The Impact of Inadequate Information and Communication Technologies on Teaching and Learning of Pre-service Teachers at a Rural University in South Africa

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ABSTRACT The use of information and communication technologies (ICTs) has made impact on institutions of learning across the globe. The purpose of the study was to explore the impact of inadequate ICTs on teaching and learning of pre-service teachers at a rural university in South Africa. The Technological Pedagogical and Content Knowledge theory informed the study. A qualitative approach and a case study design were adopted. A purposive sampling technique was used to identify fifty participants. Data were gathered through face-to-face and focus group interviews. Thematic frames and thick descriptions were used to analyse and present data through verbatim quotations. The study revealed that the institution had limited ICT infrastructure needed to integrate technology in teaching and learning. The study concluded that inadequate ICT infrastructure at the institution deepens the digital divide. Funds should be injected in ICT development projects at the institution to improve the network and buying of more ICT gadgets.

INTRODUCTION

The use of ICTs has impacted on socio-economic development of society and there is great attention in digital technology at institutions of learning. Online education and globalisation had been growing as strategic priorities for many university leaders around the world as observed by Adegbenro et al. (2017). Information and communication technologies are essential at an institution of higher learning. Adegbenro et al. (2017), Du Plessis and Webb (2012) and Haji et al. (2017) point out that 21st century skills are important for students of today because ICT skills prepare the students for the world of work. The growth of ICTs, ease of use, the power and diversity of information transfer allow teachers and students to have access to a world beyond the classroom which is needed by the world of work (Majumdar 2006; Steyn and van Greunen 2014). It is argued that ICTs have the potential to change the nature and process of the learning environment creating a new learning culture and preparing students for the world of work (Jayson et al. 2014). Scholars further argue that interactivity, flexibility and convenience are promoted in the ICTs supported environment. Also ICTs enable

learners to access, extend, transform, and share ideas and information in multi-modal communication styles and format (Majumdar 2006; Montrioux et al. 2015). It helps the learner to share learning resources and spaces, promote learner centred and collaborative learning principles and enhance critical thinking, creative thinking and problem solving skills (Majumdar 2006; Nawaz 2013; Reese 2015).

This study focused on a rural based university in the Chris Hani District Municipality (CHDM) in Eastern Cape, South Africa. The university's catchment area is the disadvantaged communities. The university does not have student accommodation thus students are scattered throughout CHDM. The use of digital technologies in education is of importance because space and time barriers to learning are compressed (Albugami and Ahmed 2015). That is geographic boundaries are torn down by ICTs which make equal information accessible to all who are connected (Idowu and Esere 2013). Institutions of learning are going paperless but is this the case with some rural universities? While blended learning is still in its infancy in some developing countries, few institutions have taken an innovative approach to finding a com-

bined effect between technological innovations and their application in global engagement strategies (Adegbenro et al. 2017). Many universities that are attempting to engage globally through technology, have experienced several barriers related to cost, quality, recognition, and outcomes (Adegbenro et al. 2017). In support of the above point, Asiyai (2014) argues that universities in the developing world including Africa are faced with outside problems emanating from their location and also inside problems emanating from their own culture and structure, these hinder the use of ICTs in teaching and learning. Idowu and Esere (2013), Ouedraogo (2017) and Wentrup et al. (2016) argue that some institutions are not going paperless due to poor and unevenly developed information infrastructure at some African Higher Education institutions.

Background

The use of ICTs in education has gained attention and funds are being routed towards the use of technologies in education. According to Tubin (2006: 13), this is being done “in the belief that ICT is the vehicle that will assist schools in completing the transition from the Industrial to the Information Era...” There is a shift from traditional methods of teaching and learning, the chalk and board, to the use of ICTs. The traditional methods of teaching and learning confine both the lecturer and the student in the lecture room. This sharply contrasts with e-learning which allows learning to take place anytime and anywhere (Kang et al. 2011). Online learning prepares the student for the information society, lifelong learning and the world of work. Collaborating with others across the globe, producing academic work and communicating new knowledge are some of the requirements at the workplace (Steyn and van Greunen 2014). Information and communication technologies such as the internet provide opportunities for the marginalised and disadvantaged students who are not able to attend classes (Sesabo et al. 2015; Shraim and Khalif 2010). Internet allows easy transmission of information, creating global networks and economic interaction. If ICTs are adopted and fully implemented in the education system, they could promote equal access to education for all if all stakeholders have the necessary skills to use ICTs. It is of importance to

note that not all members of society have ICT skills and the income required for an individual to fully utilise ICTs. Furthermore, an ICT driven education allows institutions with inadequate human and material resources, such as journals and textbooks, to overcome the challenge (Krubu and Osawaru 2010). Therefore, this study sought to explore the impact of inadequate ICTs at an institution of higher learning.

Statement of the Problem

Observations made by the researchers of this study clearly show that some rural institutions of higher learning are on the wrong side of the digital divide. Digital divide is defined as the “gaps between individuals, households, business and geographic areas at different socio-economic levels with regard to both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities” (Organisation for Economic Co-operation and Development (OECD) 2001: 5; Wentrup et al. 2016). Persons use ICTs at different levels due to differences in educational, geographic and income levels. Universities situated in rural areas’ catchment area are mostly rural, that is some of the students are from the disadvantaged rural communities. Some students might be belonging to poor households which do not afford ICTs and might also have attended poorly resourced secondary schools, as echoed by Du Plessis and Webb (2012) who argue that disadvantaged schools in South Africa lack resources and the students at such schools remain digital immigrant due to lack of ICT infrastructure such as the internet. It is at an institution of learning where students from various backgrounds are all exposed to ICTs. The researchers have observed that students are unable to research for assignments and study using the internet due to poor network connectivity. Aguele (2007), however, lays the blame on underfunding of higher institutions of learning in Africa and other developing parts of the world. It is difficult if not impossible to sustain the ICT infrastructure if funds are not available to universities. The question is if ICTs are inadequate for the staff and students at some institutions of teaching and learning what then is the impact of inadequate ICTs on teaching and learning at some rural universities in South Africa?

Theoretical Framework

This study was informed by the Technology Pedagogical and Content Knowledge (TPACK) framework which refers to “the synthesised form of knowledge for the purpose of integrating information and communication technology/educational technology into classroom teaching and learning” (Koehler and Mishra 2009: 61). With the rise of blended learning, technology education becomes an integral part of teacher training at some institutions. This study was conducted at a university which trains secondary school teachers who might teach at schools that have already diffused ICT use in teaching and learning. Therefore TPACK model is relevant to the study as it also “functions as a theoretical and a conceptual lens for researchers and educators to measure pre-service and in-service teachers’ readiness to teach effectively with technology” (Drummond and Sweeney 2017; Koehler et al. 2013: 4). The student teachers’ ability to learn via ICTs might be an indication of their ability to integrate the technologies in classroom when they become in-service teachers. Full integration of ICTs by lecturers might be hindered by inadequate technologies at an institution of higher learning and this study sought to explore the impact of such a scenario into teaching and learning.

The teacher’s content knowledge and pedagogy could be associated with effective and efficient teaching (Jang and Chang 2016; Swallow and Olofson 2017). Lecturers’ ICT skills are at a different level, some obtained their degrees way back before technology was as advanced as it is today (Czerniewicz et al. 2006; Kalanda and De Villiers 2013). Lecturers with limited digital skills might only transmit knowledge via ICTs or simply ignore integrating technology in teaching. This is detrimental to the pre-service teachers who are denied the opportunity to learn through technology and practice using ICTs in preparation for the world of work. Also, limited ICT resources at some institutions of learning negatively affect the interplay between technologies, pedagogy, and content (Koehler et al. 2013: 6). At an ill-ICT resourced institution, it is tough for the lecturer to effectively teach through technology regardless of one’s technological, pedagogical and content knowledge. This framework promotes constructive learning, and this is only possible at a university where accessibility to

the internet and the computer is easy for both the student and lecturer (Idowu and Esere 2013).

Objectives of the Study

The objectives of the study were to:

- ♦ Explore the effects of inadequate ICTs on teaching and learning
- ♦ Propose suggestions to the management at the institution.

Literature Review

Information and communication technologies are defined by Czerniewicz et al. (2006: 13) as “the amalgam of computing and telecommunications technologies, including equipment, such as computers, the Internet, tablets, smartboards, CD-ROMS and other software as well as the digital cameras that can be used as part of the teaching and learning process.” If properly integrated into the teaching and learning processes, ICTs can positively impact on teaching and learning (Francis et al. 2017). Information and communication technologies have made electronic learning possible; e-learning is an amalgamation of digital information and communication technologies (Holmes and Gardner 2006: 15; Olele 2014). The use of ICTs enables a person to gather and disseminate information and lecture. Students can interact via Web 2.0 technologies, such as wikis. Teaching and learning can be freed from the walls of the classroom and the class timetable by the World Wide Web (Aguale 2007). The universities should therefore equip employees, such as lecturers with ICT skills and not forgetting the students themselves. The curriculum should also include teaching through ICTs.

Technology has also made formative and summative assessment easy for the lecturer who normally has large classes (Chigona et al. 2010; Kang et al. 2011). Students get immediate feedback through e-assessment, such as online quizzes. The use of discussion forums encourages peer learning and assessment. Vast learning material is easily accessed online, this includes e-books, journals and study guides for students. Assignments are also uploaded online, students get paperless feedback from lecturers and this saves printing paper and cartridge which are expensive (Chigona et al. 2010).

Information and communication technologies have not only changed pedagogics and learning at institutions but also the administration of the institutions. Data such as, institutional policies, time-tables, official student results and examination papers can be stored electronically for easy access and sharing (Idowu and Esere 2013). An institution with inadequate ICTs burdens not only the academic staff but also the non-academic with a lot of paperwork which can be misplaced or destroyed by natural disasters (Chigona et al. 2010).

The unavailability of some ICTs such as data projectors, micro-phones, computers in lecture theatres and poor network connection is a thorn in the flesh. It leads the lecturer to resort to the face-to-face traditional method of teaching (Du Plessis and Webb 2012; Spelman and Marongwe 2018; Youssef and Mohammed 2016). This also promotes lecturer centred teaching methods which thwarts the development of independent thinking, creativity and growth among students. Other ICTs which enhance learning and are unavailable to all lecturers include laptops and home internet, this is not only detrimental to the production of quality academic work but it also makes it difficult for the lecturer to be fully involved in research and community engagement. Inadequate ICT infrastructure adversely impacts teaching and learning at an institution. Internet is at the core of the socio-technical pattern of an institution and those with little or no access to it are on the wrong side of the digital divide (Thaver 2015; Wentrup et al. 2016).

Furthermore, inadequate ICTs at an institution of learning hinder the progression from traditional methods of learning to e-learning. E-learning is defined as the “flexible learning using ICT resources, tools and applications, focusing on; accessing information, interaction among teachers, learners, and the online environment, collaborative learning, and production of materials, resources and learning experiences” (Department of Education 2004: 15). Accessibility to computers in the laboratory is difficult for the students because the desktop computers are inadequate compared to high numbers of students enrolled (Albugami and Ahmed 2015; Chigona et al. 2010; Steyn and van Greunen 2014). Aguele (2007) also argues that in the developing countries, the provision of hardware and bandwidth is still problematic. Unreliable tele-

communication services especially in remote and rural areas hinder ICT implementation, not forgetting the exorbitant costs of bandwidth. These challenges negatively impacts the use of ICTs in teaching and learning. Few ICTs at university might mean that students are not fully prepared for the world of work and cannot also fully participate in social forums.

Limited technologies at some rural institutions hinder the use of ICTs in the lecture room and also other online activities done anywhere and anytime, such as discussion forums and collaborative writing (Montrieux et al. 2015). Inadequate ICTs perpetuate digital divide within the institution. The successful implementation of technologies in teaching and learning is also affected by the level of ICT skills possessed by students. Some are from disadvantaged homes which may not afford ICTs, and joining an institution with limited ICT infrastructure is a double tragedy because it is difficult for them to develop advanced ICT skills. Students from families which can afford buying ICT gadgets are on the right side of the digital divide and the opposite is true for those students from disadvantaged families (Du Plessis and Webb 2012). Hence, it is also a challenge for the lecturer to fully integrate technology in teaching and learning processes. The lecturer might also be less prepared to use ICTs in teaching and learning. There is a danger that a teacher training university with inadequate ICT infrastructure might produce teachers who only have content and pedagogy knowledge, and lack the technological knowledge domain required by the contemporary/21st century teacher and as suggested by the TPACK theory adopted in this study.

METHODOLOGY

The study adopted the qualitative research approach as it sought to explore the impact of inadequate ICTs on teaching and learning. Creswell (2014) and Mouton and Prozesky (2001) state that qualitative research attempts to produce findings arrived at from real-world settings where the phenomenon of interest unfolds naturally hence chosen in this study. The case study design was utilised since it allows a researcher to focus on a small scale study primarily for rigor and in-depth understanding (Maree 2007). A case study design was considered suitable also because it provides an in-depth study

of a particular situation rather than a sweeping statistical survey, a method used to narrow down a very broad field of research into one that is easily researchable (Maphosa et al. 2008; Marongwe et al. 2016).

In-depth face-to-face interviews were used as the key source of data gathering because it provides access to what is inside the person's head and that it makes it possible to size what a person knows (knowledge and information) and what a person thinks (attitudes and beliefs) (Bless et al. 2013; Cohen et al. 2007). Furthermore, Mncube (2009) states that interviews help to understand the internal dynamics of the operative of ICTs at this rural university. The aim of using interviews was to get "under the skin" for the participants to reveal the opinions and experiences regarding the use of ICTs. Face-to-face interviews were complemented by focus group interviews for the same reasons stated above.

Purposive sampling technique was used to draw fifty participants. Five lecturers and five students were considered for the interviews while forty students participated in the focus group interviews of ten students per group. The figure may appear small, but it aligns to a qualitative approach. Creswell (2014, 2007) substantiates this view when he argues that a sample size of this nature suits a qualitative study.

Data Analysis and Presentation

Data collected was analysed and presented qualitatively using the thematic approach. Verbatim quotations and thick descriptions were also employed to present data.

Ethical Considerations

Ethics is "concerned with the attempt to formulate codes and principles of moral behaviour" (May 2011: 61), therefore, research ethics guide research, from commencement to the end of the study (Bless et al. 2013; Bryman and Bell 2011). Human subjects were involved in this study and the code of conduct was honoured. The researchers sought permission to conduct research from the University Campus Research Office. Furthermore, anonymity and confidentiality of research participants were observed. Protecting participants' identity enhances validity since the participants may share sensitive information (Kuada 2012; Ogden 2008). The research-

ers strictly followed the research ethics and collected data within the university premises where participants were protected from harm.

RESULTS

From the findings themes related to the problem statement emerged. These themes are discussed below and illustrated by means of quotations from the interview and focus group interview texts. The quotations are presented verbatim.

- ♦ Lecturers and students lacked digital competency to integrate technology
- ♦ Shortage of instructional materials and ICTs
- ♦ Suggestions to mitigate the challenges faced

Coding: Lecturer- **L1-5**, Student Interview- **SI 1-5** and Student Focus Group- **SFG 1-4**

Most Lecturers and Students Lacked Digital Competency to Integrate Technology

All participants used in the study were asked to respond to the question on knowledge of ICTs skills. The recurring key theme throughout this study was that most lecturers and students had basic ICT skills but lacked digital competency to integrate technology in teaching and learning. The phrases below support this view, **L3** expressed that:

*I only have basic ICT skills which I obtained years back and I am not confident to use ICTs for fear of being mocked by students, that's why I resort to traditional methods of teaching and learning. I love my duster, chalk and chalkboard they will never fail and embarrass me. Our university doesn't have enough ICT gadgets, it is a rural university and we are not exposed to technology that much (**L3**).*

L5 in the same line of thought indicated that:

There are so many issues that affect what happens and why we aren't technologically orientated. How are you expected to expose students to technology when you as a lecturer don't know how to use it competently? I remember that we were once workshopped for one day on how to use WiseUp. We were shown everything in one day how to upload assignments, create folders, etc. of which I can't even remember how to do it.

L1 in support of the above view vehemently lamented that:

The network is always down-Monday to Friday no internet connections. There are old ICT gadgets which are outdated. The other ones need repair and good maintenance. Ordinary lecturers don't have even a simple laptop and you are expected to set tests, use projectors, access internet, how then do we do it? In short there is no ICT infrastructure here.

The interviewed students also shared the same experiences as expressed above by their lecturers.

SI 2 highlighted that:

My ICT skills are limited. I was at a high school where we were never exposed to computers. I thought by enrolling at a university my technology thirsty was going to be quenched but unfortunately it's a dream far to come true. Seemingly our university doesn't have enough space for us students, the computer laboratory is too small with only a few functional computers and it is reserved for students who have an IT component.

The **SFG** reiterated the above views and indicated that their ICT knowledge was not sound, there was shortage of ICT gadgets and network failure all the time, lecturers were incompetent when it comes to technology use and there was one size fit all training session by the university.

Shortage of Instructional Materials and ICTs

The recurring key theme throughout this study was that the university faced a myriad of challenges when it comes to acquiring of ICT gadgets and other instructional materials.

L2 painfully pointed out that:

An institution of higher learning should provide and expose both lecturers and students to technology to show that it is really a university preparing student for the world of work. Our students are not technologically competent when you compare them with students from other universities which have proper ICT infrastructure. What we have are the old broken gadgets. We don't have the instructional materials and the ICT gadgets are not adequate. No overhead projectors, printers, photocopiers and other basics. If you need to use them one has to book.

SI 3 echoed the same idea as expressed above by **L2** that:

As students we can't type our assignments because the university doesn't have adequate

computers, can't access internet to look for information and do our research. The study materials we have are old and not enough. Sometimes we go for a week without internet connection. The furniture suitable for computer usage is inadequate and this has a bearing on our studies that translates to the way we perform academically. We were not given laptops or desktop computers; the university is not supporting us on that front.

It should be noted that data reached saturation on shortage of materials and ICT infrastructure because all participants interviewed concurred and kept repeating the ideas that were raised by other interviewees.

The other key question asked to the participants was based on what the university could to address the problems raised in the study. Different views were collected and below are a few examples taken among the many views. The **SFG** uttered:

We want our campus to have an ICT committee that compromise of students too and all students should be given an opportunity to use computers at University level. Study materials should be sourced.

SI 4 suggested that:

The university should pay attention to the training of staff and students on ICTs usage and there should be motivation and follow up because some students can't use ICTs because of their lecturers and we fail because of that.

SI 5 proposed that:

As a rural university that is still growing I think management should have a campus based ICT policy and there should be checks and balance to ensure that the policy is implemented. The policy should show the purchasing, repairing, maintenance and usage of ICTs.

L5 also suggested that:

Our ICT infrastructure doesn't match the size of classes we are having. The enrolment is increasing yearly but the materials and ICTs gadgets are not expanding, I therefore, suggest that the university should look for donors and also apply for funding because we can't have a university whose standards are below those ones of a high school. The teachers we are training are incompetent when it comes to ICT usage.

DISCUSSION

The research findings revealed that most of the lecturers interviewed only had basic ICT

skills, limited ICT infrastructure and lack digital competency to fully integrate technology in teaching and learning. They pointed out that they were trained on how to upload teaching material on blackboard but were not taught how to integrate ICTs in teaching and learning and could not even remember how to upload the teaching material. It has been established from the study that the training lecturers and students got was one day training blanketing all the competent and incompetent users of computers. This finding is in line with what was established by Koehler and Mishra (2009) where the training sessions were “one size fits all” yet lecturers’ ICT skills and subject content differed. This impacted negatively on some lecturers’ execution of duties using ICTs because so could not know how to integrate ICTs in teaching and learning of their particular subject, since they had trained as teachers in the 80s and had never used computers (Adegbenro et al. 2017). Some lecturers also said that uploading study material on blackboard is only beneficial to students who are digitally competent. This also affected some students interviewed who echoed the same sentiments that not all of them had digital skills and the incompetency had a bearing on their study skills, presentation of assignments etc. which subsequently impacted negatively on their academic performance. This supports the finding by Alzahrani (2017) that training in ICT skills is thus required for lecturers and students.

It emerged from the study that some students attended secondary schools where they were never taught computer skills and their homes did not have computers. It was revealed that computer lessons were only done by CAT students at the high school where some learnt so majority did not know how to use the computer. This clearly shows that digital divide also exists in some secondary schools and is penetrating up to some institutions of higher learning as evidenced by the research findings in this study. The above finding is in line with the finding by Ouedraogo (2017).

Furthermore, it surfaced from the study that this growing rural university was ill-equipped facing a critical shortage of ICT gadgets and instructional materials. Nawaz’s (2013) finding that some institutions of learning in the developing countries face challenges which include high learner-teacher ratio and shortage of instructional materials supports the findings in this

study (Ohiwerei et al. 2013). There were very few computer laboratories at the university, some of the desktop computers were not functioning at the time that this study was carried out. Students were also unable to access study material on blackboard when the internet is unavailable; this forced lecturers to resort to hard copy study material and traditional teaching methodology. The study also stated that accessibility to overhead projectors, printers, photocopiers and the internet was a major challenge at the institution.

It stemmed from the study that the campus had a serious shortage of ICT gadgets to the extent that if a lecturer wants to use an overhead projector in class, an individual had to book for it, otherwise he won’t be able to use it. Albugami and Ahmed (2015) argue that an institution of learning should support teachers so that they are stimulated into using ICTs in teaching and learning (Haji et al. 2017). It was indicated that some lecturers were not given a laptop or a desktop computer, and were using their personal laptop showing that there was no support at this particular campus.

The study also noted that network was very poor and sometimes unavailable at all and students and lecturers were not able to research for assignments and lecturing respectively. This negatively affected lecturers and students who wanted to research and upload study material on blackboard. Talking of collaborative learning with fellow classmates and also with students from other universities will be far-fetched considering the few ICTs available for the students and the limited ICT skills among some students and lecturers (Drummond and Sweeney 2017). This means that some students are left of the information ring. Inadequate ICTs are a barrier to teaching and learning. Participants in the study complained that some few lecturers would tell them that they uploaded some material on Wiseup, but then failed to access it because of internet connection failure as established by Mafuna and Marongwe (2018). Most students could not afford to buy data bundles and some did not even have laptops. Such sentiments are not surprising considering the fact that the institution is a rural university and some of the students are from disadvantaged families who may not afford buying laptops for their children.

It is at institutions of learning where students regardless of the social backgrounds are exposed and taught digital skills in preparation for the

world of work and lifelong learning (Du Plessis and Webb 2012; Department of Education 2004). However, the observations done by the researchers proved otherwise. There were few desktop computers resulting in at least four students sharing a computer and only those with ICT skills were in control whilst the rest simply watched, thus digital divide deepens. The researchers also observed that students were trained ICT skills once and most of their lectures do not include technologies, only projectors were used for presentations by some lecturers and students. Furthermore, computer lessons that some students receive in class are theoretical in nature hence have no impact on their studies and society at large. Inadequate ICT infrastructure at an institution of learning also hampers constructive learning as also established by Alzahrani (2017).

CONCLUSION

Inadequate ICT infrastructure at an institution of learning does not only perpetuate the widening of the digital divide, but it also deepens the divide. Students who attended secondary schools where they were not taught computer skills remain on the wrong side of the digital divide. Therefore, the study can conclude that some of the student teachers at this institution leave the university with inadequate computer skills and become in-service teachers who would be unable to integrate technology during teaching and learning at secondary schools, hence they are “half-baked cakes”. This institution is thus only equipping students with pedagogical and content knowledge domains and the technological knowledge domain is lacking, yet 21st century skills are a necessity for one to fully participate in society. There is need for institutions of learning to fully equip themselves to ICT infrastructure and also digital skills so that they do not remain outside the information ring.

RECOMMENDATIONS

The above findings clearly show that the issue of inadequate ICT infrastructure at a higher institution of learning requires urgent attention. The paper recommends that money be injected in ICT development projects at the institution, such as improving the network and buying more ICT gadgets. Digital skills training sessions for lecturers and students should be frequently

done so that they frequently improve ICT skills and be able to adapt to new technologies. The paper further recommends the formation of an ICT committee to look into the issues raised above. The researchers also recommend that all lecture rooms should have fitted overhead projectors, computers, microphones, etc. for lecturers and students not to scramble for a few ICT gadgets in the campus.

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