ADOPTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN TEACHING AND LEARNING AT A UNIVERSITY

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ABSTRACT

The study was a cross-sectional exploratory survey to determine lecturers' and students' use of the core e-learning site, e-Thuto, at the Central University of Technology, Free State (CUT). The goal was to determine the adoption of electronic learning via information and communication technologies (ICTs) towards the improvement of the quality of teaching and learning. Yet, research cites several resource and skills challenges hindering ICT adoption in teaching and learning in developing economies that remain unaddressed. Data were collected from 10 lecturers in the Department of Communication Sciences at the CUT and 90 undergraduate students from all the four CUT faculties in order to correlate lecturers' and students' perspectives. Therefore, a structured interview schedule was used. Data were analysed using the emic and etic approaches where the respondents' categorisation of behaviour, correlated with conceptual categories from literature, was regarded as the reality in the study context. The findings indicate a limited adoption of e-Thuto in teaching and learning due to several impediments. The policy implications point towards a more systematic integration of ICTs into the curriculum.
Keywords: adoption, diffusion, e-Thuto, ICTs, learning, teaching

INTRODUCTION

The benefits of integrating Information and Communication Technologies (ICTs) in teaching and learning have been celebrated in the light of the fast technological advancement of the world. This era has been widely known as the Fourth Industrial Revolution (4IR), characterised by developments in "genetics, artificial intelligence, robotics, nanotechnology, 3D printing and biotechnology, anticipating to realise smart systems; homes, factories, farms, grids or cities" (Schwab and Samans 2016, V). Thus, the utilisation of ICTs in bringing together separated traditional education media such as books, writing, audio and video recordings, databases, and games; extending and at the same time converging learning time and spaces to embrace the technologically advancing world, has been heightened (Livingstone 2011). Several benefits of technology-enhanced teaching and learning have been presented in literature such as "online publication, talking and listening to native speakers when learning a second language, and/or

preparing a multimedia presentation" (OECD 2016, 68). Other benefits include "motivating learners, making learning distance easier, making learning more fun, enabling independent learning with proper guidance, enabling learners to create knowledge, confirmed availability of more content, access to knowledge experts, and more quality learning material" (The E-learning Africa Report 2012, 32). However, the exact impact of such 4IR transformations on society and the planet is still unknown. Nonetheless, it is likely to bring intense and speedy change, hence the need to adopt ICTs in teaching and learning institutions, which are the hubs of skills training, cannot be overemphasised.

The concept of e-learning has been widely defined. According to Ozkan and Koseler (2009, 1), e-learning refers to "... the use of electronic devices for learning, including the delivery of content via electronic media such as Internet, audio or video, satellite broadcast, interactive television ...". E-learning has also been defined as information delivered on a digital device, such as a computer or mobile device, for the purpose of supporting learning (Mayer 2011). Logan (2010 cited by Šimonová 2015, 19) describes the "e" in "e-learning" as not referring to electronic, but "*e*volving, *e*verywhere, *e*nhanced, *e*xtended or *e*ffective". Implied in the foregoing definitions is the concept of convenience, with Logan's description further indicating extended learning time. This kind of learning is ideal in the volatile Higher Education environment of South Africa due to students' increasing protests. The findings of a 2017 Internet Access in South Africa study, conducted by World Wide Worx (2017), with the support of Dark Fibre Africa, indicate that the most common use of the Internet among South African adults is communication, reported by 31 per cent of respondents, followed by social networking, 24.9 per cent and information, 23.7 per cent, then lastly, entertainment, at 22.1 per cent. These statistics indicate that internet availability is significant enough to seize the opportunity to maximise it for teaching and learning.

Though several benefits of ITC integration in teaching and learning have been celebrated, its implementation and adoption has been problematic in developing economies such as South Africa. This is largely due to the myriad of developmental problems faced particularly by developing countries. In that light, Isaacs (2007) laments that though there are several historical ICT policy documents, South Africa does not have a coherent policy that adequately promotes ICTs in higher education. Elsewhere, on the continent, Nigeria have improved cyber use in tertiary institutions. For example, a 2015 survey of online presence of universities among other institutions revealed that more federal universities are participating in the numerous benefits of cyberspace, with more than 97 per cent being online. However, it was noted that universities need to broaden their utilisation of cyberspace to teaching and learning (Mbanaso Chukwudebe and Atimati 2015). Yet, Chuma-Okoro (2018) cites that in Nigeria, copyright remains a threat

to digitisation. In that regard, Swartz, Gachago and Belford (2018) indicate the necessity to provide a stable infrastructure with appropriate copyright policies, network securities and safety measures. Of concern, Nigeria is the largest economy in Africa, followed by South Africa. Therefore, these countries are likely to be viewed as Africa's role models by the international audience. Thus, they should be seen to be leading in seizing the opportunities offered by ICTs in all their sectors, and particularly, education.

The myriad of impediments to ICT adoption in developing economies is widening the gap between the developed and the developing world. Yet, a few educators in South Africa have effectively integrated ICTs in the classroom (Nkula and Krauss 2014; Padayachee 2017). Barriers to ICT adoption include a lack of methodological training of staff members, a lack of ICT support staff, irregular internet connection, absence of ICT-related projects, as the nature of the curriculum would need to be re-packaged (Obiri-Yeboah, Kwarteng and Kyere-Djan 2013; European Union 2014; Padayachee, Wegner-Welsh and Johannes 2018). Thus, glossing over ICT adoption without considering factors such as group size, the time allotted for lectures (duration) and to lecturers (slots), learner-characteristics, and awareness of the purpose of using ICTs, is in vain (Stensaker et al. 2007). The European Union's (2014) call for certified pedagogical training for all teaching staff, and the introduction of obligatory continuous professional development could yield more effective ICT integration into the curriculum. Although numerous studies have been conducted on ICT integration into the curriculum, there has been no consensus regarding the best suitable model for the recommended diffusion process.

Therefore, this study was found apt in cognisance of one of CUT's five-year project focus areas: a sustainable and well-equipped university with smart campuses and digital transformation ... (Maritz, Makanyane and Modisenyane 2018). University training is the main bridge between schooling and the world of work, which is technologically transformed. Hence the justification of the current study. Although based on a case study of CUT's one campus (Bloemfontein), the study could influence policy at a broader level, considering the list of problems hampering ICT adoption cited in literature. Therefore, determining the extent of the adoption of one ICT software at a university is only a quest to add to the large body of literature. Importantly, a systematic and sustainable model of ICT integration in teaching and learning could be more effective.

The study aims to determine the extent of adoption of the core e-learning software, e-Thuto, from user perspectives at the (CUT) in a quest is to find a systematic and sustainable ICT integration in teaching and learning. The anticipation is to improve on quality, and more importantly, to remain relevant in a technologically fast-changing world. The objectives of the study are:

To survey the extent of the adoption of the CUT core ICT software for teaching and learning, e-Thuto, by lecturers and students, the challenges faced and to develop a roadmap of ITC integration in teaching and learning. The research questions are:

1. To what extent are lecturers adopting ICT software in teaching and learning at CUT?

2. To what extent are students adopting ICT software in teaching and learning at CUT?

3. What problems are being faced by lecturers and students in using the CUT's core e-learning software, e-Thuto, in teaching and learning?

INSIGHTS FROM LITERATURE

Insights from literature were extracted from two perspectives: Policy, hardware and software availability and ICT adoption; and structural and functional impediments to ICT adoption in teaching and learning, as these have been found pertinent.

Policy, hardware and software availability and ICT adoption

Etzkowitz and Laydesdorff (2000) challenge relevant stakeholders that the Triple Helix model denotes not only the relationship of university, industry and government, but also internal transformation within each of these domains in order for ICTs to be fully embraced in teaching and learning. A study by Tinyane (2009 cited by Odeyemi 2011) on internet access of university students in South Africa among first year students at Rhodes and Fort Hare universities indicates that access to the Internet is skewed according to population groups in South Africa. The study indicates that while nearly all White, Coloured and most of Indian/Asian students have desktop computers or personal laptops at home (98.3%, 94.7% and 81.6% respectively), about half (53%) of African students have desktop computers or personal laptops, and most African students (76.9%) disproportionately do not have Internet access at home. Considering that the African population, at 79.4 per cent, is the largest population group in the country, the low frequency (53%), implies that the majority of South African youth do not effectively utilise the benefits that the Internet offers (Odeyemi 2011). Tinyane's (2009) study indicates a wide gap where some students coming from privileged backgrounds form part of the global digital native population, whilst other students are introduced to ICTs when they first enrol for their university studies.

A different dimension from Skiba's (2014) study focusing on connectivity through applications designed for mobile devices found that 79 per cent of tertiary-level students own the newly innovated smartphones. Skiba (2014) further suggests that youth attending tertiary institutions value interaction, to the extent that 70 per cent were found to be utilising mobile

phones during class sessions. The findings reveal that students have access to the Internet. The smartphone is the most convenient gadget used in business and personal transactions via the Internet (Shava, Chinyamurindi, and Somdyala 2016). Such gadgets that are more accessible to students can be utilised in teaching and learning if systematic models are developed.

Though availability and benefits of ICTs have been acknowledged, many institutions fail to integrate ICTs into teaching and learning as they are using ICTs to replicate their traditional practices. Yet, effective integration requires transformation where stakeholders review their existing structures and practices, Bates (2000), contending with Sife, Lwoga and Sanga (2007), if universities and colleges are to successfully adopt technologies for teaching and learning. Therefore, research should focus on planning to improve ICT adoption in teaching and learning.

According to Brown and Czerniewicz (2010), technology should be integrated into the educational curricular to gauge its relevance in all sectors and careers. The foregoing authors argue that basic digital literacy and implementation of the skills can enhance adequate understanding of how to apply and innovate with technology among learners. This can be achieved by keeping curricula up to date, and teachers reviving their skills and knowledge. Yet the challenge with this recommendation by Brown and Czerniewicz is its contradiction with other research findings indicating teachers' reluctance to embrace technology. The challenge is to develop frameworks that compel all teachers to train and implement ICTs in their teaching and learning.

While Universities of Technology (UoTs) in South Africa often use the adoption of educational technology as fundamental in their professional identity and to gauge their innovative teaching and learning strategies (Du Pré 2009), there is limited empirical evidence on how they have used technologies innovatively to transform their curricula design and delivery. South African universities, particularly UoTs, are reportedly struggling with integrating educational technologies into their curriculum design and delivery, thus hampering technology adoption (Bozalek, Ng'Ambi and Gachago 2013; Gachago et al. 2013). As such, the increasing availability of educational ICTs within South African universities has not automatically converted into transformed curricula and pedagogical practices (Carr 2013). Hence the need to continue research on how best ITCs can be integrated into the curriculum.

Structural and functional impediments to ICT adoption in teaching and learning
Though the importance of digital technologies for tertiary education in developing countries has been echoed, Hawkins (2002), the fact that they are not yet fully operational in many areas, and friendly Internet access is not widely available in most developing countries, is worrisome. Shea, Pickett, and Sauli (2005) used Rogers' innovation characteristics to analyse the factors

that prevent faculties from using technology in their class. They examined 913 lecturers in universities in the United States and found that factors such as level of interaction during the course, technical support, positive previous experience, university department and course content affect faculties' attitude to integrating technology tools in teaching. These findings resonate with those by Pelgrum (2001) and Mereku et al. (2009) who indicate unwillingness to change and lack of the various resources required to embrace ICTs. However, the latter findings, which highlighted resource challenges, contradict the findings stated earlier which pointed out innovation characteristics as impeding factors.

A comprehensive OECD (2005) study on the applications of the new technologies in tertiary education institutions in 13 countries pointed innovation characteristics as hurdles to adoption, especially pedagogic challenges. The foregoing impediments to ICTs adoption can be surpassed through innovation as advised by Van den Berg (2018). Hence teachers should research and utilise technologies accessible to students in a fun way. In cognisance of Bagozzi's (2007) remarks that factors hampering effective ICT adoption are multifaceted, researching before implementing any ICT initiative is essential in order to achieve the necessary outcome. As Chigona et al. (2010) assert, existing studies on the adoption of ICTs in education have focused mainly on the factors that affect the adoption, but have failed to yield the effective integration of ICTs.

Apparently, teachers' resistance to adopt technology in teaching and learning has been largely confirmed (Guri-Rosenblit 2004; Kurtz 2008; OECD 2005; Trucano 2005). For example, in a dual-mode university like the University of British Columbia, a typical course team includes a professor; a course developer, combining project management and instructional design skills; a technology expert; an editor; and a graphic designer (Bates, 2000 cited by Guri-Rosenblit 2004). The professors continue working with other professionals in the actual teaching: tutors, evaluation experts and technology support staff. Yet, interestingly, Guri-Rosenblit (2004) notes that professors who value academic freedom in teaching, view this teamwork as intrusion. He further comments that many comprehensive reviews and studies revealed that most teachers have indicated that there are little or no systematic rewards to motivate them to utilise technologies in their teaching.

THEORETICAL FRAMEWORK

The diffusion of innovations theory, which underpins the current study, attempts to predict the behaviour of individuals and social groups in the process of adoption of innovations. The theory considers personal characteristics, social relations, time factor and the innovation characteristics (Padel 2001). According to Rogers (2003), diffusion of innovations is a kind of

social change that can be described as the cumulative pattern of individuals' decisions about adopting, rejecting, or discontinuing an innovation within a social group. Adoption is understood as "the decision to make full use of an innovation" (Monge, Hartwich and Halgin 2008, 2). Set in the modernisation theoretical paradigm, diffusion approaches believe progress is achieved by inducing change in individuals' attitudes and behaviours (Paolo 2008, 58). Monge et al. (2008, 2) defines an innovation as "anything new successfully incorporated into social or economic processes", in line with Rogers' (2003) perception of new idea, practice or project. While innovation hardware is described as the tool that embodies the technology in the form of a material or physical object, software is the information base for the tool (Rogers 2003). Since software as a technological innovation has a low level of observability, its rate of adoption is quite slow (Sahin 2006, 14), a factor which compels effective communication.

Rogers' (2003) diffusion of innovations theory is a five stepped approach indicating the stages through which an individual goes until he/she makes a decision to adopt or reject an innovation. The first stage is the knowledge stage, where the individual is exposed to an innovation for the first time and expected to acquire more information about it. This stage is ensued by the persuasion stage, where the prospective user develops an interest in the innovation and seeks more information about it. The current findings from the student respondents indicate a lack of intensive e-Thuto training. This makes the decision to implement the innovation, which is the third stage, uncertain. As a result, the findings from both student and lecturer respondents indicate that implementation of e-Thuto, which is the fourth stage, is lacking.

Furthermore, in his quest to determine factors influencing adoption, Rogers (2003) suggested five innovation characteristics that promote or hamper an innovation's adoption. Rogers (2003) defines the relative advantage of an innovation in terms of how better an innovation is compared to what precedes it. Though not replacing the traditional face-to-face teaching and learning and administration forms, e-Thuto has the advantage of more convenient information, data and record management, as well as varied teaching and learning tools that stimulate interest. The current findings from both the lecturer and student respondents, showing limited use of e-Thuto tools, could confirm the cited lack of training. Rogers also presents the characteristic of compatibility, which he refers to as consistency with existing values, past experiences and needs. The transition from traditional to blended learning forms where ICTs are being embraced is still an ongoing process in South Africa that requires the co-operation of all the relevant stakeholders (the government, who is the policy maker, the academia and the industry).

Rogers (2003) further identifies complexity as another crucial factor in the diffusion and

adoption process, implying that the easier and more comprehensible an innovation, the faster its adoption. E-Thuto is an ICT software requiring learning of new skills. Both the student and lecturer respondents reported lack of training for skills acquisition, with the lecturers indicating inconvenient training sessions that clash with their lecture sessions. Trialability is the fourth of Roger's innovation characteristics in which an innovation is experimented on, then implemented on an accrual trend. The current findings, showing only a few e-Thuto tools being used by both lecturers and students, reflect a lack of motivation to accrue utilisation thereof. Rogers presents his fifth category of observability where the fruits of an innovation are realised, thus influencing observers to also adopt it. Despite the several benefits of adopting ICTs in teaching and learning, it is difficult to determine the extent to which ICT adoption has improved teaching and learning outcomes since it has not been applied systematically in tertiary institutions in South Africa.

Rogers (2003) further claims that the nature of the social system affects individuals' innovativeness, which is the main criterion for categorising adopters. Rogers categorises people according to how early or late they adopt innovations. He classifies these as innovators, early adopters, early majority, late majority and laggards based on their promptness or slowness to adopt innovations. The current findings indicate that students are more inclined to adopt e-Thuto than the instructors. However, classifying the study respondents under any one of Roger's adopter categories would be difficult, considering the various problems pointed as impeding ICT adoption. Generally, different variables converge in the diffusion of innovations, and this calls for effective communication to yield effective adoption.

RESEARCH METHODOLOGY

The study was conducted as both a qualitative and quantitative survey, which is a mixed research design, to yield both the breadth and depth of ICT adoption and at the same time, one paradigm countering the weaknesses of the other. The population was drawn from the CUT staff and student community at the Bloemfontein campus. This is an embedded case study where subunits (lecturers and students) were examined (Yin 2009). Convenience sampling was used to draw a sample of 90 undergraduate students from all the four faculties of Humanities, Management Sciences, Engineering and Information Technology, and Health and Environmental Sciences to garner a variety of voices across disciplines and study levels from the first to the fourth. The sampling strategy and relatively small sample size were chosen due to time constraints. Nonetheless, the population is mostly homogeneous in terms of age-group and likely to consume technology in the same way (Walliman 2011).

A purposive sample of 10 lecturers was drawn from the Communication Sciences

Department for the purposes of getting the perspectives of knowledge instructors. Future research should focus on all the faculties to get a clearer picture. Both sampling strategies fall under the non-probability sampling category (Vogt, Gardner and Haeffele 2012, 128) and thus cannot be generalised to other populations. Nonetheless, the findings could add to the body of literature on the overarching subject of how ICTs could be integrated into teaching and learning. Data were collected using a structured questionnaire/interview guide where all the respondents were asked the same questions (Hofstee 2006). Quantitative data were coded manually and presented in frequencies. Qualitative data were coded manually and presented in descriptive theme categories drawn from the survey questions and from Roger's innovation characteristics. The data were cross-tabulated to corroborate emerging themes from both the two sample groups insofar as the adoption of e-Thuto for teaching and learning is concerned.

RESEARCH FINDINGS

The quantitative and qualitative data were consolidated in order to deduce rich and plausible conclusions from the findings. Question types used were adopted from Du Plooy (2009) and Geilfus (2008) and included dichotomous, follow-up, mirror and open-ended questions in order to elicit underlying information and suggestions.

Demographic details of the respondents

The majority of the student respondents were females 54 (60%), while the males were 36 (40%). The majority were within the 18–23 age-group, 64 (71%). The distribution according to faculty was as follows: Engineering and Information Technology, 17, Humanities, 33, Management Sciences, 30, and Health Sciences, 10, giving a total of 90 respondents. However, only 72 (80%) students out of 90 confirmed using e-Thuto and these comprised the realised sample. Data were collected from 8 (80%) female lecturers and 2 (20%) male lecturers who all confirmed using e-Thuto. None of them indicated their age-groups.

Section A: Presentation and discussion of quantitative data

Table 1: Tools on e-Thuto being used by the respondents

e-Thuto tool	Number confirmed using e-Thuto tool			
	Lecturers (n=10)	%	Students (n=72)	%
Announcements	10	100	72	100
Giving online tests	8	80		
Grade Centre	2	20		
Conducting surveys	2	20		

e-Thuto tool	Number confirmed using e-Thuto tool			
	Lecturers (n=10)	%	Students (n=72)	%
Learning materials	7	70	47	65.3
Build content	3	30		
Clickers	2	20		
Course guides			15	20.8
Question bank			2	2.7

The information presented and discussed in Tables 1 to 4 provide answers to research questions 1 and 2 which sought to determine the extent of adoption of e-learning by lecturers and students. The findings in Table 1 indicate a limited number of e-Thuto tools used by the respondents compared to the total number of eThuto tools in Table 2. Importantly, the students' responses are only a reflection of their lecturers' use of e-Thuto because the latter are the instructors of the learning tool. Apparently, only the announcements tool is used by all the respondents, probably because of its ease of use. Student respondents indicated utilising only four tools: announcements, learning materials, course guides and question banks. This could imply that these are the only tools they are exposed to by their lecturers, contending with Nkula and Krauss (2014) and Padayachee (2017) who cite lack of ICT adoption by lecturers. There was a similar trend of use of the tools by the student respondents, therefore, a distinction of e-Thuto use according to faculty was rendered irrelevant.

Table 2: Number of tools on e-Thuto

Main tools on e-Thuto	Number of sub-tools under each main tool	Number of sub-tools utilised by the respondents
Radio Add	1	
Content	4	2
Content collection	1	
Course tools	28	5
Evaluation	4	
Grade centre	4	1
Groups and users	2	
Customisation	6	
Packages and utilities	5	
Help	3	

The tools being utilised by both the lecturers and students are limited and fall under only three categories of the main tools on the e-Thuto site: content, course tools and grade centre. This finding shows a very limited extent of e-Thuto adoption. Both sample groups were then asked how often they use the e-Thuto tools they had indicated and the findings are presented in Table 3.

Table 3: Frequency of using e-Thuto

	Lecturers: Frequency (n=10)	%	Students: Frequency (n-72)	%
Daily	2	20	32	44.4
Weekly	5	50	29	40.2
Sometimes	3	30	11	15.3

The findings in Table 3 indicate that on the one hand, only an insignificant 20 per cent of the lecturer respondents use e-Thuto daily, whilst the majority, 50 per cent, use it weekly, and a fairly significant 30 per cent use it sometimes. On the other hand, a significant percentage of students use e-Thuto daily, (44.4%) and weekly, (40.2%), and an insignificant 15.3 per cent use it sometimes. The daily and weekly frequencies are significant enough to surmise that with adequate facilitation from the lecturers, who are the instructors, students can adopt e-Thuto to a greater extent in their learning. It could be inferred from this finding that students, some of whom are digital natives, affording the hardware and software gadgets, are being stifled from embracing technology in learning by the lecturers. Some lecturers are digital immigrants, those born before digital era and are therefore finding it difficult to transform from traditional to technological teaching and learning pedagogies.

Section B: Presentation, discussion of qualitative data and consolidation with quantitative data

Table 4: Other ICT software being used to enhance teaching and learning

Students' responses	Lecturers' responses
WhatsApp	WhatsApp
YouTube videos	YouTube videos
Power Point	Power Point
E-mail	None
E-books	
Google	
Student portal	

Both sample groups were asked of other ICT software being used in teaching and learning in an attempt to explain the limited use of e-Thuto. The findings in Table 4 clearly indicate that students are more inclined to use ICTs than the lecturers, as they have indicated more ICT software that they are using in their learning. The use of only three software tools, WhatsApp, Power Point and YouTube videos from the lecturers' responses shows a trend of their limited use of ICTs in teaching. These three tools do not offer the wide variety of teaching and learning

opportunities, as well as grading and record keeping offered on the e-Thuto cite and other software. An interesting finding from one of the lecturer respondents, that there is no other tool being used in teaching and learning, other than e-Thuto, clearly indicates reluctance to use ICTs in teaching, resonating with findings by (Guri-Rosenblit 2004; Kurtz 2008; OECD 2005; Trucano 2005). The limited adoption of e-Thuto in the quantitative findings prompted the inquiry of impediments to e-Thuto adoption.

Table 5: Problems experienced in using e-Thuto

Lecturers' responses	Students' responses
Students are lazy to access e-Thuto.	Lecturers do not post materials on e-Thuto as promised.
The e-Thuto system often shuts down and cannot be accessed.	Slow internet connection.
None, it is user friendly.	Lecturers post notes that have not been explained.
It is tedious as we have to register students and subjects on e-Thuto every year.	When passwords expire, it is difficult to reset them.
Inadequacy of computer labs for students to access e-Thuto.	Computer labs on campus are often full and there are time restrictions to use them.
Some students cannot access e-Thuto when away from campus due to lack of data to use on their phones.	Failure to access materials due to lack of airtime and data to access e-Thuto on cell-phones.
The process of creating tests on e-Thuto is taxing.	Lack of WIFI on campus.
Lack of knowledge of how to use e-thuto among both lecturers and students.	Lecturers delay to upload and update materials.
Inconvenient training periods.	

The data in Table 5 and the ensuing discussion responds to the third research question which sought to determine the problems hampering adoption of e-Thuto. Corroborating findings from both groups are highlighted in blue. Several problems hampering the adoption of e-Thuto have been identified from the qualitative data presented in Table 5, and these are correlated with findings from the quantitative data, indicating limited adoption of e-Thuto. Therefore, some descriptive categories were deduced from these qualitative findings in Tables 4 and 5, and they are discussed below. These categories have been classified by adapting Rogers' (2003) innovation characteristics. Furthermore, Roger's prosed stages in the diffusion of innovations are used to underpin the findings.

Compatibility of e-Thuto with infrastructure and pedagogies

A lack of e-Thuto accessibility due to slow internet connection and an absence of WIFI in some parts of the university premises were highlighted by both the student and lecturer respondents. This could discourage both groups from using e-Thuto as confirmed by the limited adoption in the quantitative findings. Another corroborating finding from both sample groups is inadequacy of computer laboratories, which results in time restrictions for students to access e-Thuto. Even

though students could use their cellular phones to access this tool, they reported a lack of data and airtime. These findings indicating infrastructural and pedagogic impediments are similar to findings by Pelgrum (2001); OECD (2005); Mereku et al. (2009); but different from findings by Shea et al. (2005) that indicated structural, disciplinary problems and a lack of observability of positive gains instead. Another concern from the lecturer respondents is inconvenient training periods that clash with their teaching sessions. However, this latter concern could be countered on the basis of confirmation by the e-Learning Director in the e-Learning and Educational Technology Forum held on the 20th of September 2018. He indicated that departments can arrange and request for training at a time that suits them and that individual lecturers can make appointments for consultations. Therefore, in the light of this revelation, a lack of commitment to uptake training by the lecturers is notable.

Complexity of using e-Thuto

The lecturer respondents reported the tediousness of creating online tests, unlike Bate's (2000) findings indicating team work. This could be aggravated by the cited lack of knowledge of e-Thuto use. Others cited the task of registering subjects and students on e-Thuto every year, which is rendered invalid as lecturers are assisted by the e-Thuto managers. A related concern from the student respondents was expiry of students' passwords after six weeks and the problems faced in resetting these passwords. Importantly, the CUT e-Learning Director confirmed that students' e-Thuto passwords would henceforth expire after one year. He further indicated that a few improvements have been made to make e-Thuto more user-friendly. However, the inadequacy of hardware for students to learn using this software indicated in Table 5 remains problematic.

Relative advantage of using e-Thuto

One interesting finding is that while lecturers accuse students of laziness to access e-Thuto, students on the other hand indicate that lecturers do not post materials on e-Thuto as promised, that they delay to upload and update materials, and upload notes that have not been explained. This finding implies that the students may not find the relative advantage of using e-Thuto, similar to Guri-Rosenblit's 2004) finding that teachers do not perceive the relative advantage of using eThuto where there are no rewards. Therefore, it becomes difficult to persuade the users, as Rogers (2003) argues for the crucial role of persuasion, to adopt an innovation. Considering students' indication that unexplained notes are posted, lecturers could be using e-Thuto to escape from the involving face-to-face sessions where they are compelled to explain information. It could be surmised from this finding that the use of e-Thuto for teaching and

learning is not driven by purpose but rather convenience, contending with Chigona et al. (2010), thus explaining the failure to fully integrate it.

Trialability of e-Thuto

The various factors cited by both the sample groups to be impeding e-Thuto adoption, such as shortage of computer hardware, slow network, absence of WIFI in some areas within the university premises, and system shutdown, could be significant in discouraging both the lecturers and students from using e-Thuto on an accrual basis. These findings reinforce the assertions by authors like Guri-Rosenblit (2004), and by the OECD (2005), that highlight the fear and perceived risk higher education professors associate with technology adoption, as well as an absence of systematic rewards to motivate for adoption.

Observability of the positive outcomes of ICT adoption

The outcomes of integrating ICTs in teaching and learning have been confirmed and are abundant in literature (Livingstone 2011; E-learning Africa Report 2012; OECD 2016). However, the lecturer respondents in the current study seemed reluctant to adopt ITCs to a greater extent since the hurdles they cited can be curbed. The findings indicate that they use a few ICTs other than e-Thuto, as compared to the student respondents, who have shown an inclination to use varied ICTs with the adequate support that they need. It could be surmised that this lack of motivation to adopt technology could be a result of a lack of a systematic ICT policy in the South African education system as a whole. These findings reveal a myriad of complexities impeding adoption of e-learning, contending with Bagozzi's (2007) findings. Tackling these challenges as parts of a whole education system could be more fruitful. Thus a roadmap of ICT adoption in teaching and learning is developed.

The model of ICT adoption stakeholder mobilisation seeks to appeal to the various stakeholders from all the relevant sectors to converge in order to embrace the Fourth Industrial Revolution. Lest the gap between the developed and developing world continues to widen, making the notion of a global village a fallacy. These stakeholders include national governments, industry, the academia, and technology experts, who should pool resources to develop more systematic models to support ICT integration from primary through to tertiary learning. These stakeholders should collaborate to promote the development, provision and use of compatible and sustainable ICTs. This should be done in close consultation with the education system as indicated by the two way arrows.

Therefore, the circular model indicates close and continuous consultation and communication processes between the government, industry, academia and technology experts
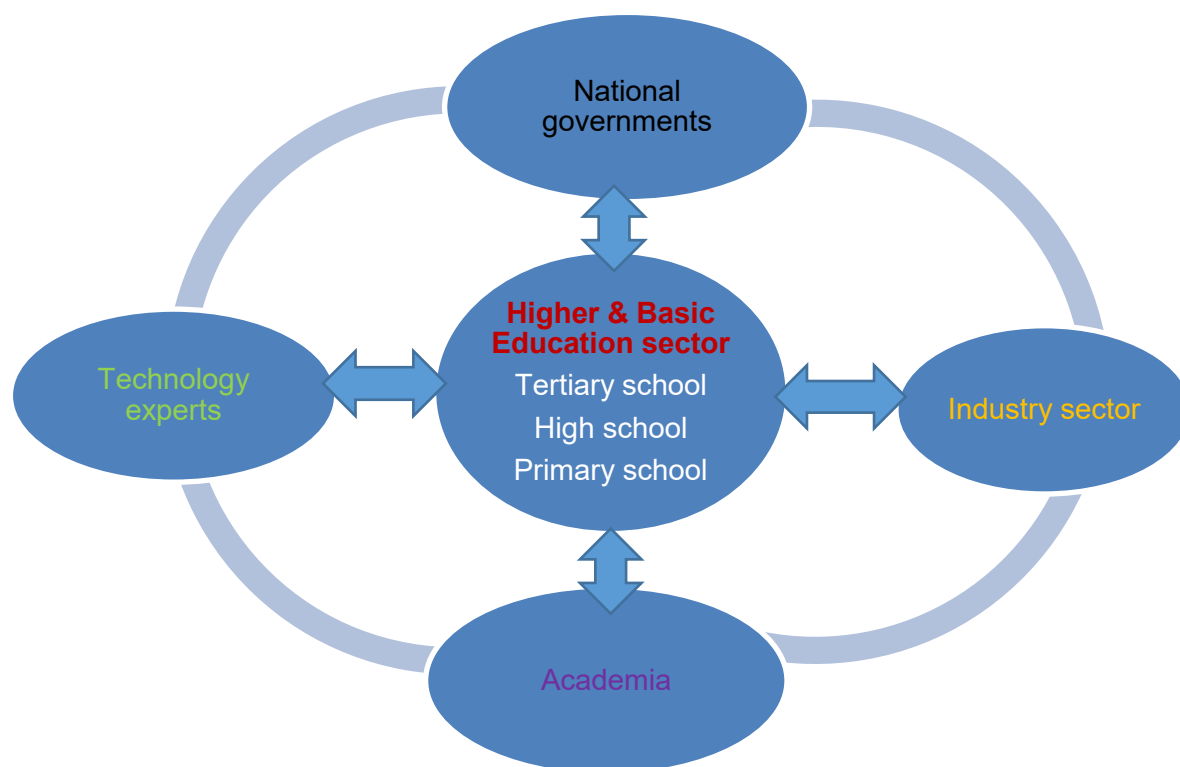
Model developed by the researcher

Figure 1: Model of ICT adoption stakeholder mobilisation

to support the education sector which is the training hub of all skills. The academics have a challenge to conduct research to find the requirements in industry and society to feed the technology experts and the government. This could enhance development and acquisition of more relevant ICTs and their integration to boost the rapid technological take-off characterising the 21st century. Therefore, training of ICT skills should form an integral part of the education system, as these skills are now a basic requirement to fit into the technology-dominated world of work. The formation of public-private partnerships should be effective in order to improve acquisition of the hardware and software required to embrace technology for teaching and learning. This is in the light of shortage of infrastructure indicated in the current findings. Largely, the model implies a holistic approach and a change of stakeholders' mind-sets to achieve this seemingly scary goal of embracing technology to keep abreast with the fast changing world.

CONCLUSION AND IMPLICATIONS OF THE STUDY

Largely, there is a lack of utilisation of the many tools on e-Thuto – more especially by the lecturers. Students are more inclined to use e-Thuto if the instructors take the lead. Students

utilise a relatively wider variety of other ICTs in their learning than lecturers. It is rational to conclude that the students' limited adoption of e-Thuto is perpetuated by the lecturers' lack of utilisation of this software as they are the instructors. This limited adoption of e-Thuto slackens the achievement of one of CUT's goals of being a technologically transformative UoT. It is concluded that there are several problems impeding e-Thuto adoption, which are categorised from some broad perspectives as infrastructural, pedagogical, structural, functional, intellectual and motivational. However, with adequate initiative, motivation and support, these impediments can be curbed.

The theoretical implication of the study is considered from a broad perspective emanating from similar findings in the literature and the current study. A more systematic model of ICT integration in teaching and learning should be developed from the foundational through to tertiary levels of education to keep abreast with the technologically fast-changing world. The practical implications of the study hinge on intensive and continuous training of both staff and students to remain relevant in a technology-dominated world. The training of ICT literacy should be made compulsory from the foundational levels. Similarly, the training and reskilling of teachers in using ICTs should also be made compulsory at the different levels as incentives such as certification have not yielded much positive impact. The use of the e-learning sites available should be made compulsory in educational institutions. The policy implications of the study suggest a radical transformation of the ICT policy in the education system as a whole where ICT integration into the curriculum should be systematic and compulsory. Only then can the shift from the discourse of adoption, to finding effective models of ICT integration into the curriculum be realised.

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