data analysis, three analyses were observed. Those of analyzing the quantitative data (questionnaires), analysis of quantitative data (online observations) and the analyzing of the qualitative data (face to face interviews). The next section for discussion was the ethical considerations which focused on the following variables: harm to participants informed consent, anonymity and confidentiality. The section preceding the summary section was based on explaining the position of the researcher. The next chapter dealt with chapter 4 was the analyses of the study's results.

Chapter 4

This chapter presented the analyses and results of both the quantitative and the qualitative data. The first presentation was on students' quantitative data results. The analysis focused on the e-tutors' TK of the design process. The results were presented in four item questions in relation to the RQ1 of the study. The next analysis focused on the PK of Technology Education design process of the students. In this section four question items were asked to students regarding their views on the influence of the learning of the design process by e-tutors acquired pedagogical knowledge. Furthermore, the CK of the

design process for Technology Education content were presented. This section related to the nine question items asked to students regarding the influence of e-tutors content knowledge on effective teaching and learning of the design process.

The next section of results which were analysed were the results from the online observations for the e-tutors' TK of the design process. This section was presented in three items based on the research question regarding the extent to which the e-tutors have acquired technological skills for online content delivery. The online PK skills for e-tutors of the design process in an online environment were also analysed. This section's results were presented in three observation items regarding the extent to which the e-tutors have acquired pedagogical knowledge skills for the delivery of online content for the design process.

An analysis on the semi-structured interviews was also presented. This was based on three RQ's. RQ1- *To what extend does the relationship between the e-tutors' technological, pedagogical, content knowledge influence the teaching of the design process in Technology Education?*

From the RQ1, three themes emerged of theme 1: E-tutors used online tools to deliver the design process content; theme 2: the e-tutors familiarised themselves with the technology tools and theme 3: the e-tutors' experience of teaching the design process.

The RQ2 was based on: how do the e-tutors' acquired pedagogical knowledge influence the students' learning of design process? Two themes emerged during the analysis of data. Theme 1: e-tutor qualifications influence the teaching of the design process and theme 2: e-tutor training influences the teaching of the design process.

The RQ3 focused on: How do e-tutors' content knowledge influence effective teaching and learning of the design process? From the *RQ3,* there were three themes which emerged from the given research question. These themes were practical activities that influence e-tutors' content knowledge of the design process, problem solving influences e-tutors' content knowledge and content knowledge influences the teaching of the design process. The chapter ended with a conclusion.

Chapter 5:

Chapter 5 concludes this study on ‘a case study of competencies for technology education e-tutors in construction of design process at an Open and Distance e-Learning institution’. The structure is constituted by components of, the introduction fore worded by the summary of study chapters, discussion of the results with the specific focus on the research objectives 1-3. The section was specific with a focus on e-tutors’ technological knowledge, e-tutors’ pedagogical knowledge of the design process and the e-tutors’ content knowledge of the design process. The study’s limitations were closely focused with the study’s recommendations closely aligned in discussion with the recommendations. The reflection and the conclusion of the study were last a focus in this study.

5.3 DISCUSSIONS OF RESULTS

Earlier in section 3.4.1 triangulation design, the purpose of triangulation design was mentioned to be the use more than one method or source of data in the study of a social phenomenon so that findings may be cross checked. In this section of the study, triangulation was used as an instrument to facilitate veracity of data. This means, as a researcher, I formulated that it is possible that data might also be triangulated. This formulation created a possibility for a methodological triangulation which was preferred earlier and discussed in (section 3.4). therefore, there was some form of data convergence taken from a variety of sources from data collection. In this study, data was obtained from the online surveys, the online observations together with the semi structured interviews.

The following research objectives as indicated in section 1.5 were pursued:

- To explore the e–tutors’ acquisition of the technological skills for online content delivery.
- To establish the influence of the e-tutors’ pedagogical knowledge on students’ learning of design process.

- To determine the influence of the e-tutors' content knowledge on effective teaching and learning of design process.

Research Objective 1: To explore the e–tutors' acquisition of the technological skills for online content delivery.

5.3.1 E-tutors' technological knowledge of the design process

This section of the study constantly revealed positive findings from three constructs out of the four about the e-tutors' technological knowledge. The study revealed that e-tutors could use digital materials that map stages of the design process for the Technology Education content in the ODeL context. Furthermore, the study established that e-tutors had knowledge of technologies which benefit studies in an ODeL space. Also, there was an exposition that e-tutors were able to implement the design process lessons for Technology Education in the ODeL context.

These results were supported by the findings from the interviews which revealed that e-tutors rely on the focused initial training of digital tools in order to teach the design process. This finding is in line with training on the components of TPACK that are associated with technological knowledge. The technological knowledge component makes e-tutors to feel efficient and this finding is in relation, Mishra and Koehler (2006) opinions that this type of knowledge has the potential to change the nature of classrooms in ODeL spaces. The results also are in line with how dialogue is increased so as to reduce the transactional distance (Jung 2001; Cheng & Willits 1999; Moore 1993).

In this case it means the e-tutors were able to optimise interaction between learner and instructor. In line with Goerge Siemens' cognitive connectivist, the study findings are congruent to the idea of Lombard & Ditton (1997) that networks interactions enrich the connective cognitive presence and the perceptual interactions between students online. Literature (Wayne, Yoon, Zhu, Cronen & Garet 2008; Ingarson, Meiers & Beavis 2005; Guskey 2000) highlighted the positive value of technological knowledge for online activities as a result of initial e-tutor training.

However, the postings of both the e-tutors and the students from the online observations contrasted the above results. A set of results revealed that e-tutors lack the skills of choosing digital materials for the stages of design process which is taught in the ODeL settings. Another multiple for the study revealed that students' e-tutors could not provide sufficient opportunities to work with different technologies in an ODeL context. Furthermore, the study showed the e-tutors' knowledge of technologies is seen not to be transferred to the students to make the teaching of the design process interesting. In addition, it was further publicised that e-tutors have not acquired skills for using online technologies towards the delivery of the design process for Technology Education content in the ODeL settings. The fact that the technological knowledge is at its lowest from these sets of results, it means that the students cannot rely on the e-tutors' technological instructional knowledge in order to close their communication gaps. This finding is in relation to (Moore 1991; 1973) transactional ideas about communication gaps. Furthermore, the idea that the technological knowledge of the e-tutors is at its lowest speaks to the notion of teacher presence which in this case showed that there was no form of any support and sustained communication on the Web. This finding is in relation to Kop (2011) inkling that such students would not become independent users of Webs. Furthermore, within the TPACK framework, it is also evident that the e-tutors' still lack the knowledge and important technological skills for the design process. This way of thinking is in line with (Harris, Mishra & Koehler 2009; Koehler & Mishra 2008; Harris 2008) that this type of knowledge within TPACK is developmental and needs to be generated and adapted over time through interactions and experiences. Literature supported the study's finding (Klimova & Poulova 2010; McPherson & Nunes, 2004; Merisotis & Phipps, 1999; Rogers 1951) regarding the influence of technological knowledge on student support. Klimova and Poulova (2010) exposed that the ability and knowledge to use multimedia technologies is an indispensable part of optimising student support and interaction for online students.

The next presentation focused on the Research Objective 2 of the study.

Research Objective 2: To establish the influence of the e-tutors' pedagogical knowledge on students' learning of design process.

5.3.2 E-tutors' pedagogical knowledge of the design process

Based on the five items which were developed for this section of the study, the results are fewer positive results based on the pedagogical knowledge within TPACK framework. From the study, it was revealed that e-tutors were ill equipped with relevant teaching approaches to deliver the design process in an ODeL environment.

Further results from the study revealed that e-tutors perform at less than average to dispel the misconceptions and to articulate common understandings about the design process especially in an ODeL context. At the same time, the study further showed that there is no creativity from the e-tutors in terms of assessing the cognitive aspect of the design process in an ODeL environment.

The above postings of both the e-tutors and the students' responses were mirrored against the online observations for the study. The study revelations were corroborated by less positive results towards the study. The first study results cohort publicised that e-tutors have not acquired abilities to use a wide range of online teaching strategies for the design process to suit the demands of students' learning needs. Secondly, it was revealed in the study that e-tutors lack some of the varied skills that could enhance the explanation of concepts for the different stages of the design process. Furthermore, the study revealed that e-tutors do not understand the teaching of the core content of the design process. The focus of these study results was based on the TPACK framework's e-tutors' pedagogical knowledge component. The results evidenced that the e-tutors lacked the pedagogical knowledge for the design process. In line with the results, the results agree with connectivism of social presence and learner autonomy (Moore 2013; Dron 2006) that the lack of pedagogical knowledge hinders learners who might become autonomous as a result of the teaching approaches which they were introduced to. Similarly, within TPACK framework the results indicated that the pedagogical knowledge of the e-tutors cannot handle the requirements for teaching the design process. The line of thought is

supported by Heitink et al (2017) that the knowledge of such pedagogical strategies which e-tutors have employed to implement the design process must reflect in their teaching strategies so as to make them to become professional. Studies (Howard-Jones 2002; Turnbull 2002; Hill & Anning 2001; Murphy & Hennessy 2001; Atkinson 2000) were in line with the findings about the pedagogical approaches of the e-tutors. Howard-Jones (2002) established that the strategies employed by teachers provided challenges since they were not able to support why such strategies and learning styles were used for their students in classes. Various learning styles and strategies are used to teach the design process. The next presentation focused on the Research Objective 3 of the study.

Research Objective 3: To determine the influence of the e-tutors' content knowledge on effective teaching and learning of design process.

5.3.3 E-tutors' content knowledge of the design process

The final study results for this section were based on the e-tutors' content knowledge within the TPACK framework. Some positive results were revealed for the study. Firstly, the study revealed that some of the e-tutors perform at an average in as far as helping the students to conceptualise the fourth stage of the design process. In addition, the study revealed that e-tutors perform at an average in as far as helping the students to communicate and present best ideas in the final (communicate) stage of the design process. Furthermore, the study revealed e-tutors perform at an average in terms of their responsibilities towards engaging with the design process that benefit students in an ODeL setup. The results in this section of the study revealed average levels of the technological knowledge. The results have an impact on the TPACK domain of content knowledge since the e-tutors might not engage with the complex application of the design process with the results. The impact of the results reflected Kop's (2011) idea of an average particular level of depth performance in the educational process of the design process for cognitive presence in connectivism theory. In addition, the TPACK domain of content knowledge framework, the study revealed moderate engagement of e-tutors'

content knowledge with the design process. Literature (Chang et al 2016) idea of moderate content knowledge claimed that it is important to understand especially when one manages technologies in the continuously changing technologies.

On a less positive aspect, the study at first showed that e-tutors still lacked capacity to facilitate and teach the design process in an ODeL space. Furthermore, the study also proved that e-tutors struggled with how to sequence the stages of the design process. In addition, the study substantiated that e-tutors lacked abilities to help students to conceptualise the first stage of the design process. At the same time, the study further confirmed that e-tutors were not able to help the online students to conceptualise the third stage of the design process. The final exposure of the study was that some of the e-tutors do not help students to conceptualise the second stage of the design process.

The study's results which were presented based on fewer positive aspects were corroborated by the results from the online observations. These were obtained from the postings from the e-tutors and the students' responses. The study substantiated that e-tutors were not able to help the students conceptualise the first stage of the design process in an ODeL environment. Moreover, the study also revealed that the students would not perform as expected in terms of all the stages of the design process. In addition, the study revealed that students were not supported in order to present best ideas about their projects. The results in this construct reveal a human challenge of lack of content knowledge within TPACK domain. Studies in line with an absence of content knowledge (Chang, Hsu & Ciou 2016; Lumat 2015; Mishra & Koehler 2006; Shulman 1986) built some common ideas on content knowledge. Mishra and Koehler (2006) expressed that an e-tutor must know and understand the subject that they teach about the central facts, concepts and procedures within a field. In line with Mishra and Koehler (2006), Shulman (1986) cautioned that e-tutors have special responsibilities in relation to content knowledge as they serve as the primary source of student understanding of the subject matter. Shulman (1986) corroborates Moore (2013) on the idea of learner autonomy in transactional distance theory that it is a crucial characteristic of student engagement for their content knowledge learning since it naturally reduces their experiences of distance. In light of teacher presence in connectivist pedagogy, the results have not achieved the

idea Reeve (2015) to a high level of presence that enhances the depth of learning of the students online. Literature (Atkinson 2012; 2011; 2009; Lawler, McTaminey, de-Brett & Lord 2012; Ellis, Steed & Applebee 2006) is in line with the above results. Atkinson's (2012) line of thinking confirmed the idea that the design step experience of teachers directed to entrenched misconceptions. Atkinson's (2012) study is corroborated in Ellis et al (2006) that misconceptions dominate the university e-tutors' approaches to the teaching of the content knowledge of the design process.

5.4 STUDY LIMITATIONS

The study took place in an ODeL university with more than 30000 students worldwide. Out of this total, the sample of the students used for the questionnaire was a limitation in this study whereby only 145 students were used as respondents. The second limitation related to only five e-tutors who were interviewed out of the total of those who were active as e-tutors in the university.

The ODeL institution offers its qualifications through seven colleges and institutions but this study was conducted in one college of which this resulted as a third limitation.

The fourth and final limitation was that this study was realised in only one department and that it involved only two modules.

Despite the limitations given in this study, there is no suggestion that the authority of the study is invaluable. Therefore, there is a need to take these limitations into account in an effort not to generalise the results but for the results to be transferable into other studies.

5.5 RECOMMENDATIONS

The following recommendations are proposed following the results which emerged from the data which were collected and analysed from the use of three instruments.

The following was observed in terms of the results which were obtained based on the technological knowledge from the e-tutors. The results (see section on table 4.1) showed

that less than 50% of students believe that their e-tutors could not provide students with sufficient opportunities to work with different technologies in an ODeL context.

Another set of results (see section on Table 4.19) showed the results which indicated that the e-tutors lack the skills of choosing digital materials for the stages of design process which is taught in the ODeL settings.

Furthermore, some results (see section on Table 4.20) suggested that e-tutors have not acquired skills for using online technologies for the delivery of the design process for Technology Education content in an ODeL space. It is noted from the submission of the results that the focus is on the lack of the ability to choose digital materials, non-acquisition of skills for online technologies and also the lack of provision for opportunities to work with different technologies from the e-tutors. In the light of the above, it is recommended that the training of e-tutors should be focused on the technological knowledge aspect in order to create purposeful learning of the design process particularly in an ODeL environment.

There were some results which revealed fewer positive results based on the pedagogical knowledge by the e-tutors. From this section, there was an indication (see section on table 4.8) that the e-tutors were ill equipped with relevant teaching approaches to deliver the design process in an ODeL environment.

In addition, there were also results (see section on Table 4.21) to the fact that less postings were observed from the e-tutor sites which indicated a lack of varied skills that could enhance the explanation of concepts for the different stages of the design process.

Finally, another set of results (see section on Table 4.22) revealed that e-tutors have not acquired abilities to adapt their teaching styles to suit students' learning needs of the design process in an ODeL environment. To sum up, the results informed about ill equipped e-tutors for relevant teaching approaches, a lack of varied skills for teaching the design process and e-tutors who possessed no abilities to adapt their teaching styles to suit students' learning needs. Based on the results obtained, it is endorsed that it be ascertained that the approach taken to empower e-tutors' pedagogical knowledge be re-analysed in order to avoid misrepresenting the design process from such approaches.

It should be noted also that there were results which were obtained from the e-tutors' content knowledge construct. From one of the results' tenet (see section on Table 4.11) it was concluded that the e-tutors still lacked capacity to facilitate and teach the design process in an ODeL space.

There was another set of results (see section on Table 4.12) which indicated that e-tutors struggle on how to sequence the stages of the design process.

At the same time, there were some results (see section on Table 4.13) which showed that the e-tutors lack abilities to help students to -conceptualise the first stage of the design process.

Furthermore, there were results which were obtained (see section on Table 4.15) about the e-tutors who were not able to help the online students to conceptualise the third stage of the design process. In this section of the results, reference was made to e-tutors who lacked capacity to facilitate and teach the design process in an ODeL space, e-tutors who struggle on how to sequence the stages of the design process, e-tutors who lack abilities to help students to conceptualise the first stage of the design process and e-tutors who were not able to help the online students to conceptualise the third stage of the design process. Following from the results which were highlighted, additional support for the e-tutors content knowledge is recommended since content knowledge is linked to the achievement of the set goals for the design process.

5.6 REFLECTION ON THE STUDY

On a personal level, this research improved the researcher's research skills which provided a foundation to produce publications in scholarly outputs. The evidence is in the list of sources in this research.

The TPACK framework under girded this study. The selection of such a framework was based on its application of integrating technology which is mostly used in the HE institutions of learning. In this study, the TPACK conceptual framework was adapted for the questionnaires in order to organise how the design process is conceptualised in an

ODeL setting. The second adapted framework was used as an instrument for the online observations to evaluate the online interactions between the e-tutors and the students online. The two adapted frameworks are modest contributions of this study towards a body of knowledge for instruments in an ODeL setting.

Reviewing the literature relative to the design process in an ODeL context proved very scanty. As a result, the researcher opted to use the literature which is available for face to face context. In the light of the circumstances, this research generated literature on teaching the design process which will be used in an ODeL setting.

Finally, this research produced deeper insights into how e-tutors conceptualise the design process in an ODeL context. The research pointed to the teaching of something that is important, but which cannot be learned as a result of the e-tutors' lack of content knowledge. It therefore means their application is minimal in terms of accuracy of the design process content knowledge for an ODeL setting.

The second reflection was based on the application for the knowledge for technology tools. The application for knowledge of technologies indicated that e-tutors were not able to use such technologies to benefit the students' learning. It was also established that the different technological tools such as discussion tools and myUnisa are not easily accessible to the student who have no access.

The final reflection was girded on the pedagogical strategies which the e-tutors use to explain the concept of the design process. E-tutors' pedagogical approaches were not adequate to be applied in a way that enhances student learning through the ODeL context. Given these results, they will impact on the future planning and development of the curriculum for the design process in ODeL institutions. The above challenges indicate a lack of competency in the technological, pedagogical and content knowledge of the design process, resulting in poor student support for the design process in an ODeL environment.

5.7 CONCLUSION

This study drew on two theories of connectivism and the transactional distance learning theory to determine the relationship between the e-tutors' technological, pedagogical, content knowledge of teaching design process in Technology Education.

Literature was reviewed based on how the design process is taught in an ODeL context. A mixed method approach was employed for the study with both purposive and convenience sampling techniques. The total participants of the study were 145 students of two modules of Technology Education.

Concepts such as validity, reliability and methodological triangulation were discussed. A questionnaire was used to conduct the survey for the online students. The results from the survey were discussed in three themes which reflected the objectives which were set for the study. Online observations were also used to collect data from the e-tutor postings and students' responses. Data was also collected from the structured interviews between the e-tutors. In this study, it was found that e tutors still lack the technology knowledge in order to deliver the content aimed for the design process in an ODeL environment. This finding is critical for the university management to consider since it speaks to e-tutors who provide support for the online students.

Also, it was evidenced that the e-tutors have not acquired pedagogical strategies for driving the pedagogy of the design process in an ideal context of ODeL. University authorities and management should consider this finding since it is important that the e-tutors were appointed on the basis that they possessed necessary pedagogical strategies for an online setup.

It should also be borne in mind that findings on the content knowledge indicated that the e-tutors still lack the knowledge for exploiting content knowledge of the design process to suit an ODeL environment. The university management is under a radar as to how this finding will influence their future in terms of how e-tutors are appointed as a labour for student support.

On the overall, a conclusion on the study was that the e-tutors still have not acquired the technological, pedagogical and content knowledge for an ODeL environment in order to deliver the objectives of the design process curriculum. Findings in this study highlighted a need for competent e-tutors who are competent in the skills of technological pedagogical and content knowledge for the design process. Further studies that include the technological, pedagogical and content knowledge are recommended that could add value to design process learning in an ODeL environment.

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APPENDIX 1

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2018/04/18

Ref: 2018/04/18/07724101/23/MC
Name: Ms MZ Sedlo
Student: 07724101

Dear Ms Sedlo

Decision: Ethics Approval from 2018/04/18 to 2023/04/18

Researcher(s): Name: Ms MZ Sedlo
E-mail address: sedlom@unisa.ac.za
Telephone: +27 72 571 7777

Supervisor(s): Name: Prof MZ Ramorola
E-mail address: ramormz@unisa.ac.za
Telephone: +27 12 429 6965

Title of research:

A case study of competencies of Technology Education e-tutors in the construction of design process at an Open and Distance e-Learning Institution

Qualification: PhD in Science and Technology Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2018/04/18 to 2023/04/18.

*The **low risk** application was reviewed by the Ethics Review Committee on 2018/04/18 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
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APPENDIX 2

RESEARCH PERMISSION SUB-COMMITTEE (RPSC) OF THE SENATE RESEARCH, INNOVATION, POSTGRADUATE DEGREES AND COMMERCIALISATION COMMITTEE (SRIPCC)

27 July 2018

Ref #: 2018_RPSC_037

Decision: Research Permission

Approval from 27 July 2018 until 26 July 2019.

Ms. Zipporah Sedio
Student #: N/A
Staff #: 90258509

Principal Investigator:

Ms. Zipporah Sedio
Department of Science and Technology Education
School of Teacher Education
College of Education
Unisa
sediom@unisa.ac.za, 012 429 3643/ 0725717777

Supervisor: Prof Zipporah Ramorola, ramormz@unisa.ac.za, 012 429 6965/ 0716407432

A case study of competencies of Technology Education e-tutors in the construction of design process at an Open and Distance e-Learning Institution

Your application regarding permission to conduct research involving UNISA employees, students and data in respect of the above study has been received and was considered by the Research Permission Subcommittee (RPSC) of the UNISA Senate, Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC) on 16 July 2018.

It is my pleasure to inform you that permission for the study has been granted. You may:

1. Gain access to the email addresses of 6 e-tutors teaching LADTECX and PFC103S modules in order to invite them to participate in face-to-face interviews through the gatekeeping assistance of her supervisor.
2. Send an online questionnaire to undergraduate and postgraduate students registered for LADTECX and PFC103S Modules through the gatekeeping assistance of ICT.

3. Gain access to the MyUnisa pages for the two modules mentioned above through the gatekeeping assistance of her supervisor, in order to ascertain the interaction of the e-tutors with the students.

You are requested to submit a report of the study to the Research Permission Subcommittee (RPSC@unisa.ac.za) within 3 months of completion of the study.

The personal information made available to the researcher(s)/gatekeeper(s) will only be used for the advancement of this research project as indicated and for the purpose as described in this permission letter. The researcher(s)/gatekeeper(s) must take all appropriate precautionary measures to protect the personal information given to him/her/them in good faith and it must not be passed on to third parties. The dissemination of research instruments through the use of electronic mail should strictly be through blind copying, so as to protect the participants' right of privacy. The researcher hereby indemnifies UNISA from any claim or action arising from or due to the researcher's breach of his/her information protection obligations.

Note:
*The reference number **2018_RPSC_037** should be clearly indicated on all forms of communication with the intended research participants and the Research Permission Subcommittee.*

We would like to wish you well in your research undertaking.

Kind regards,

pp. Dr Retha Visagie – Deputy Chairperson: RPSC
Email: visagrg@unisa.ac.za, Tel: (012) 429-2478

Prof Lessing Labuschagne – Chairperson: RPSC
Email: llabus@unisa.ac.za, Tel: (012) 429-6368

APPENDIX 3

LETTER OF PERMISSION FOR E-TUTORS

Date: 27 February 2018

DEAR PROSPECTIVE PARTICIPANT

My name is **Sedio MZ** and I am doing research under the supervision of MZ Ramorola a Professor in the Department of Science and Technology Education towards a PhD at the University of South Africa. We are inviting you to participate in a study entitled: **A case study of competencies of TE e-tutors in the construction of design process at an Open and Distance e-Learning Institution.**

This study is expected to collect important information that will inform better practices for e-tutor programme where the participants are involved. You are invited because you are employed as one of the e-tutors in the Department of Science and Technology Education Department of UNISA for Technology Education specialization. I obtained your contact details from the files in the Department of Science and Technology Education departmental secretary which were given to me because I am the lecturer who works directly with you in the two modules for Technology Education. In total, this study targeted six e-tutors including your-self for participation in this study.

The study involves audio tapping the semi structured interviews. Your role in this study is to provide information on your online tutor experiences in relation to the teaching of design process in Technology Education. The questions which were formulated **only** focus on the aspects of TPACK framework. The expected duration of participation is thirty minutes for the interviews and ten minutes for questions of clarity which might arise from the interviews.

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

There are no possible benefits for you as a participant. The scientific community stands to benefit from this study's findings with a contribution to a body of new knowledge.

The e-tutors were selected on the basis that they were adults and classified as a less vulnerable group. From the classification as being less vulnerable it means they can react in discomfortable situations. I foresee no risks or possible side effects as the study does not involve sensitive information. The responses from their participation will be treated anonymously. In an unforeseen and regrettable event of harm or injury to the participant, my supervisor will be alerted as the first line manager and she will escalate the matter to the relevant authorities.

You have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. Your answers will be given a code number or a pseudoname and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

Only the transcriber will have access to data and will maintain confidentiality by signing a confidentiality agreement. Your answers may be reviewed by people responsible for making sure that research is done properly, including transcriber, external coder and members of the Research Ethics Review Committee. Otherwise records that identify you will be available only to people working on the study, unless you give permission for other people to see the records. A

report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

Hard copies of your answers will always be stored by the researcher for a period of five years in a locked cupboard in the office locked for future research or academic purposes. Electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hardcopies will be shredded, and electronic copies will be permanently deleted from the hard drive of the computer through the use of relevant software programme.

No financial payment, rewards, incentives or otherwise will be made for participating in this study. Travel costs incurred for participating in this study were minimised since the interviews will be conducted at regional offices of UNISA nearer to the participants.

This study has received written approval from the Research Ethics Review Committee of the College of Education, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.
If you would like to be informed of the final research findings, please contact Ms Mpipo Sedio at: 012 429 3645 or email: sediom@unisa.ac.za. The findings are accessible for a period of five years. Should you require any further information or want to contact the researcher about any aspect of this study, please contact Prof Ramorola MZ at: 012 4296965 and email: ramormz@unisa.ac.za.
Should you have concerns about the way in which the research has been conducted, you may contact Prof Ramorola MZ at: 012 4296965 and email: ramormz@unisa.ac.za.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

_____
Mpipo Sedio Ms

APPENDIX 4

Technological Pedagogical and Content Knowledge Framework TPACK Survey

		LIKERT SCALE				
Item	**TECHNOLOGICAL KNOWLEDGE**	SA	A	N	SD	D
1	My e-tutor possesses appropriate technical skills for my benefit					
2	My e-tutor provides sufficient opportunities to work with technology					
3	My e-tutor introduced me to various online resources					
4	My e-tutor helped me to learn how to use technology easily and effectively					
5	My e-tutor helped me to exploit the online resources in the module to support my learning					
6	My e-tutor helped me to acquire skills to access online resources when I needed to					
7	My e-tutor helped me to solve my own technical problems					
8	My e-tutor helped me to become confident and use appropriate technology in real life situations					
9	My e-tutor helped me to keep up with important new technologies					
10	My e-tutor helped me to use social media for my module (face book, Watts app)					
	PEDAGOGICAL KNOWLEDGE					
11	My e-tutor prepares me to organize and maintain virtual classroom					
12	My e-tutors' teaching sessions are well structured					
13	My e-tutor runs the module smoothly and it is well organized					
14	My e-tutor can plan for group activities for his/ her students					
15	My e-tutor can guide students to discuss effectively in group work					
16	My e-tutor can use a variety of strategies to guide students thinking					
17	My e-tutor can guide students to monitor their own learning					
18	My e-tutor can adapt teaching to address current and later problems from students who did not understand					
19	My e-tutor can guide on how to assess performance of students with different needs					
20	My e-tutor is familiar with his or her students' understandings and misconceptions					
21	My e-tutor uses a wide variety of teaching approaches in a virtual classroom					
22	My e-tutor can assess student learning in many ways					
23	My e-tutor can adapt the teaching approaches based upon real life needs					
	CONTENT KNOWLEDGE					
24	My e-tutor is an expert with content of Technology subject					
25	My e-tutor has sufficient knowledge about Technology subject					
26	My e-tutor has helped me to gain sufficient knowledge about Technology subject					
27	My e-tutor is good at explaining aspects of the content					
28	My e-tutor has helped me to gain deeper understanding about the content knowledge of my subject					
29	My e-tutor has helped me to gain confidence to teach content knowledge for the Technology subject					
30	My e-tutor is confident with explaining the design process					
31	My e-tutor has various ways of explaining the different stages of the design process (IDMEC)					
32	My e-tutor can help me to understand investigation which is the first stage of the design process					
33	My e-tutor helps me to formulate alternative solutions to a problem and provide scenarios based on the investigation stage					
34	My e-tutor can help me to understand design which is the second stage of the design process					
35	My e-tutor helps me to understand how to draw possible diagrams by using 2 dimensions and 3 dimensions shapes					
36	My e-tutor can help me to understand make which is the third stage in the design process					
37	My e-tutor can help me make a project from start to finish by using IDMEC					
38	My e-tutor can help me to understand evaluation which is the third stage of the design process					
39	My e-tutor can help me to evaluate the solutions which I provided which link to real life needs					
40	My e-tutor can help me to understand communication which is the final stage of the design process					

APPENDIX 4

41	My e-tutor can help me to communicate my ideas freely in order to achieve the aim in the design process					
	Technological Pedagogical Content Knowledge					
42	My e-tutor can use strategies which infuse content technologies and teaching approaches in my modules					
43	My e-tutor can provide leadership in helping students to combine the use of content, technologies and teaching approaches for my module					
44	My e-tutor can choose technologies that enhance the content of a lesson					
45	My e-tutor can teach lessons that maximally combine content subject, technologies and teaching approaches					
46	My e-tutor can create self- directed learning activities of the content knowledge with appropriate ICT tools (blog, web quest)					
47	My e-tutor can design inquiry activities that guide students to make sense of the content knowledge with appropriate ICT tools (simulations, web base materials					
48	My e-tutor can design lessons that appropriately infuse content, technology and pedagogy for student – centered learning					
49	My e-tutor can combine content, pedagogy and technology to introduce his/ her students to the real-world scenarios					

APPENDIX 5

INTERVIEWS SCHEDULE WITH THE TE E-TUTORS

Semi Structured Interview Schedule

TECHNOLOGICAL KNOWLEDGE

- What technological tools do you use to support students in the e-tutor programme?

Probe: What are the reasons for selecting or using such tools?

- Are you familiar with myUnisa tools?

Probe: Which tools specifically are you referring to?

- Have you undergone some form of training on myUnisa Learning Management System (LMS)?

Probe: How long was the training?

Probe: Who offered the training?

- How did the training benefit you / did your teaching of the content improve after the training?
- What needs to be done in future to improve the training provided?

Probe: Name other support you are getting for teaching design process stages

PEDAGOGICAL KNOWLEDGE

- What approaches do you use in teaching online?

Probe: How long have you been using such approaches for online teaching?

- How effective are these approaches to learning?

Probe: Why do you regard them as appropriate to online teaching?

- Which activities did you design to support online learning?

Probe: Why do you think those activities are appropriate and working?

- How are the students' responses towards your varying activities?

Probe: Can you make any suggest such activities for other e-tutors?

CONTENT KNOWLEDGE

- What is your highest qualification in the module that you are offering?

Probe: How is the qualification benefitting you in the delivery of e –learning content?

- How many years of experience do you have in teaching online?

Probe: Do you think that experience is assisting you as an e-tutor?

Probe: How?

- Do you have e-tutor guides in your modules?

Probe: How do you provide support without / with the guides?

- How familiar are you with e-tutor guides?

Probe: Do you find the e-tutor guide user friendly?

Probe: How often do you use the guides?

- What is the most difficult section/s or chapter/ chapters of the curriculum to present even to students?

Probe: How do you simplify the section/sections or chapter/chapters?

- If you could improve any section on design process in your subject, what section of content would you improve?

Probe: Why

PARTICIPATION

- What is the learner ratio that you are engaged with online teaching?

Probe: How does the ratio affect your delivery of the e-content?

- How long do students engage in the system?

Probe: How do you motivate the students to engage in the system?

- Which strategies do you use to encourage students' participation?

Probe: Why do you think the strategies work best for you?

- What do you think could be the main reason of poor participation in e-tutoring by students?

Probe: Can you maybe suggest a solution based on your experiences?

APPENDIX 6

ONLINE OBSERVATION DATA TABLES

Knowledge of different technologies by e-tutors				
Construct	**E-tutors**	**Postings**	**Responses**	**Percentages**
		E-tutors	**Students**	
E-tutors use knowledge which provided online students with sufficient opportunities to work with different technologies	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			
E-tutors used digital materials that map stages of the design process.	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			
E-tutors know and use technologies that online students can use to understand Technology Education concepts.	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			

APPENDIX 6

Knowledge of different pedagogical strategies by e-tutors

Knowledge of different pedagogical strategies by e-tutors				
Construct	**E-tutors**	**Postings**		**Percentages**
		E-tutors	**Students**	
1. E-tutor uses different strategies to explain concepts for Technology Education	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			
2. E-tutors adapted their teaching styles to suit students' learning needs.	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			
3. E-tutors use a wide range of teaching approaches in a virtual classroom setting.	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			

APPENDIX 6

Knowledge content domain for e-tutors

Knowledge Content domain for e-tutors				
Construct	**E-tutors**	**Postings**		**Percentages**
		E-tutors	**Students**	
1. E-tutors help students to conceptualize the first stage of the design process using different scenarios	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			
2. E-tutors help students to understand all the four stages of the design process	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			
3. E-tutors were able to help online students to communicate and present best ideas about their final projects	ETS1			
	ETS2			
	ETS3			
	ETS4			
	ETS5			

APPENDIX 7

CONSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have had explained to me and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) _____

_____ _____

Participant Signature Date

Researcher's Name & Surname (please print) _____

_____ _____

Researcher's signature Date

APPENDIX 8

8 April 2020

Madam

I have edited your dissertation and found it to be interesting and informative. It was thoroughly researched and well written.

During my editing, there were some changes that had to be made without leaving track changes on. There are however, some suggestions that I made with regards to sentence construction and usage of some terms instead of others that are in comment boxes. Should you feel strong about them, please *reject* the changes and if you agree, *accep*t them.

I have noted aspects that need to be taken care of and these are:

- The use of the letter 'z' in words like minimize, realize, etc. are for US English.
- The double quotation " " marks should be used in quotes within a quote, use ' '.
- The word Data can either be a plural or singular. Using it in plural, be consistent with its use throughout the document.
- Block quotations do not use quotation marks.
- Check the use of extent and extend.

I hope you find this in order.

Kind regards

Mike Njuza