SOUTH AFRICA INTERNATIONAL CONFERENCE ON EDUCATIONAL TECHNOLOGIES

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**Preface**

We live in a world where nothing is constant except change. As we all know, technology is on the forefront of that change, influencing the world of work more substantively than anything else. As educationists, we need to be aware of how technologies influence young people, in terms of how they think and how these technologies can be harnessed to make education relevant.

The South Africa International Conference on Educational Technologies (SACET) is a scientific forum for policymakers, academics and researchers to network and present a wide range of views to address issues relating to educational technologies. It is the intension of African Academic Research Forum (AARF) to regularly bring colleagues from Africa and beyond together to ensure that there is a cross-pollination of ideas including sharing best practice from our domains. It was on this basis that we themed this 4th South Africa International Conference on Educational technologies (SAICET) to be: Beyond Familiar Territories. The theme is in recognition of the fact that we need to think beyond our outdated teaching practices in line with the technology savvy student we encounter in our lecture halls.

We received a total 56 submissions for presentation at the conference, 32 of which were meant to be long papers. This book of Proceedings contains 20 long papers that had gone through a rigorous, blind peer review process and were accepted for publication.

We thank the keynote speaker, the workshop presenters, the reviewers of the full papers, and the editors of proceedings who have worked diligently to make the conference a success.

SAICET will continue to be an annual event, so we look forward to seeing you and many other participants next year, at SAICET 2019.

Prof A. Mji
Conference Chair

**List of Reviewers**

The organising committee of SAICET 2018 would like to greatly thank the following reviewers who took the pains to review the conference papers.

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**Review Process**

In total, 55 manuscripts in different areas within the field of Educational technology were received. Of these manuscripts, 32 were intended to be full papers while the rest were to be short papers. All the full manuscripts were subjected to a double blind review. The reviews were carried out by experts from different countries. Their brief was to base their reviews on 21 criteria they were supplied with. They were also requested to look at the manuscripts with the aim of assisting authors to produce good quality presentations.

Following the review process, the editorial committee considered the reviewers' comments and 8 manuscripts were found to be unsuitable for publication. Reports were forwarded to the remaining 24 authors with suggestions of what needed to be addressed. After receiving the re-worked manuscripts, the editorial committee finally accepted 20 for inclusion in the proceedings. This means that the acceptance rate was just about 63%.

**Editors**

U. I. Ogbonnaya
S. Simelane-Mnisi

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# LEARNING IN OPEN AND DISTANCE: POSTGRADUATE STUDENTS TELL THEIR E-LEARNING EXPERIENCES

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**Abstract**
E-learning experiences of MEd in ODL students in a dual university initiative do not enjoy a wide research coverage as yet. The purpose of this variation theory-framed phenomenographic was thus to explore e-learning experiences of the University of South Africa (Unisa)'s academic staff enrolled in the MEd in ODL programme between 2012 and 2015, as a dual initiative with University of Maryland University College (UMUC). The aim of the programme is to train Unisa's academic staff to teach via online technology – a requirement in an ODL environment. Seven staff members who participated in the programme were interviewed. Findings were reported under three themes, which are e-learning experiences, object of learning experiences and social media experiences. The participants' views presented under these themes show that the participants benefited from the programme, but that there were challenges that they faced related to e-learning.

**Keywords:** Open and distance learning; e-learning experiences; phenomenography; students; variation theory, university, technology.

## 1. Introduction

This phenomenographic study explored the e-learning experiences of the staff members of Unisa enrolled in the dual Unisa–UMUC MEd in ODL programme for the period 2012 to 2015. E-learning is flexible learning that technology-dependent (Ally, 2008). It uses internet-based technological tools and resources to delivery teaching, research, assessment and communication (Michigan Department of Education, 2014). With the help of the e-learning platform that these technological tools can offer, space and time do not totally control teaching and learning activities between the teacher and student (Higher Education Authority, 2009). On the other hand, e-learning experiences are students' activities with computers and understanding, which can reflect their attitudes expressed through their likes, dislikes, self-confidence of self-efficacy and ideas about the worthiness of a course (Abbiss, 2006, p. 34).

The above programme is a partnership project between Unisa and UMUC since 2012, to further develop Unisa's staff who works in an ODL context. Most university lecturers including Unisa's lack an ODL qualification. The MEd in ODL addresses the existing gap in the teaching in ODL and e-learning skills demanded by the technological and digital era. UMUC offers the coursework component and Unisa offers two additional modules and dissertation component. The introduction of this MEd in ODL programme at Unisa triggered this study. There is wide coverage of e-learning students' experiences in ODL literature, but not as it pertains to dual university initiatives, particularly for those students enrolled for MEd in ODL. The experiences of academics enrolled in the programme can help inform e-learning dependent programmes at Unisa in future. The following question was posited in respect of Unisa staff who were part of this programme: *What are Unisa staff members' e-learning experiences of the MEd in ODL offered by Unisa and UMUC?*

## 2. Theoretical lens and literature study

This study was framed in a variation theory in order to flash out variations of students' experiences. Variation theory is the tradition of phenomenographic research (Marton, 2000; Tong, 2012). According to this theory there are varied ways to experience a particular phenomenon due to a considerable variation in people's discernment (Tong, 2012). Students experience learning in varied ways based on their understandings and epistemologies. The theory stresses the object of learning, i.e. what is or is to be learnt (Marton *et al*., 2003). Variation theory was thus found relevant in this study as it helped to create an understanding of the varied experiences of MEd in ODL students, who are Unisa staff.

The advancement and complexities of the e-learning technology and social media tools dictate that learning be effectively delivered through e-platforms such as WebCT, Sakai and Blackboard. These learning management platforms offer media tools such as blogs, discussion forums and wikis. This will then make students participate comfortably in discussions, completing of assignments, posting their contribution and responding to other students' postings (Government Accountability Office, 2011). However, given the digital immigrant nature of many teachers (who belong to the old school of traditional teaching), compared to the digital natives (their students who belong to the much younger generation – computer culture), it is imperative that students such as the ones who participated in this study be orientated towards the use of the e-learning technology as a priority. The challenges faced by students creates this fervent need. Teaching in an ODL institution, where lecturers rarely meet students face-to-face heightens this need. Yet students' orientation into online courses is reportedly an under-researched subject (Gullixon, 2010; Melick, 2014). Insufficient orientation of students into an e-based learning programmes is much lower (Simpson, 2012), thus attributable to the low retention of students in the programme (Jones, 2013). Jones (2013) reports a USA-based study in which College students were orientated face-to-face in ten years, but were confused and unable to complete their online coursework from home after the orientation. Technical problems such as incorrect software and computers were blamed for their problematic setup (Jones, 2013, p. 44). This situation highlights the importance of student orientation into a programme in order to induce their active participation.

Properly orientated into the technology for learning, students can enjoy actively engaging in learning and constructing knowledge (Zhu, 2012). Students form a web of connections which enable them to reach each other through online technological means (Siemens, Downs & Tittenberger, 2009). According to Peters (2002), students' knowledge construction has strongly influenced online education and converted teacher-controlled teaching to student-controlled teaching lately. This can lead to meaningful learning and assessment of students' learning as it mostly happens online through quizzes, papers, tests, group projects, discussion contributions, online educational games, reflections and visual representations (Arend, 2007). Arend has found students' assessment compromised as it emphasises the grading that they get for participating in online learning activities more than the quality of their work.

## 3. Methodology

This study followed a phenomenographic design, which, in line with variation theory, reveals different ways a phenomenon is experienced (Suhonen, Thompson, Davies and Kinshuk, 2008). Varied experiences of participants received exploration in this study. Seven participants were purposively selected from the list of staff members enrolled in the MEd in

ODL programme. One participant, who was not included in the main data collection, was used to pre-test the semi-structured interview guide to validate it (Delport and Roestenburg, 2011; Foster, 2013). The seven participants were interviewed individually for about 35 minutes each ultimately. These participants were not coerced to participate in the study in keeping with ethical standard in social science research. Their names were concealed for confidentiality purposes. The interviews were duly recorded and analysed during data gathering for possible modification of the gathering instrument and to gauge saturation.

Rigour and bracketing as pertaining to personal perceptions (subjectivity) were accounted for. Member-checking and participant-based triangulation were performed on the gathered data. The analysis followed reading each interview transcript severally and marking words and phrases that emerged from the data suing three indicators as a guide. These were frequency of the words or phrases, position of statements, and statements that appeared important to the participants. The analysis and interpretation followed a thematic approach according to the three themes, i.e. e-learning experiences, object of learning experiences and social media experiences. An analysis based on the variations in experiences is illustrated in table 1.

**Table 2: Participants' variations of experiences according to the themes**

| **Theme 1** | **Theme 2** | **Theme 3** |
|---|---|---|
| **1. E-learning experiences** | **2. Object of learning experiences** | **3. Social media experiences** |
| • Learning about ODL | • Active participation and criticality | • Social media: Twitter, Blogger, wikis, Facebook, etc. |
| • Student orientation | • Variety of methods | |
| | | |

The thick descriptions of methodology and data analysis processes pointed to the reliability of the methods used.

A full account of the methods is available on the institutional repository at: http://encore.unisa.ac.za/iii/encore/record/C__Rx1015725__Sgumbo__Orightresult__U__X4?lang=engandsuite=cobalt.

## 4. Findings

4.1 An overview of findings

A glimpse of the findings is presented in table 1, which includes their profile. This is followed by more detailed presentation and discussion.

**Table 1: Participants' profile**

| **Item** | **Participant** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** |
| **Gender** | F | F | M | M | F | F | F |
| **Age range** | 40–49 | 50–59+ | 50–59+ | 40–49 | 40–49 | 30–39 | 50–59+ |
| **Race** | Black | Black | Black | Black | Black | Black | Black |
| **Studied online before?** | No | No | No | No | Yes | Yes | Yes |
| **Designation** | Col. of Education | DSPQA | Col. of Education | Col of Science, Engineering & Technology | Col. of Graduate Studies | Col. of Graduate Studies | Directorate: Cur & Learning Devt |

| Item | Participant | | | | | | |
|---|---|---|---|---|---|---|---|
| | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** |
| **E-learning experiences** | Great and informative | Well done | Theoretical than practical | Learn about ODL to use skills in my tuition | Relevant | Good | Good and welcoming |
| **Object of learning experiences** | Videos, audio streaming, conferences and group work assisted students to understand concepts | Various teaching methods made concepts clear | I assumed some leadership position in a group | I participated in all discussion topics | Resources were provided and I could share my experiences | Equips me with technologic al skills | |
| **Social media experiences** | | I found it hard to keep following various networks that I created during | Formed a community of learning | I wish I could use them but myUnisa does not allow them | | | |

**4.2 E-learning experiences**

Participants stated their reasons to enrol in the ODL programme, such as the basic understanding of ODL, developmental, knowledge and skills. P2 and P3 felt that the programme would increase their understanding more in education and ODL technology. P4 *was new at Unisa and saw the programme as an opportunity to learn about ODL so that I can use acquired skills in my tuition*. Participants' mixed reactions about the programme could be explained in the following manner: *good and welcoming* (P7), *necessary, relevant and prepared me* (P5), *really great and gave me information* (P1), *good* (P6). To P1 orientation into the programme was needed for someone who has never studied online before. However, to P3, the orientation was *more theoretical than practical*, and challenging to P4 *especially in cases where I started late after others had begun*.

New learning approaches in the programme demanded participants to adapt quickly. According to P4 and P5 the course was demanding in terms of time needed to complete assignments, participate in online discussion and readings. The weekly submission of tasks presented *a lot of pressure that needed discipline and determination* (P1). P2 felt that the programme was *very intensive* for someone who works, and this affected timeous submission of assignments. She experienced *the foundation module had more than four actions per week requiring research and hands-on experience of technology that was not too familiar for a beginner; I did not expect to pass*. P1 had to adjust and acquire skills *on how to approach e-learning*. The programme needed a 24-hour internet access and connection *in order to contribute to the online discussions* (P6). But the programme was easier for P3 because he *was technologically and computer literate*. The programme brought transformation to P4's practice as he now understood *what students go through in order to learn online;* to P2 for now being *sensitive to students' explanations of why they did not complete work on time;* to P6 for gaining a better *understanding of the theories on design and facilitation of e-learning*; to P2 for being *equipped for e-learning*.

The participants also variedly experienced a change of mind in the programme. For instance, P1 realised that *it is possible to work as a group in an online classroom*, and P4 realised that there was a lot that one could learn online. P5 changed her mind about gaming as she stated, *I thought that gaming was a waste of time but the assignment on gaming changed my mind into recognising the beneficial and educational parts of gaming.* E-learning enriched the pedagogical strategies of P2 and P3. P7 *saw for the first time constructivism promoting social and communication skills by creating a classroom environment that emphasises collaboration and exchange of ideas.* This enabled collaboration and contribution of ideas on discussion forum.

Variations were more illuminated through participants' views about their educational backgrounds. P3 remarked that students did not come from the same educational background. As a result, according to P2, most Unisa staff members were not able to finish the programme. P4 felt that the participants had different learning experiences; *those who were not new to an education qualification, e-learning, and had plenty of time would have a different learning experience.* These variations were topped with how the participants battled with a few issues: *navigate the different tools or platform of myUMUC* (P3); *interpretation of what the instructor said was sometimes very difficult. Group work and discussion forums grading were sometimes very subjective* (P7). Some participants felt positive about assessment, while others did not. P2 doubted the fairness of assessment, and P7 felt that assessment for group work and discussion forum was subjective.

**4.3 Object of learning experiences**

Under this theme the participants shared their views about knowledge construction. P7 *saw for the first time constructivism promoting social and communication skills by creating a classroom environment that emphasises collaboration and exchange of ideas.* The participants participated actively in online discussion forums and completion of tasks and assignments. P4 *participated in all discussion topics every week*, while P7 did most of the work on her own. P1 felt that she *fully participated in the group project assignment.* P1 participated in the co-creation of knowledge from the theories learned in the course. *Learning was a two-way traffic, instructors were also learning from us because we brought a particular experience* (P3). But according to P2 *there was no time as the most important thing was to meet deadlines for the submission of assignments*.

In addition, the participants experienced varied method of explaining difficult concepts, e.g. *videos, audio streaming, conferences and group work were used to assist students to understand concepts* (P1). But from a constructivist perspective, P2 felt that class interaction was the most viable method to explain the concepts through *various teaching methods.* At times it was not clear what the instructors really wanted from the students, had difficulty in presenting the course, were not always present particularly on discussion platform. Some participants felt that they wanted to work individually, while others felt that they owned their learning experiences Despite this the participants had a thirst to learn about new trends in ODL. P5 was motivated to learn new concepts, pedagogies and technologies such as ooVoo. P1 learnt about wanted to develop herself by seeking how ODL operates. P6 would *be among the few colleagues at Unisa ready to contribute towards successful roll-out of ODL.*

**4.4 Social media experiences**

Learning about the social media tools such as Twitter, Blogger, Facebook and blogs transformed the participants' approach to their work at Unisa. Social media made the participants to form *a community of learning* (P3). P5 even started a blog on distance education. P1 experimented with a number of social media tools such as blogs and YouTube and created a Blog to interact with her students. P4 stated that learning about social media opened his eyes, since he did not know before that social media could be used for educational purposes. P2 *found it hard to keep following various networks created because of time constraints.*

**5. Discussion**

Unisa is an ODL institution, hence, consideration of this MEd in ODL brought hope to develop and build confidence in the staff participating in the programme. The participants' positive views attest to this claim. Engaging in an e-learning-based programme enabled the participants to confront their fears about technology which could make them service their students effectively in an ODL environment. The participants had the opportunity to explore a variety of social media tools. They realised the educational value of social media tools. The ability to manipulate Web 2.0 technology can transform the lecturers' teaching to the benefit of students (Alexander & Levine, 2008; Zhang & Kelly, 2010). This makes the MEd in ODL even more necessary – generally, academics are currently teaching the net generation; teaching in distance education environments means academics should master instructional technologies and design their programmes from such perspective. Furthermore, understanding the theories of distance education is important as it makes students understand ODL better. The e-learning platform also allows the co-creation of knowledge, owning to the e-learning experiences and collaboration that can be enjoyed (Peters, 2002). In this light the study's findings point to social constructivism through which the participants approached their learning as the learning activities were designed such that they encouraged the contribution of ideas within a group platform. Students who are engaged in collaborative learning conditions experience more constructive learning processes (Zhu, 2012; Council on Higher Education, 2014).

However, the findings reveal two main sticking points that threaten the realisation of the maximum benefits of the MEd in ODL programme. These are:

- Orientation into the programme that does not familiarise the students with what is expected from them and the technological tools that they will engage.
- Workload of the programme versus the time that the students have as employees.

Orientation into any programme is something that cannot be taken at face value as that can negatively impact on the performance of the students (Borzath *et al*., 2004; Kelly, 2013). It can discourage students from enrolling or delving deeper into the programme. This study reveals that orientation into the MEd in ODL is more theoretical than practical. The above age categories of the students in the programme show that these are older people who could be technophobic to some extent – participants expressed their concerns in that regard. Variation theory helps with the understanding participants' experiences as informed by factors such as age, culture, context, etc as it is shown with the factor of age here. The phenomenon of variation (Marton, 2000; Suhonen *et al.*, 2008) noticed in the study is the participants' experiences of e-learning in the MEd in ODL. This theory flashes variation in an aspect as experienced and can be discerned (Tong, 2012, p. 3) as the object of learning

(Marton *et al.*, 2003, p. 16). The participants in the programme found it intensive given that they have work and family responsibilities as older people who are employed as well. Tight submission dates for the work to be done in the programme may affect the quality of the work as well as discourage the students. Fetzner (2013) observes that students drop out because they cannot cope with the course schedule.

## 6. Implications

This MEd in ODL potentially offers learning and career pathways to academia, and provides students with opportunities for online access, exit points and articulation with programmes at other ODL courses elsewhere. To prepare students to develop the knowledge and skills implied in the purpose of this programme and their general expectations, the MEd in ODL has been structured in line with the qualification registered by the South African Qualifications Authority (SAQA) on the Higher Education Qualifications Framework (HEQF). There were students who were new and inexperienced regarding e-learning technologies and those who were more experienced. This meant that the participants experienced transformation in various ways. As academics, they felt that they had developed a new understanding of how their students at Unisa experienced learning in an ODL context. As a result, the participants understood how they should support their students towards success. This change of mindset can contribute towards improved cognitive student support. It can also contribute towards more positive outcomes for ODL students in general as a way of countering the high dropout rates at ODL institutions.

Lack of orientation into ODL and e-learning especially in participants enrolled in the MEd in ODL, suggests a more focused orientation programme that would see the success of the dual degree between Unisa and UMUC. The candidates were clearly not prepared for the demands of the interactions and the input needed to achieve success in the MEd in ODL, which frustrated some badly. It is therefore recommended that orientation include a part where Unisa staff enrolled in the MEd in ODL receive initial hands-on training so that they can understand how the programme is presented.

A needs analysis is needed in order to assess the online technological knowledge and skills of the students prior to the orientation programme. This analysis should be done so that the necessary intervention initiatives that can provide on-time learning support. Unisa staff who were trained in this programme should address the strategy of contributing towards knowledge creation more effectively in e-learning. This could be done by creating opportunities for students to take part in social media tools and other e-learning technologies available on the myUnisa platform. Additionally, student support strategies based on the technology-enhanced learning need to be a priority in e-learning at Unisa. A good balance between the demands of work in the programme, employment and time should be ensured so that students can cope well in the programme.

Constructivism is such an integral part of e-learning. The fact that some of the participants did not take part in the co-construction of knowledge is a reason why more in-depth research is necessary. This study validates the fact that not all academics are on the same page regarding e-learning strategies and educational theories in the digital age. It is therefore important to consider the re-training of academics to ensure that students get the learning experiences and support they need for the workplace. This way Unisa may realise the good outcomes of student support from the e-learning perspective.

## 7. Conclusion

This study investigated students' experiences of studying the MEd in ODL. The findings showed varied participants' experiences. These can inform decisions that might be taken to improve the offering of e-learning programmes. The most valuable contribution of this study is that e-learning students at all levels need orientation and support to prevent them from dropping out of courses. This study indicated that even when professional staff member enrol for an e-learning programme, they get frustrated and drop out because they cannot master e-learning technology. A further aspect is the need to provide academic support to students to assist them in mastering the academic work on time and planning their learning journey in advance.

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# CHALLENGES OF IMPLEMENTINGDIGITAL TECHNOLOGY IN TEACHING AND LEARNING IN SOUTH AFRICAN RURAL SCHOOLS

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## Abstract

The purpose of this study was to explore educators' perceptions towards the use of digital technology in South African rural schools. Specifically, this was because the Department of Education (DoE) has identified twenty secondary schools to pilot the technology project to be used to develop educators' skills, knowledge and to improve learners' performance. The population of this study comprises 50 educators of rural schools. The participants' ages range from 29 years and 39 years and from 40 and above. One-on-one interviews were used to collect data. The interviews were conducted with educators purposefully selected from the study site. The factors affecting the implementation of digital technology in South African rural schools were explored. The results of this study revealed that ICT qualifications, skills, knowledge, finance and infrastructure impacted negatively on the implementation of digital technology in rural schools. For example, educators painted a bleak picture about lack of modern teaching technology in schools. One limitation of this study was the fact that there was a relatively small number of respondents compared with what could have been accessed had a questionnaire been used. It is therefore crucial for the department of education to pay crucial attention to the challenges facing the implementation of digital technology in rural areas.

**Keywords:** Digital technology, teaching and learning, infrastructure, learner performance

## Introduction

In this 21st century technology has made teaching and learning more effective, with a mouse click learners can access information on the internet. For instance, installing software in computers and tablets can be used to promote the culture of teaching and learning. Regarding this, numerous studies conducted demonstrate the potential positive impact of information and communication technology (ICT) in teaching and learning. For example, a study conducted in Australia on the impact of ICTs on teaching and learning confirms that ICTs enhance investigating reality, building knowledge, active learning and authentic assessment, engage students by motivation and challenge, provide tools to increase student productivity, provide scaffolding to support higher level of thinking, increase learner independence, collaborate and cooperative learning, allow tailoring of learning to the learner; and overcome physical disabilities (Makgato, 2014). In fact, ICT refers to the hardware, software, networks, and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, images), as well as related services (Khumalo, Molepo& Mji, 2015). While South Africa is still behind in ICT development, the government has made some attempts to address this by increasing the use of ICT in rural schools to support

teaching and learning based on the belief that this will improve teaching and learning outcomes (Makgato, 2014).

## Literature Review

This section looks at the importance of the use of in education and factors affecting the implementation of ICT in South African rural schools.

### The importance of the use of ICT in Education

The key factor that has become critical in the learning and teaching context is Information and Communication Technology (ICT). Researchers (e.g., Sinko & Lehtinen, 1999; Smeets, et al., 1999) report that in many countries ICT has become more and more critical in education where the aim is to embed it in primary and secondary education as well as in teacher education. In developing countries, such as South Africa, the government has started the universal rollout of ICT across the education spectrum. This is happening in schools that were previously disadvantaged. In this regard Garrison and Anderson, (2003, p. 51) have lamented the fact that:

> Electronic communication and digital networks are transforming the way we work and are reshaping personal communication and entertainment. This transformation has had a tremendous effect on the need and opportunity to learn. Unfortunately, the transmission model that still dominates education has changed little.

The utility of ICT stems from the fact that it enables the download of information; enables learners and teachers to gain easy access to learning and teaching materials online without time constraints; the planning of lessons; provides the ability to connect with educators and learners all over the world; enables learners to actively engage with the learning content and explore learning materials on their own at their convenient time; and it may enrich learners' knowledge through access to online notes, projects, assignments, and tests. All this is achievable through the use of the internet. The introduction of ICT at schools may assist administratively as well as in the actual teaching. For example, ICT may help to facilitates schools' administrative functions such as the registration of learners, keeping and retrieving of learner records, while it may also enable the electronic handling of marks. In the teaching context, educators may provide simulations of experiments that learners could not perform, for instance, because of the non-availability of laboratories. Furthermore, in the rural schooling context in particular, ICT has the potential of being part of the solution in addressing the changing learning needs of learners (Garrison & Anderson, 2003).

In Canada (Canadian Council on learning, 2006) for instance, where there is a high rate of connectivity in both urban and rural schools the virtues of ICT that are exemplified here are possible. On the contrary this is not the case in South Africa where internet connectivity for example comes with all attendant problems in terms of broad band and accessibility. In Education policy terms however, it is declared that every South African manager, educator and learner should be able to use ICT confidently and creatively in order to develop the skills and knowledge they need as lifelong learners to achieve personal goals and to be full

participants in the global community (DoE, KZN, 2004). Meantime, it is argued that "… the role of educational technology should be to replace classroom discourse patterns with those having more immediate and natural extensions to knowledge-building communities …" (Scardamalia & Bereiter, 1994, p. 265).

**Challenges affecting the implementation of digital technology**

Within a very few years, ICT has turned out to be an effective educational technology which promotes some dramatic changes in teaching and learning processes. In fact, ICT has the potential to transform education by improving educators' design work, enhancing the roles of learners, educators and helping to create a collaborative learning environment (Khan, Hossain, Hasan & Clement, 2012). However, developing countries are far from reaping these benefits because of certain challenges. It is argued that the integration of ICT into teaching and learning is a complex process and one may encounter a number of difficulties (Mathevula & Uwizeyimana, 2014). These challenges are summarised in Figure 1 and each of them is briefly discussed below.

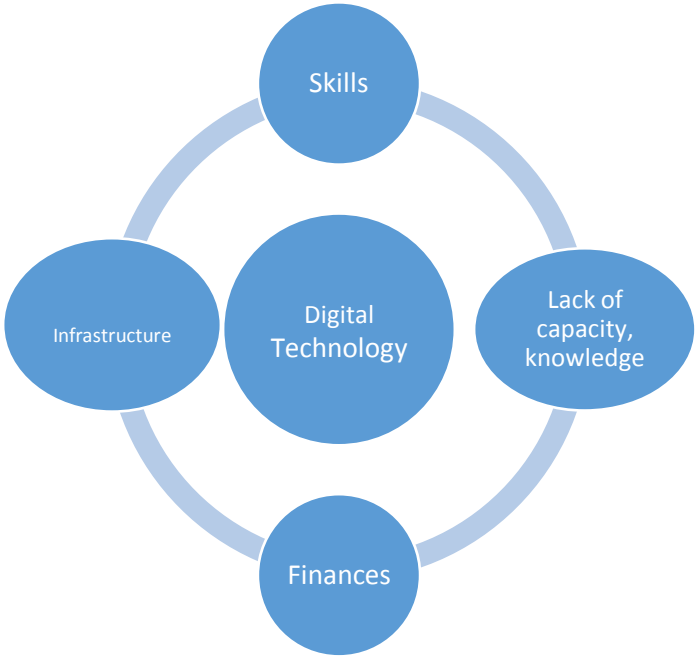


**Figure1:** Factors affecting implementation of digital technology

South African educators encounter numerous challenges in the implementation of digital technology in their schools. Literature tends to highlight resistance to change not necessarily a barrier in itself but could be an indication of the presence of much deeper problems. These deeper problems appear to be the lack of necessary knowledge and skills which should be brought in education by technology (Sello, 2014). Naturally, the integration of ICT in teaching and learning requires continuous training programmes to build sufficient capacity among educators and proper infrastructure (Mathevula & Uwizeyimana, 2014). However, this is still a dream in South Africa because educators lack capacity in ICT usage. Also, poor infrastructure in rural areas remains a major obstacle. In fact, the then Minister of Education

(Naledi Pandor) proposed the distribution of laptops to all qualifying educators which should have been completed by the end of 2011. Unfortunately, because of funding problems and educators who are either blacklisted or not credit worthy, this objective has still not been achieved by 2018.

## Statement of the problem

One of the challenges that the post-apartheid South African democracy faces is to transform curriculum by introducing technology that will enhance teaching and learning (Lethoko, Heystek & Maree, 2001). In fact the development of the nation lies on the effectiveness of how technology is used in schools. The use of ICT has been a challenge for some of the educators in rural schools. The integration of ICT into the school curriculum remains significantly underdeveloped in developing countries. This situation is caused by many factors such as; ICT qualification, lack of basic infrastructure such as electricity, lack of skills and knowledge, shortage of finance and other related factors (Mji & Makgato, 2006; Khumalo & Mji, 2014). This study seeks to explore challenges or factors affecting the implementation of digital technology in South African rural schools.

## Research question

The main research question of this study therefore is: *What are educators' perceptions towards the factors affecting the implementation of digital technology in South African rural schools?* To answer this question, two sub-questions were used in one-on-one interviews with the participants. The sub-questions were: *(i) Which factors are to be addressed when implementing digital technology in rural schools in order to improve curriculum delivery? (ii) How do you perceive the use of technology and how it would enhance teaching and learning?*

In this regard the objectives of the study were therefore to:

(a) To explore challenges affecting the curriculum delivery in schools.
(b) Find out the perceptions of educators towards the use of technology in teaching and learning.

## Study site

This study was conducted in rural areas of KwaZulu- Natal where the first author works. This in a sense means that he has first-hand knowledge of what goes on in this area's rural schools. Schools in this part of the province are faced with challenges related to poor infrastructure and the shortage of schools using digital technology to enhance teaching and learning in secondary schools. Rural schools function in environments that are quite different from urban settings. This situation means that lack of resources often have greater impact upon rural schools and educators because of complex setting in which they occur.

## Method

In this study, a qualitative, non-experimental, exploratory and descriptive approach was followed (Babbie, 1998). This approach was seen as ideal, because the aim was to capture in-depth views of educators. Such views would hopefully put into perspective the perception of educators towards the use of technology in teaching and learning to enhance curriculum

delivery. The views would provide empirical evidence whether educators are assisted from this initiative.

### *Participants and procedure*

#### *Sample*

The target population for this study were the schools in rural areas of KwaZulu- Natal (KZN). The population comprised 50 secondary schools. The researchers in this study used the non-probability sampling to find out the daunting challenges affecting the implementation of digital technology in South African rural schools. Fifteen educators were interviewed from schools who participated. For logistical reasons, such as the ability to have access to all schools and to minimise transport costs, the intention was to interview a sample of 20 members of the population. However, five participants were unavailable to be interviewed on the appointment dates. The educators were purposefully selected because the department of education has provided their schools with digital technology as baseline for piloting technology project. Therefore, in this qualitative study, the interviews were limited to fifteen educators.

#### *Instrument and procedure*

The data were collected by means of open ended interviews. The aim of interviews was to give an independent voice to the participants. In particular, participants were encouraged to provide honest views as they felt were applicable to them. In collecting the data, the participants were visited in their schools. In doing this, the researchers were mindful of the argument that a researcher has to go to the setting of the study because if participants are removed from their setting, it may lead to contrived findings that are out of context (Creswell, 1998).

### Validity

Validity refers to the capacity of research techniques to express the essential features of concepts being studied, and to measure what the methods were intended to measure (Leedy & Ormrod, 2005). In a qualitative perspective validity may be defined as a contingent construct, inescapably grounded in the process and intentions of particular research methodologies and projects (Winter, 2000, p. 1). To ensure the validity of this study I ensured that all processes were consistent. For instance, we asked the same questions consistently to participants. We ensured that our views were not expressed whatsoever even when participants asked for these. We simple indicated to them that it was their views we wanted not ours.

### Reliability

Reliability refers to the degree to which a measure yields consistent results (Leedy & Ormrod, 2005). It is worth to point out that reliability from a quantitative perspective is different to how it is defined from a qualitative context. It is argued that reliability is a concept to evaluate quality in a quantitative study with a "purpose of explaining" while the quality concept in a qualitative study has the purpose of "generating understanding" (Stenbacka, 2001, p. 551). To ensure reliability in this qualitative study, a number of

activities were followed. For instance, educators who were intimately involved with the installation of ICT software's in schools formed part of the sample. Also, to ensure that whatever the participants said was correct, we took the transcripts to them for their verification.

**Results**

Here, an analysis of the collected data, its interpretation as well as the findings from the participants' perspective is provided. In particular, participants' perceptions towards the use of digital technology in teaching and learning in South African rural schools was critically analysed. Importantly, actual words used by the participants are quoted in this paper.

**Table 1 Biographical data of the sample** (N = 15)

| Category | N | % |
|---|---|---|
| Gender | | |
| Women | 5 | 25 |
| Men | 10 | 75 |
| Age | | |
| 29 – 39 | 5 | 25 |
| 40 + | 10 | 75 |
| Highest academic qualification | | |
| Grade 12 | 2 | 20 |
| Diploma (e.g. Diploma in primary education) | 3 | 30 |
| Degree or higher (e.g. B.A. or B.A. Honours) | 10 | 50 |
| Teaching experience (Educators) | | |
| 0 – 9 | 5 | 25 |
| 10 or more | 10 | 75 |

## Participants Views

It is worth to point out that fifteen participants were educators from different schools. Educators responded to the question: *Which factors are to be addressed when implementing digital technology in rural schools?* Most participants viewed current professional ICT qualifications, skills, lack of capacity, infrastructure and finances as a contributing factors to poor curriculum delivery in rural schools. With regard to ICT qualification, all participants did not possess relevant ICT qualifications to teach. For instance, participant 7 said … "I attended ICT training courses that were too basic and too short to make an impact on ICT

competencies. In this regard, participants 4, indicated that I have no knowledge and skills to use computers… therefore, the introduction of technology will develop my knowledge as my qualification does not allow me to be computer literate…" When probed how he was going to be assisted, he said, "After acquired relevant skills… I would be able to assess and download information for my learners using activities installed. Participant 5 added, the programme is designed to assist educators with relevant information, therefore, I will be comfortable to teach because I will be exposed to sufficient information provided by the programme. The importance of assessment was indicated by participant 8, who said …preparation of the learners for assessment manifest a huge problem … the learners' assessment activities are not relatively typical of knowledge and skills that will be required by assessment activities. Participant 15 emphasise that activities of assessment that are done during the course of the year bear little relationship with what learners may possible encounter at the end of the year. Sharing the same sentiment, participant 6, said… learners are missing valuable information, therefore, this technological programme will enable and prepare learners to answer question papers that are not set within the school. On the same view, participant 1 said that "… lack of finance to build proper infrastructure suitable for effective teaching and learning is a challenge." On the other hand, participant 3 argued that the absence of technology and educators who are not suitable qualified to teach using ICT affect educators' capacity to perform as expected. In South Africa English is used as the medium of instruction across the board. For example, participant 10 said "… this programme will assist educators and learners to use English as the language of communication in my school …" When asked to what extent, he said "... learners will be taught on how to construct simple sentences in English. To that effect, participant 15 insisted "… the implementation of this technology programmes in schools will have a positive impact on the academic performance of learners." Similarly, participant 12 indicated "… using technology will motivate educators because important and critical aspects such as lesson plans, activities and solutions are catered.

In the second interview question, participants were asked: *How do you perceive the use of technology and how it would enhance teaching and learning?* All participants viewed technology programmes as a contributing factor in learning and teaching in all the subjects. In this regard, participant 9 said … these technology programmes will assist educators to be lifelong learners. For example, participant 11 said "… novice and experienced educators will not battle with the challenges of curriculum implementation. Using technology programmes to teach improves subject knowledge content …" On the same view, participant 2 argued, "… using technology in schools will promote time management. For instance, participant 14 indicated that … the implementation of the latest technology should assist the learners to enjoy learning and teaching. In fact technology serve as a catalyst to complete the curriculum on time and gives enough time for revision to take place. On the same view, participant 13 said … technology is learner centred and not educator centred and it will allow problem solving skills to be developed and learners can work with others in a very informal but constructive way. In this regard, the majority of the participants indicated that "… the installation of technology programme plays a vital role in our education and makes life so simply for us as educators …"

## Discussion

The discussion presented here focuses on the schools that were piloted because the problems that were identified were really about them. For example, schools who are underperforming because of poor infrastructure, lack of capacity, knowledge, finance and ICT qualification

have been provided with technology programmes to access the teaching and learning of different learning areas in their schools. In fact, ICT qualifications are critical because it is the knowledge and expertise that is required in helping learners to understand different subjects. For examples, *participants 4, indicated that "... the introduction of technology will develop my subject knowledge as my qualification does not allow me to teach in FET phase..." When probed how he was going to be assisted, he said, "I would be able to assess my learners using activities installed ... the programme caters educators with relevant information, therefore, I will be comfortable to teach due to sufficient information provided by the programme.* Participant 1 said that "… *due to shortage of proper infrastructure suitable for effective teaching and learning, learners are compromised."* On the other hand, participant 3 *argued that the absence of technology and educators who are not suitably qualified to teach, affect educators' capacity to perform as expected*. About this matter it is argued that "... academic and professional qualifications of educators explain their roles of being scholars and subject matter specialist" (Robinson, 2010, p. 194). Also, it is worth to point out that "… educators should possess knowledge and skills to assist learners in solving problems, communicating clearly, making informed decisions, and in constructing new knowledge, products, or systems in diverse, engaged learning environments" (Khumalo & Mji, 2014).

Also identified by the participants was language of instruction. Here the participants identified lack of proficiency in the language of instruction as a problem. For example, participant 10 said "… *this programme will develop knowledge and skills among educators and learners in using English as the language of communication. As a result learners will be taught on how to construct simple sentences in English ... even if the educator is not around, learners will find it easy to follow the instructions because the facilitators are subject specialist and they are not struggling with subject knowledge ..." To that effect, participant 15 insisted "... the implementation of this technology programme in schools will have a positive impact on the academic performance of learners.* This problem related to English proficiency means that it is difficult for learners as well as educators to comprehend and express themselves fluently in English. The issue raised by participants is vital because inefficiency in the language of teaching and learning plays a major role in learners' performance. About this matter, it is argued that learners who struggle to communicate in English are at a disadvantage, since that is the language that is used to respond to questions in the examination (Asraf & Ahmad, 2003).

Regarding the implementation of technology programmes and how it will enhance teaching and learning, *participant 9 said ... these technology programmes will assist educators to develop skills and knowledge to be lifelong learners.* Regarding this, ICT are increasingly used in schools to support teaching and learning based on the understanding that this will improve teaching and learning outcomes (Makgato, 2014). Therefore, the role of educational technology is to support the development of subject content knowledge, related pedagogical content knowledge and classroom competence.

## Conclusions and recommendations

In this paper it is indicated that participants' perceptions of the installation of digital technology in secondary schools enhance teaching and learning and improve learners' performance. In this regard, the purpose of this research is to recommend strategies that could

be used to improve the use of technology in teaching and learning activities in secondary schools. In fact technology is seen as the tool that will be used to transform teaching and learning in the 21st century. However, for technology to be fully integrated in the day-to-day teaching and learning it is hampered by lack of technology equipment, skilled educators and poor infrastructure in developing countries including South Africa. In fact, there should be enough computers at schools even if there are other invention such as tablets in order to supplement each other and should be regular computer literacy and training for educators (Makgato, 2014). Also, schools and Department of Education should make a credible audit of the technology resources available at schools and ICT skills of teachers in order to develop a well-informed comprehensive intervention strategies. The absence of ICT qualified educators in rural schools was perceived to be critical. This study has shown that ICT qualification is important. This factor was identified as critical in assisting schools to improve learners' performance and enhance the professional management of the school. It is pointed out that internationally "… recruiting quality teachers is a problem due primarily to the low status of teaching (as evidenced in some countries by very low salaries) and the lack of appeal found in the profession" (Cooper & Alvarado, 2006, p. 9). Therefore, it is recommended that school managers and Department of Education should address factors such as ICT qualifications, skills, lack of capacity, infrastructure and finances that affect the implementation of ICT in order to improve curriculum delivery.

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# EFFECT OF COMPUTER ASSISTED INSTRUCTIONAL (CAI) PROGRAMME ON THE TEACHING AND LEARNING OF SOCIAL STUDIES

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**Abstract**
Social studies as a multi-disciplinary subject is taught widely using the traditional methods and this has retarded the process of learning to mere studying to pass examinations. As a result of this factor, this study examined the effects of computer assisted instructional (CAI) programme on the teaching and learning of social studies students' achievement and attitude towards social studies as a junior secondary school subject. The study adopted pre-test, post-test quasi experimental design using 2 X 2 X 2 factorial matrix. One hundred and twenty-five students from eight intact classes in junior secondary schools in Ekiti state were selected for the study. Five (5) instruments used were: Training package on tutorial mode of CAI, Students achievement test in social studies (r = 0.75), Students attitude to CAI questionnaires (r = 0.79), Students SOS attitude scale (r = 0.78), Students level of computer access questionnaires (r = 0.71). The data was analysed with ANCOVA using Multiple Classification Analysis (MCA) to determine the effect of treatment on the variables. Findings from the study revealed that, the CAI brought about a significant difference in the student's academic achievement and no significant effect on students' attitude towards social studies. It therefore recommended that schools should embrace the use of CAI to teach social studies in schools in Nigeria.
**Keywords** Computer Assisted Instruction, Tutorial Mode, Achievement, Attitude, Social Studies.

## Introduction

Social Studies is a problem-solving discipline that equips an individual with the knowledge, attitude and competencies that are needed to make meaningful living in the immediate environment, and also to solve the problems of human survival, globally. Swan and Hofer (2013) posited that since human beings live in the reality of inter-dependence principles, social studies programme though, local in content but global in context. The National Council for Social Studies (NCSS USA, 2010) described social studies as an integrated study of many academic disciplines which promotes civic competence in the learners at all stages of education; ranging from pre-primary to post-graduate levels. Ajiboye, Adu and Amosun (2005) explained that the purpose of social studies is to help young people (and adult at large) develop the ability to make informed and reasonable decisions for the public good as citizens of a culturally diverse and democratic society. Ogunyemi (2011) posited that students should be prepared to assume active roles as intelligent citizens and decision-makers in a free, just and democratic society.

The use of technology in education has been a major way of improving teaching and learning in the current information age (Abimbade 2006). Hence, one may assert that technological

innovation is increasing the demand for reforms in teaching and learning approaches. That is why instructional strategies related to school reforms are now highly influenced and built around "constructivist" theories of learning which employs the use of technology in education (Barak 2007). According to Ibode (2005), technology has always been zealously promoted as a modern solution to the problems of education such as lack of productivity, inefficiency, and lack of focus. Likewise, one of the most important factors influencing education is motivation (Ogunleye 2007). There is a wide range of Information and communication Technological tools that can be used in the teaching and learning of Social Studies concepts in higher institution of learning which will improve teaching, motivate students and make contents of subject relevant to students' needs.

The computer-assisted instruction is an instructional strategy that has been acclaimed all over the world. For example a number of educationists and researchers have attested to the effectiveness of computer based instruction (Adeyemo, Adu & Adelabu, 2015; Adu 2015) educators have advocated for the introduction and effective implementation of computer education in Nigerian schools (Ogunleye 2007; Ochoyi & Ukwumunu 2008). However, in Nigeria, there is no zeal among the policy makers and the teachers to imbibe the computer-aided teaching culture, rather, most teachers preferred using the conventional method (chalk and talk method) to teach subject like Social Studies, Researchers have identified that individual teacher has preferred styles of learning such as interpreting, organizing, transforming and reporting information (Barak, 2007); and that individual could differ with respect to complexity, intellectual development, previous knowledge and other factors (Barak 2007; Niess 2005). In recent times, technological devices used in the delivery of instruction have evolved considerable integrating mechanisms based on knowledge of results that emanated from the review of learner trials. They include, mechanisms that support special interaction skills and activity-based learning which enable learners to participate actively using the instructional stimuli to construct, verify and modify their cognitive stimulation of the environment, as well as mechanisms that tailor instruction towards individual differences and needs of learner. According to Eze, Adu & Ruramayi (2013), the computer information technology has been the media of choice in this category.

According to Ogunleye (2007), computer technology in schools is one of the most far-reaching and fast growing developments in education all over the world? However, the situation is not yet encouraging in Nigerian classroom learning environment (Tella & Adu, 2010). Also, we are living in a period of a shift from an industrial to a highly technological society or post-industrial society (Ogunleye 2007). The development of computer and interactive data retrieval systems (Abimbade 2006) and the fact that the growth in new product, technology, and ideas have increased exponentially, means that there is a greater dependence on information and innovation than ever before (Organisation for Economic Cooperation and Development), (OECD 1995). Eze and Adu (2013) reiterated the real wealth producer in post-industrial society is neither land nor infrastructure, but knowledge. This fact has resulted in pressures for change in classroom organization and school curriculum and instruction. Increased use of information technology has led to an increase in media. There is a perceived need for the generality of Nigerian school teachers to interpret such information though the pressure for this has been felt more in mathematics and science (Ogunleye 2007).

More comprehensive research findings on the effect of computer-based instructions on different types of learning outcomes in the various subjects including Social Studies in

Nigeria are still very limited. Abimbade (2006) observed the need to provide empirical basis for use of CAI in the Nigerian schools adding that the effect of CAI is scantily researched in Nigeria but this has widely been researched into in different parts of the world by scholars such as Whitley (1997), who conducted studies on gender differences and computer related attitudes and behaviours. These scholars, therefore, solicit for a vigorous and systematic work, and inquiry into the potentialities of CAI in Nigerian setting.

However, the use of computer in schools has been challenging within the secondary schools in Nigeria, this is due largely to the level of access that students have to the use of these computers and other ancillary devices. The level of computer access is the extent to which students have opportunities to interact with computers based on the various avenues through which computers are available to them. Ibode (2005) posited that computers in schools exposed students to information and communication technology (ICT) that they can use to expand their knowledge. Providing access to computer technologies in education has met numerous initiatives from the federal government during the last two administrations.

However, access was more than supply, i.e. the availability of computers. Access also involved connectivity and the up-to-date software, as well as classroom layouts that allow for wiring and computer desk (Karademir 2009). Eze and Adu (2013) affirmed that proper access requires ubiquity-that computers and peripherals be located where everyone within a school has access as needed. The importance of having convenient access to computer technology was supported by the studies of Adeyemi (2012), who found that access was the second most significant factor related to the use of computers in the classroom. This was supported by Owusu, Monney, Appiah and Wilmot (2010) that access to computer use has a significant relationship with the low level of use.

**Theoretical Framework**

This study is guided by Bandura's (1991), social constructivist's theory. The theory provides a theoretical perspective to assists in gaining insight into the efficiency in the use of computer-assisted instruction (CAI) in the teaching and learning of social studies. The constructivism theory founded by John Dewey (1933-1998) and later developed by Vygotsky (1978) is a learning theory that explains how people may acquire knowledge and learn. This theory suggests that human beings construct knowledge and meaning based on their personal experiences in their environment which is directly applied to education.

The social constructivist's theory is used in the teaching-learning process because learning occurs faster as learners are actively involved in the learning process as opposed to the conventional teaching method of learning (Adu 2015) when the students passively receive information. It is a theory based on interaction with others and on this premise rests this study because the use of computer assisted instruction (CAI) to teach social studies and other disciplines enables the learner to be actively involved in the teaching-learning process which leads to the retention of what is learned. The constructivist theory is relevant to this study because the computer-assisted instruction enabled learners to construct logical ideas that are inter-related. Learning activities in constructivists settings are characterised by active engagement, inquiry, problem solving and collaboration with others. In this study, the learners acquire knowledge through involvement with the content instead of learning by imitation or repetition. Each participant in the study actively participated in the learning

process by building or constructing to their own knowledge and this encourages the student to be responsible and autonomous. The teaching programme also enabled the learners to be at the centre of their learning, and changed the teachers to facilitators, who only moderated learning activities.

**Research Question**

(1) Will Computer Assisted Instruction (CAI) improve the secondary school students social studies knowledge and classroom practices?

**Research Hypotheses**

The following null hypotheses were tested at 0.05 level of significance

(1) There is no significant main effect of treatment on secondary school students'
(a) Achievements in social studies (b) Attitude towards the social studies
(2) There is no significant main effect of level of computer access on students'
(a) Achievement in social studies (b) Attitude towards the social studies
(3) There is no significant main effect of gender on students'
(a) Achievement in social studies (b) their attitude towards the subject.

**Methodology**

**Research Design**

This study adopted the pre-test post-test control group quasi experimental design in order to answer the research question and test the hypotheses. This design is one of the most effective approaches in carrying out research of this magnitude as it helps in determining the effect of the independent variables on the dependent variables. The design is schematically represented below as:

$O_1$ $X_1$ $0_3$……. Experimental Group (Tutorial CAI Instruction)
$O_2$ $X_2$ $O_4$ …….. Control Group (Conventional Instruction)

Where $O_1$ and $O_2$ represent pre-test observations for experimental and control groups respectively.

$O_3$ and $O_4$ represent post-test observations for experimental and control groups respectively.

$X_1$ = Experimental treatment on tutorial CAI Instruction
$X_2$ = Control (Conventional instruction)

**Table 1. A representation of the 2 X 2 X 2 Factorial Matrix**

| TREATMENT | GENDER | LEVEL OF COMPUTER ACCESS | |
|---|---|---|---|
| | | High | Low |
| 1. TUTORIAL CAI | Male | | |
| | Female | | |
| 2. CONTROL | Male | | |
| | Female | | |

**Population**

This study is made up of all junior secondary school students of Social Studies that have computer facilities in their schools in Ekiti State, Nigeria.

**Sampling and Sampling Techniques**

Convenience and Purposive Sampling Techniques were used to select 360 students initially from privately owned secondary schools due to the consideration of the fact that they are better equipped especially with computer systems than public schools but only 125 students completed the study. Four schools were randomly selected for this study. Eight intact classes of Junior Secondary School 2 was used. The Stratified random sampling was adopted to cater for the Gender of the students.

**Instruments**

The following instruments were developed and used in this study.

(I). Training package on Tutorial Mode of CAI (TPTMC)

(II). Students' Achievement Test in Social Studies (SATSOS)
(III). Students' Attitude to CAI Questionnaire (SACQ)
(IV). Students' Social Studies Attitude Scale (SSSAS)

(V). Students' Level of Computer Access Questionnaire (SLCAQ)

**Training package on tutorial mode of CAI (TPTMC)**

The TPTMC was designed by the researchers with the assistance of a system programmer. This package, which is a self-learning package consists of Computer Assisted Instruction whose presentation is through tutorial mode of instruction, frames, stimuli and correct responses. The TPMTC requires that a learner goes through the frames and responds to the question at the end of each frame. If the learner obtains the correct response at first attempt, the package gives him 3 marks, second attempt attracts 2 marks while third attempt is 1 mark. However, if at the third attempt, the correct answer is not obtained, the package then displays the correct answer for the student. The validation of this package was done by expert computer programmers and educational technologists for proper scrutiny and content validity.

**Students Achievement Test in Social Studies (SATSOS)**

The students achievement test in social studies (SATSO) adapted from Niess (2005) was used to measure the students' ability to perceive and process a given set of information. It was made up of twenty items with four options: A-D, per item with only one correct option. It was based on the JSS 2 syllabus and topics taught in social studies. The test was designed to measure the students' level of cognition. The test blue print is presented below.

**Table 2. Blue Print for Social Studies Achievement test**

| Topic | Knowledge | Comprehension | Application | Total |
|---|---|---|---|---|
| Culture | 3 | 1 | 2 | 6 |
| Marriage | 3 | 1 | 2 | 6 |
| Socialisation | 4 | 2 | 2 | 8 |

| | | | | |
|---|---|---|---|---|
| Total | 10 | 4 | 6 | 20 |

This instrument was given to experts in the faculty of education (social studies department) for face and content validity. The average item difficulty index of 0.44 and reliability of 0.75 were obtained using KR-21 formula.

**Students' Attitude to CAI Questionnaire (SACQ)**

The questionnaire was adapted from Attitude towards Computer as tools for instructional purposes (Isleem 2003). The questionnaire was given to secondary school computer teachers to determine their position regarding CAI in schools. The 30 items in the questionnaire were evaluated as Strongly Agree, Agree, Disagree, and Strongly Disagree. The draft instrument was validated using peer/expert review. To establish its reliability, the questionnaires were subjected to Cronbach method. The Psychometric property of the instrument revealed a Cronbach alpha value of 0.79.

**Students' Social Studies Attitude Scale (SSSAS)**

The SSSAS consisted of two parts:

i. students' background information (Section A) and
ii. Social studies attitude scale (Section B).

Students' background information dealt with demographic information about the students such as gender and school, while, section B is a 20-item scale developed by the researcher. The responded by indicating the extent of their agreement with each item on a four pint modified Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Positively worded items were scored 4,3,2, and 1, while negatively worded items were scored 1,2,3, and 4 in that order respectively. The items were examined by expert teachers in social studies who found the test items appropriate for JSS 2 students. A Cronbach alpha of 0.78 was obtained as its measure of reliability.

**Students' Level of Computer Access Questionnaire (SLCAQ)**

This instrument was administered to JSS2 students; the instrument consists of two parts:

(i) Students' background information (Section A)

(ii) Students' Level of Computer Access (Section B)

Students' background information deals with variables such as demographic information about the students in terms of students' gender and school. The second section is a 10 item scale developed by the researcher. The respondents ticked YES or NO for some questions and indicated the extent of their agreement with others. This was validated by computer studies experts while reliability was ascertained using Cronbach method which yielded an alpha value of 0.71.

**Validity and Reliability**

To ensure the content validity of each instrument used in this study, the instruments were given to experts in the field of teacher education, evaluation and social studies education at the university level for their perusal and suggestions. For the reliability of the instruments, the

test re-test method was used for SACQ, SSSAS and SLCAQ respectively using Cronbach Alpha with co-efficient of 0.79, 0.78 and 0.71 respectively while Kuder-Richardson 21 was used to estimate the reliability of SATSOS which yielded 0.75. The instruments were administered on one hundred and twenty- five students in three (3) private junior and two (2) public junior secondary schools in Ekiti state, Nigeria.

**Data Analysis**

Data collected were analysed using descriptive statistics (mean and standard deviation) and inferential statistics using the SPSS 22 software package, i.e. Analysis of Covariance (ANCOVA). The Multiple Classification Analysis (MCA) aspect of ANCOVA results was used to determine the magnitude of the mean scores of the various groups.

**Results and Discussions**

**Table 1: ANCOVA Table for the Effects of Treatment, Level of Computer Access and Gender on Students' Achievement in Social Studies**

| Source of variance | | Hierarchical model | | | | |
|---|---|---|---|---|---|---|
| | | Sum of Square | df | Mean of square | F | Sig. |
| Covariates | Pre-test achievement | 36.179 | 1 | 36.179 | 1.147 | .285 |
| Main effects | (Combined) | 561.903 | 3 | 187.301 | 5.936 | .001 |
| | Treatment | 399.528 | 1 | 399.528 | 12.661 | .000* |
| | Computer access | 2.971 | 1 | 2.971 | .094 | .759 |
| | Gender | 159.405 | 1 | 159.405 | 5.052 | .025* |
| 2-way interactions | (Combined) | 21.167 | 3 | 7.056 | .224 | .880 |
| | Treatment X Level access | .853 | 1 | .853 | .027 | .869 |
| | Treatment x Gender | 6.795 | 1 | 6.795 | .002 | .963 |
| | Level access x Gender | 19.961 | 1 | 19.961 | .633 | .427 |
| 3-way interaction | Treatment x Level access x Gender | 4.612 | 1 | 4.612 | .146 | .702 |
| Model | | 623.861 | 8 | 77.983 | 2.471 | .013 |
| Residual | | 11075.739 | 351 | 31.555 | | |
| Total | | 11699.600 | 359 | 32.589 | | |

*significant at p <0.05

From table 1, there is significant effect of treatment on students' achievement in social studies (SOS) ($F_{(1,351)} = 12.661$; $p < 0.05$). This means that the achievement score of students taught using the tutorial CAI and those in the control group significantly differ. Hence, hypothesis 1 is rejected. However, students with high level access to computer had higher mean score in social studies (SOS) (Adeyemo, Adu & Adelabu, 2015) than those with low level of computer access

The MCA Table 2 presents the magnitude of the various groups in the 2x2x2 factorial ANCOVA carried out.

**Table 2: Multiple Classification Analysis of Social Studies Students' Achievement According to Treatment, Level of Computer Access and Gender.**
Grand mean = 18.03

| Treatment + category | N | Predicted mean | | Unadjusted deviation | Eta | Adjusted deviation for factors and covariates | Beta |
|---|---|---|---|---|---|---|---|
| | | Unadjusted | Adjusted for factors and covariates | | | | |
| Treatment: CAI | 180 | 16.933 | 17.210 | -1.100 | .123 | -.822 | .144 |
| Control | 180 | 19.133 | 18.856 | 1.100 | .015 | .822 | |
| Level of access: | | | | | | | |
| High | 162 | 18.129 | 18.098 | 9.630 | .180 | 6.534 | .010 |
| Low | 198 | 17.954 | 17.979 | 7.878 | | -5.35 | |
| Gender: | | | | | | | |
| Male | 292 | 17.537 | 17.68 | -.495 | | -.346 | .126 |
| Female | 68 | 20.161 | 19.519 | 2.128 | | 1.485 | |
| R = .226 | | | | | | | |
| R square = .051 | | | | | | | |

Table 2 shows that students taught with CAI performed better in achievement ($\overline{x} = 18.86$; Adj. Dev. = .82) than their counterparts in the control group ($\overline{x} = 17.21$; Adj. Dev = - .82).
$H_{01}$b: There is no significant effect of treatment (tutorial CAI) on students' attitude towards SOS.

**Table 3: ANCOVA Table of Students' Attitude to SOS by Treatment, Level of Computer Access and Gender**

| Source of variance | Hierarchical model | | | | |
|---|---|---|---|---|---|
| | Sum of square | df | Mean of square | F | Sig. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Covariates | Pre-test attitude | 65.344 | 1 | 65.344 | .575 | .449 |
| Main effects | (Combined) | 509.809 | 3 | 169.936 | 1.495 | .216 |
| | Treatment | 3.802 | 1 | 3.802 | .000 | .985 |
| | Level of access | 131.171 | 1 | 131.171 | 1.154 | .283 |
| | Gender | 378.599 | 1 | 378.599 | 3.331 | .069 |
| 2-way interactions | (Combined) | 276.096 | 3 | 92.032 | .810 | .489 |
| | Treatment x Level of access | 59.705 | 1 | 59.705 | .525 | .469 |
| | Treatment x Gender | 213.425 | 1 | 213.425 | 1.878 | .171 |
| | Level of access x Gender | 69.608 | 1 | 69.608 | .612 | .434 |
| 3-way interaction | Treatment x Level of access x Gender | 4.612 | 1 | 4.612 | .146 | .854 |
| Model | | 855.118 | 8 | 106.890 | .940 | .483 |
| Residual | | 39892.745 | 351 | 113.655 | | |
| Total | | 40747.864 | 359 | 113.504 | | |

Table 3 shows that there is no significant main effect of treatment on students' attitude towards SOS ($F_{(1,351)} = .000$; $p > 0.05$). This means that the difference between the attitude scores of students in each of the tutorial CAI treatment and control group is not significant. Hence, $H_{01}b$ is not rejected.

To determine which of the two groups had better attitude to SOS, Table 4 is presented

**Table 4: Multiple Classification Analysis of Students' Attitude by Treatment, Level of Computer Access and Gender**

Grand mean = 84.48

| Treatment + category | N | Predicted mean | | Unadjusted deviation | Eta | Adjusted for factors and covariates | Beta |
|---|---|---|---|---|---|---|---|
| | | Unadjusted | Adjusted for factors and covariates | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Treatment: | | | | | | | |
| CAI | 180 | 84.472 | 84.877 | 8.333 | | .397 | |
| Control | 180 | 84.488 | 84.083 | 8.333 | .001 | -.397 | .037 |
| Level of access: | | | | | | | |
| High | 162 | 83.851 | 83.868 | -.628 | .053 | -.612 | .052 |
| Low | 198 | 84.994 | 84.981 | .514 | | .501 | |
| Gender: Male | 292 | 84.948 | 85.014 | -.468 | .091 | .533 | .104 |
| Female | 68 | 82.470 | 82.190 | -2.010 | | -2.290 | |
| R = .119<br>R square = .014 | | | | | | | |

From table 4, students in the tutorial CAI had higher attitude score ($\bar{x}$= 84.88; Adj. Dev. = .39) compared with the control group ($\bar{x}$= 84.08; Adj. Dev. = - .39). However, this difference is not significant as seen on Table 4.

$H_0$ 2a: There is no significant effect of students' level of access to computer on their achievement in Social Studies.
Table 4 shows that students' level of access to computer has no significant effect on their knowledge of SOS ($F_{(1, 351)} = .094$; $p > 0.05$). This means the post-test knowledge of students in SOS for those with high and low levels of computer access is not different significantly. Based on this, hypothesis 3a is not rejected.
Table 4 shows further that students with high level of access to computer had higher mean score in SOS ($\bar{x}$= 18.57; Adj. Dev. = .82) than those with low level of computer access ($\bar{x}$= 17.21; Adj. Dev. = .82). However, this is not significant.

$H_0$2b: There is no significant effect of students' level of access on their attitude towards SOS.
From Table 4, there is no significant effect of students' access to computer on their attitude to SOS ($F_{(1,351)} = 1.54$; $p>0.05$). To this end, students with either higher or low level of access to computer were comparable in their attitude towards SOS after exposure to the treatment. Hence, hypothesis 3b is not rejected.
Furthermore, from Table 4, it is obtained that students with low level of computer access obtained higher attitude scores towards SOS ($\bar{x}$ = 84.98; Adj. Dev. = .50) than those with higher level of computer access (X = 83.87; Adj. Dev. =-.61) although slightly as one can see from the different mean scores.

$H_{03}$a: There is no significant effect of gender on students' achievement in SOS.
From Table 1, gender has a significant effect on students' knowledge of SOS ($F_{(1,351)} = 5.052$; $p <0.05$). This means that the knowledge of SOS of students who are males and those who are females are significantly different. Hence, H03a is rejected. Also, table 5 shows that the female students obtained higher post-test knowledge scores in SOS ($\bar{x}$ = 19.52; adj. Dev. = -1.49) than their male counterparts ($\bar{x}$= 17.69; adj. Dev. = -.35). This is to a significant level as found in Table 1.

$H_{03}$b. There is no significant effect of gender on students' attitude towards SOS.

Table 3 shows that there is no significant effect of gender on students' attitude towards SOS ($F_{(1,351)} = 3.331$; $p > 0.05$). This means that the male and female students' attitude to SOS do not differ to a significant extent. To this end, hypothesis 3b is not rejected.
From Table 4, the male students had a mean score of 85.01 in attitude towards SOS while their female counterparts scored 82.19 with adjusted deviations of .53 and -2.29 respectively. This shows that the male students were better in attitude than their female counterparts although this difference is not significant as obtained in Table 4.

**Summary of findings**
The results of this study in a nutshell are as follows:

1. There is a significant effect of treatment on students' achievement in SOS but not on attitude to SOS.
2. Students' level of access to computer has no significant effect on both achievement and attitudes towards SOS.
3. Gender has a significant effect on students' achievement in SOS but not on attitudes towards SOS.
4. There is no significant interaction effect of treatment and level of computer access on both achievement and attitude towards SOS.
5. There is no significant interaction of treatment and gender on students' achievement in SOS and attitude towards SOS.
6. The interaction effect of students' level of computer access and gender is not significant both on achievement and attitude towards SOS.
7. The 3-way interaction effect of treatment, level of computer access and gender is not significant on students' achievement as well as on students' attitude to SOS.

**Conclusion**
The study revealed that students taught with CAI (treatment group) performed better than their counterparts in the conventional method of teaching group based on achievement in social studies concepts, a statement buttressed by Adeyemo, Adu and Adelabu (2015) but not reflected in their attitude to the subject. Also, the results further revealed that students that have access to computer perform better based on research hypotheses ($Ho_2$) while those with low access to computer possess more positive attitude towards social studies and lastly, gender is shown to have effect on students' level of achievement in social studies but not in attitude to the subject.
In view of the limitations of this study the following suggestions are made for further research. This study needs to be replicated to include more states, schools whether government (public) or private. Apart from this, it would be interesting if such a study could be replicated at the senior secondary school level across the nation. More study comprising other school subjects should be used in CAI tutorial experiments to really know if it would consistently improve school achievement. More variables such as computer literacy levels, school environment, and socio-economic status could form part of the moderating factors for consideration when the study is replicated in a developing country such as Nigeria where the use of CAI in schools both at junior and senior secondary schools is low.

**Recommendations**
Based on the results of the findings, the study recommends the following among others that; schools should be enhanced with good teaching and learning environment by providing computer gadgets to facilitate learning of Social Studies in order to solve problems of under achievement in schools. All teachers must be computer literate before year 2020 and the

government should organised regular in-service training or workshops on the uses of CIA as an effective strategy of learning to all Social Studies teachers and that greater attention should be given to male students in order to increase their sensitivity to Computer and Computer Assisted Instructions, while equally encouraging their female counterparts to show more interest in the use of computer gadgets.

The views expressed in this paper, and any errors found therein, are of course that of the authors.

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# USE OF TECHNOLOGY FOR TEACHING AND LEARNING AT TERTIARY LEVEL: CASE OF LIMKOKWING UNIVERSITY OF CREATIVE TECHNOLOGY IN LESOTHO

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**Abstract**
The study sought to establish the effect of technology on teaching and learning, the levels of technological uptake by management and teaching staff as well as the challenges encountered by educators and learners with the use of technology at Limkokwing University of Creative Technology (LUCT). Information was gleaned from management, teaching staff and students from the institution through quasi experimental research, interviews with management and lecturers as well as through focus group discussions with the experiment and control groups. Purposive sampling was used to select the population under study. The study established that the use of technology impacts the teaching and learning process positively although there is reluctance on the part of the lecturers to harness and utilize technology as a teaching and learning tool. The institution should therefore empower lecturers by training how to use technology as a teaching aid as well as by providing adequate technological resources for use by lecturers and students.

**Keywords:** education technology, teaching and learning, WiFi, hotspots, connectivity, learner centered approach

## Introduction

Technology has made education more easily accessible to the majority of the citizens of the world and where it has been properly harnessed, it has enhanced learning. Educational technology is a systematic and organized process of applying modern technology to improve the quality of education (Stošić, 2015). According to Stošić (2015), the word technology is derived from the Greek word "techno" which means the willingness, skills, knowledge of the way, rule, skill, tools, and "logos" which means science, word, learning, mental state.

The use of technology in education comes in different forms whereby it can be used in face to face interaction between educator and learner under the controlled environment of the classroom, or through mediated interaction with teacher and student placed in different geographical locations, which is e-learning. Technology can also take lecture room interaction further with lecturer and student interacting beyond the lecture room as students can submit assignments or write tests and submit by means of technology. This can easily be done through sending short text messages, Whatsapp on mobile phone, submitting assignments via electronic mail, web logs or YouTube and e-laboritories, for practical work. With students scattered all over the geographical space, lectures can be posted on YouTube and students can download and play the lectures repeatedly at their own convenience and go online to chat with the lecturer for clarification or can simply write comments in the comment platform that comes along with the YouTube package beneath the video for consumers to provide feedback.

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with the application of modern educational teaching techniques. Stošić (2015) goes on to elaborate that educational technology includes instructional materials, methods and organization of work and relationships, that is, the behavior of all participants in the educational process.

Today, there is a common focus on raising student achievement while integrating technology as a tool (Costley, 2014). Policymakers and educators are renewing their commitment to programs and instructional practices that aim to enhance maximum effects on instruction and student outcomes (Costley, 2014).

Writing on the use of technology by girl children in unsafe areas of Pakistan, Winthrop and Smith (2012) say that a Mobilink- UNESCO programme increased literacy skills among girls in Pakistan at A level from 27 to 54 percent after only four months. Rasiati, Allahyar and Tan (2012) also write that technology, especially e-technology, is being increasingly employed in instruction to enhance teaching and learning. Rasiati et al (2012) continue to say that a variety of e-learning technologies are available for use in educational programmes, citing the example of e-books, simulations, text messaging, podcasting, wikis, and blogs as being invested in by education ministries and universities in many parts of the world.

According to Noor-Ul-Amin (2017), the use of Information Communication Technology (ICT) in education lends itself to more student- centered learning settings. Noor-Ul-Amin (2017), cites Sharma (2003); Sanyal (2001); Bhattacharya and Sharma (2007) saying that the various kinds of ICT products available and having relevance to education, such as teleconferencing, email, audio conferencing, television lessons, radio broadcasts, interactive radio counseling, interactive voice response system, audio cassettes and CD ROM, among others, have been used in education for different purposes.

Simmons and Markwell (2001) write that there is evidence to support the effective use of computer assisted instruction, citing Kulik (1994) in Kosakowski (1998) who wrote that using educational technology for drill and practice for basic skills can be highly effective. Simmons and Markwell (2001) go on to cite Kosakowski (1998) summarizing that students, particularly students in at-risk groups, such as in special education and from inner city or rural schools, felt more successful in school and more motivated to learn when using curriculum-assisted instruction.

However, uptake of educational technology is not easy within institutions of learning. Writing about how technological integration is difficult in the school set up, Heffernan, Militello, Heffernan and Decoteau (2010) say that the shift from steam to electric power was gradual and costly, not just because of the required investments in technology, but because the technology enabled and required fundamentally new ways of organizing and conducting work. This is quite apt in describing the situation with technological uptake within the education sector.

**Methodology**

The study employed both qualitative and quasi experimental research approach designs. Shank (2002) defines qualitative research as a form of systematic empirical enquiry into meaning. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret phenomena in terms of the meanings people bring to

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**Findings**

The study set out to establish how educational technology is integrated in lectures at LUCT. The research established that the LUCT provides computers for teaching and learning purposes with a total number of 7 multi-media labs on the main campus each containing 40 computers, 2 multimedia labs on the MP campus each with 30 computers, 2 Mac-labs on the MP campus each with 40 computers and a networking lab for IT students with 30 computers, all connected to the internet. There are 5 WiFi hotspots on the main campus; 2 for lecturers' use and 3 for students and three on the MP campus for students. The student computer ratio in the university stands at 8 students per one desktop computer.

**Table 4.1 Students` Pre –test and Post test after use of technology**

| Phase | Subjects | No. of students | Means | Standard Deviation | Independent Samples T-Test Value | P |
|---|---|---|---|---|---|---|
| **Pre-test** | ADJ (E) | 29 | 55.03 | 25.56 | -0.065 | 0.840 |
| **Pre-test** | BABJ(C) | 26 | 57.54 | 22.79 | | |
| **Post-test** | ADJ (E) | 29 | 73.89 | 21.41 | 3.546 | 0.000* |
| **Post-test** | BABJ(C) | 26 | 60.21 | 20.68 | | |

*P<0.05 Note: E is for the experimental group and C is the Control group

As shown in table 1 above, the results of the Independent Sample T-Test show that there is no significant difference between the two groups in the pre-test. The mean score of the test was 55.03 for the experimental group and it was 57.54 for the control group. Given that p =0.840, p>0.05 show that the performance in the test at pretest level was not significant. Students thus had similar proficiency before use of technology was introduced.

In the post-test, the mean score for the experimental group is 73.89 and for the control group its 60.21. This indicates that students who were exposed and used technology in their learning performed much better than those in which technology was not used and the experimental group reached a significant level shown by the independent sample T-test (p = 0.000, p<0.05). Thus table 4.1 shows that use of technology as a strategy to enhance learning is an effective method. Students performed better and the focus group interviews with them showed the experimental group enjoyed their studies more and were engaged more during the learning process.

With student respondents, the study established that technology makes research for assignments easy and students do not have to spend a lot of time in the library researching like old school students would do. Students say it is convenient to submit assignments online via email than travelling to deliver the work physically to the lecturer on campus. Students also claim that they are able to write better and in depth academic papers because they have access to more scholarly sources from the internet. Students also say that technology is useful as they are able to learn beyond what lecturers teach in class and when lecturers demonstrate concepts using technology, it is easier to grasp as compared to when something is just explained verbally.

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connectivity when you need it the most. Students also tend to engage in non academic activities once they gain access to the internet even in the middle of class.

The IT department responded that connecting lecture rooms to the internet is not a problem for as long as faculty managers make requisitions that will convince management, the rooms will either be wired or students can access internet via WiFi. However, the process for requisitions is long as the faculty management has to present the requisition to senior management academic who in turn will submit the requisition to the IT department who will send it to Malaysia for recommendations then back to the IT department then finally to senior management for approval.

The IT department also responded that software is not a big problem because some of the software comes free of charge to the institution from service providers, such as AutoDesk. For others, like Adobe CC, the updates come at the renewal of the contract between the university and the service provider.

For service, the Apple I Mac machines have to be serviced by specialists from South Africa who come to inspect the machines before bringing the requisite parts for servicing the computers.

In response to how the institution safeguards against technology abuse by both lecturers and students, the IT department said that they have put in place firewall software that filter what is viewed and downloaded. They also block social media platforms such as Facebook and YouTube during the day between 08.00hours in the morning and reactivate them at 17.00 hours in the afternoon. For those courses that require the use of social media platforms, the IT department said the institution has got 4G WiFi gadgets that the lecturers can borrow and use in class.

Responding to whether they induct lecturing staff and students in the use of technology, the IT department responded that they assume all lecturers to be proficient in the use of technology. They said that they left the staff development of lecturers on how to use latest technological developments up to faculties to empower and enlighten their own members of staff.

**Discussion of findings**

At LUCT, this study discovered that the prevalent model of lecture delivery is that traditional one, whereby a lecturer generally stands in the front of the lecture room and verbally deliver the lecture to students. This is the most ancient model that has persisted for hundreds of years without making allowances for the utilization of technology to provide support and improve the teaching/ learning process.

This study established that computers, the internet and smart phones could all be used in collaboration for all courses, but lecturers need to take into consideration the different styles of teaching as well as the type of students doing the courses. The type of lecturing that integrates technology requires a total shift in the whole approach to teaching, time required to learn how to use the educational technology by the educator and the learner as well as the models that are compatible with the integration of technology.

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Finally, variability of broadband speeds and bandwidths for both students and lectures are more debilitating than enhancing the teaching learning process.

**Recommendations**

The study recommends that LUCT should develop sustainable, education-oriented IT infrastructure, that is, quality computing systems that readily meet the objectives, and techno-savvy staff who will engage with colleagues and students to produce desired results. The university should purchase reliable, easy to access and easy to use technologies.

Although innovation is almost always bottom-up, the LUCT management should take the top-bottom approach in order to inculcate a teaching and learning technology culture into the institution. At faculty level, the institution ought to allow flexibility to the whole teaching and learning approach strongly supported by instant release of teaching and learning technology to the benefit of all.

Another recommendation is that the LUCT should elevate to positions of influence champions who know what they are doing educationally. In the university, technology should be initiated and driven by educators rather than mere IT technicians who might not have a full appreciation of the dynamics of the art and science of teaching and learning.

The study also recommends that the university give priority to the teaching and learning process over technological means and the balance sheet. The LUCT should also establish staff development in technology with mandatory training for teaching staff and students.

**Conclusion**

The study sought to establish the levels of technological uptake by management and teaching staff as well as the effect of technology on the teaching and learning process at LUCT. The results reflect that indeed technology can impact the teaching and learning process effectively. However, the challenge is with the inadequacy of the teaching technology as well as technology related equipment and facilities in the institution. The institution is also not doing enough to empower the teaching staff as the teaching staff is not receiving training on how to use the technology that is already available and the result is that the technology in the institution is underutilized by some of the teaching staff and this has a detrimental effect on the students' learning process.

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# LECTURERS TRANSFORM FROM DIGITAL IMMIGRANTS TO DIGITAL NATIVES BY UNDERGOING A LEARNING MANAGEMENT SYSTEM TRAINING IN A HIGHER EDUCATION INSTITUTION

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**Abstract**
Many educational institutions have implemented Learning Management Systems (LMS) to enhance teaching and learning especially because the current students are a net culture of the 21st century. Today's students use technology to communicate, explore, share and entertain themselves in their learning process. These students are known as digital natives, whereas lecturers who have not yet delved into digital technology are referred to as digital immigrants. These digital immigrants are challenged in the way they teach especially with LMSs. Some attempts have been made in the institution to train lecturers in the use of the LMS. Thus, this study aimed to explore how the lecturers who underwent this training have transformed their lecturing strategies through incorporating the LMS. A qualitative single case study approach was undertaken through conducting semi-standardised interviews, observations and analysis of log files generated from the LMS. This study revealed that lecturers (digital immigrants) changed their teaching strategies after the training and the necessary support provided. The training focused on how to teach with a LMS. This training was provided before the launch of the LMS and thereafter continuous support was available so that lecturers could build confidence in using the LMS when teaching. An integral part to providing support stems from having an educational technologist who is easily accessible and available to assist lecturers with using the LMS. These results demonstrate that training and support play a crucial role in influencing lecturers to use the LMS in teaching and learning in the 21st century.

**Keywords:** Learning management system, lecturers, transformation, higher education, digital immigrants, digital natives.

## Introduction

In the last decade, the adoption of LMSs in education has become a trend to facilitate the teaching and learning process in an online environment (Martin and Tutty, 2002, p. 1). However, Al-Busaidi and Al-Shini (2010, p. 4) researched that lecturers had many challenges when adopting the LMS, for example, they lack computer skills and skills for teaching with technology. Another study done by Gani (2013, p. 27) revealed that lecturers lacked experience in teaching with a LMS which left them discouraged. The study intended to explore how the lecturers who underwent the LMS training have transformed their lecturing strategies at a higher education institution in South Africa. It is crucial that these lecturers are trained and supported to use the LMS in their teaching because they have not had experience in teaching or learning with a LMS before. This is necessary because the use of education technology is rapidly increasing in the teaching halls, which affects the way academics teach and learn in the 21st century. The needs of students dictate this change as they want the

content material to be easily available and constant communication to be realised by their lecturers.

## Conceptual and theoretical framework

### *2.1 What is a LMS?*

A LMS is an online platform used to provide content material for a face-to-face or online course (Coble, 2018). Students can communicate with their lecturers, participate in blogs, discussion forums and online tests and receive feedback on formative assessments via the LMS. This platform allows for online collaboration amongst peers and the lecturer. Martin (2008, p. 138) states that "a LMS is a software environment that enables the management and delivery of learning content and resources to students". Watson and Watson (2007, p. 28) simply define a LMS as a basis that manages all elements of the learning process. For example, a LMS has the functionality for the lecturers to provide content material, administer online tests and tasks which can be automatically marked and tracked (Watson and Watson, 2007, p. 28). Even though LMSs have many functions, it is up to how the lecturer uses the LMS to its full potential.

### *2.2 LMS used in this study*

The LMS used in this study is powered by Blackboard. The activities and content material on this LMS are designed by developers of the institution (that was investigated) and are implemented by the lecturers on the module. This LMS was launched in 2014 at this higher education institution with the aim of enhancing the student learning experience by implementing a blended learning approach to teaching. However, this meant that lecturers and students would need immense training on how to use the LMS effectively. For the lecturers, it was crucial that they change their teaching strategies to incorporate the LMS so that students could adapt to the LMS quicker.

### *2.3 The need for training and support on how to use the LMS*

The need for training and support for lecturers in the 21$^{st}$ century is crucial. Prensky (2001, p. 2) stresses that digital immigrant lecturers are struggling to teach students these days because they attempt to teach them the same way they were taught in the past. However, digital natives learn differently (Prensky, 2001, p. 3). Thus, they need to be accommodated on how they are taught – they might learn slower as adults, one might have to deal with their attitudes towards technology first before they are actually trained, they might be forgetful, hence one needs to be patient in the process of training them. Jurado and Pettersson (2011, p. 10) emphasise that educational institutions should focus on lecturer professional development to ensure that lecturers are trained on how to use educational technology as this will improve the adoption on the LMS. Garrison and Vaughan (2008, p. 105) state that "technology can be a catalyst and a means to adopt more active learning approaches". The institution in question poised itself to transform and support the lecturers' teaching strategies through the LMS, which attracted this study.

### *2.4 Community of inquiry framework*

Garrison and Vaughan (2008, p. 13) describes a community of inquiry (CoI) as creating a social, cognitive and teaching presence on a LMS. This framework should be created by the lecturer so that students are willing and can see the need to access the LMS. Social presence is defined by Garrison, Anderson and Archer (2000, p. 13) as "the ability of participants in a community of inquiry to project themselves socially and emotionally, as 'real people',

through the medium of communication being used." So, for students to express their ideas and opinions freely, the lecturer should create a safe and non-threatening environment defined by the LMS (Anderson, 2008, p. 344). Cognitive presence is developing a high level of learning stimulated by critical thinking on a LMS (Anderson, 2008, p. 344). This can be achieved by setting online tasks on the LMS such as online tests, blogs and discussion forums. Teacher presence is defined by Garrison and Vaughan (2008, p. 24) as facilitating learning by providing constructive feedback to students. Teacher presence is an important aspect of the CoI framework as it binds all the elements to ensure that CoI is productive (Garrison & Vaughan, 2008, p. 24). The CoI framework was designed to guide blended teaching and learning process on a LMS (Garrison & Vaughan, 2008, p. 13). These three terms were deemed important in this study as they would inform the transformation of lecturers' teaching after undergoing the LMS training.

**Methods**

The researchers conducted an exploratory case study to achieve its aim, which was to explore how the lecturers have changed their lecturing strategies after training and support were provided. According to Luo (2011, p. 8), an "exploratory case study is used to explore situations in which the intervention being evaluated has no clear, single set of outcomes". This case study happened within the ambit of the qualitative approach, which is defined by Creswell (2003, p. 18) as an "approach in which the inquirer often makes knowledge claims based primarily on constructivist perspectives or participatory perspectives". This design was suitable for the study due to its explorative nature and focus on a single case, i.e. the institution in question. Seven participants were purposefully selected as they were defined by their participation in the LMS training and its implementation.

Semi-standardised interviews, observations and analysis of the LMS reports were used to collect data. The interviews were conducted face-to-face and participants' responses were audio-recorded and later transcribed for analysis. Three out of the seven participants were asked to showcase how they used the LMS in their teaching. The researchers visited the lecturers in their lecture rooms to observe the participants' use of the LMS in their teaching. An observation checklist was used to record the participants' use of the LMS. The observation checklist guided the researchers on how the participants used the LMS, for example, observing if the participant used the LMS tools during the lecture or out of the lecture. The interview responses and observations complemented the analysis on the LMS reports. These LMS reports were generated from the LMS system and provided information on the LMS tools which the lecturers used when facilitating their modules on the LMS. The analysis traced the patterns and themes that developed from the data. Trustworthiness of the methods was ensured by approaching data analysis from multiple perspectives as informed by the multi-method strategy and participants' views. Ethics was observed through ensuring confidentiality and concealment of participants' names, asking their consent to participate in the study, etc.

**Results**

The findings revealed that training and support provided assisted in the transformation of the lecturers' teaching strategies. This indicates the development that the lecturers realised after being offered training and support. Training and support were offered before the launch of the LMS. Thereafter continuous workshops were provided by the educational technologist

throughout the year. The effect of the training and support provided are evident from the themes that arose in the data analysis, which are discussed next.

## 4.1 Interviews

### *4.1.1 Participants' views about the LMS*

The participants viewed the LMS as a tool for communicating with their students, providing feedback on assessment and tasks, creating an environment whereby students can discuss or express the understanding of the content and to track students' performance. In addition, the participants viewed the LMS as a place to upload the lecture resources so that students could supplement their learning. One participant stated in this regard that, *the LMS created opportunities for students to engage with the content beyond the classroom*. Overall, the participants' understanding of LMS is aligned to its definition above. This indicates that they are aware of the LMS's primary function, which will then result in the way they use it for teaching and learning purposes.

### *4.1.2 Transformation of the participants' lecturing strategies*

All the participants indicated that their teaching strategy had changed since the use of the LMS because it was now more activity-driven – they would instruct their students to complete the pre-designed activities on the LMS. These activities were aimed at developing or determining the understanding of the content. For the transformation of the teaching strategies to be more activity-based meant that the lecturers had to design their lessons to be more student-centred, *my teaching strategy has changed drastically from just using the text and module pacer to now using the LMS which provides the platform to share videos, website links, activities and past exam papers*.

### *4.1.3 Creating a sense of CoI*

To determine if participants were able to create a sense of CoI, the researchers asked them which LMS tools they used when teaching. Creating a sense of CoI occurs when there is a social, cognitive and teacher presence on the LMS.

Creating a social presence on a LMS entails creating a non-threatening and supportive environment so that students can express themselves freely in the LMS. All the participants attempted to use blogs and discussion forums in order to achieve this. However, the participants stated that some students were uncomfortable to share their opinions in the blog and discussion forums. So, the participants would encourage and support the students by guiding and motivating them to participate in this space. A participant said that using blogs and discussion forums *really opened my eyes with regards to non-threatening and supportive environment*. This was because this participant could view how the discussion forums and blogs were progressing and then step in, to steer the conversation in the right direction need be. He added that *students could also comment on one another's discussion thread as well as guide one another instead of just relying on me for all the answers*. This example illustrates that lecturers need to become facilitators of the learning process by guiding students so that they can express themselves freely and comfortably in an online space.

Creating a cognitive presence on a LMS entails creating the opportunities for students to explore and construct their own meaning of the content. From the discussions, the participants expressed that they used the LMS tools such as online tests, blogs and discussion forums. The tests were set to be auto-marked which provided instant feedback to the students

if their answers were right or wrong. In addition, multiple attempts to take the tests were allowed so that students could have more opportunities to take the test: *I only used tests because I taught numeracy modules and thus wanted my students to master the skills by practicing continuously*. His colleague *administered many online tests in which students must achieve 80% or more*. If they did not, they would have three attempts to do so. This was a way of ensuring that students could master the content. One other participant preferred to *use blogs instead of online tests*. She said that setting online tests took too much time. By using the blogging tool, she could gauge if students understood the content and then would provide constructive feedback.

Creating a teaching presence on a LMS entails how lecturers promote student activity on this space by communicating and providing feedback to them. For example, some participants used the announcement tool to communicate to students what activities needed to be completed, while others provided feedback on assessments to students on the LMS. One participant expressed that he would *provide feedback after students have written a test and then upload it on the LMS so that students could access it, and then learn from their mistakes*. Yet another participant said, *at least 90% of my time on the LMS is spent on communicating to my students*. She would use the announcement tool to inform the students which activities to complete so that she could gauge if they understood the content. She found the LMS very useful in this regard.

Overall, creating a CoI on the LMS is vital for students to become active on this space. This can only be achieved if the lecturer is active on the LMS by using the LMS tools to create a social, cognitive and teacher presence.

*4.1.4 LMS training offered*

The participants expressed that they received extensive LMS training and support at the institution. This was confirmed by one participant, who mentioned that at the beginning of each year workshops were held on how to navigate and use the LMS tools available. Thereafter, workshops would be conducted throughout the year to remind and guide lecturers who struggled with using the LMS. A participant said that *there were workshops available, however, I could not attend due to my busy schedule*. On the other hand another participant held a view that she had received much training on how to use the LMS, but would have preferred training on how to use the LMS as part of her teaching strategy. Another participant expressed that *extensive training was provided on how to use the LMS, but I did not like the group-training sessions*. He preferred one-on-one training so that the educational technologists (workshop facilitators) could assist with his individual needs. From this theme, it emerged that lecturers received immense training.

*4.1.5 LMS support offered*

The educational technologist provided the training and support on the LMS. All the participants acknowledged the assistance of the educational technologists as was expressed by individual participants thus:

> *The educational technologists provided one-on-one support on the LMS; the educational technologists did save my time when creating a test or activity; I received amazing support, and everyone was supported; peer support was beneficial as my colleagues would assist if I got stuck with using the LMS*.

From the theme, it is evident that one-one-support and peer support created confidence in lecturers in using the LMS, which ultimately transformed them from being digital immigrants to falling in love with the educational technology.

*4.1.6 Participants' recommendations on training and support offered*

From discussions with the participants some recommendations on how to improve the training and support offered on the LMS were made:

- *Training should be focused on subject specific modules so that we can use the LMS more effectively in the lesson.*
- *Support documentation such as tutorial guides and video presentations should be provided after the training workshop.*
- *Emphasis on student training should be provided so that students can be comfortable on how to use the LMS platform.*
- *Additional people should be employed to assist the educational technologists with the demand of lecturer queries.*
- *Training on how to use the LMS for groupwork and peer assessments should be provided.*

**4.2 Observation**

Three of out the seven participants were observed on how they used the LMS in their lecturing strategy. The researchers sat in these three participants' lecture room while teaching and used an observation checklist to record how they used the LMS. One participant used the LMS in a computer laboratory. During the lecture she implemented direct instruction and discussions. She used a PowerPoint presentation as a visual aid and later uploaded the presentation on the LMS so that students could have access to it. During the lesson she directed the students to complete an online test on the LMS. She emphasised that students had to achieve 80% or more in the test. They would have three attempts to do so to master the content.

The second participant struggled to connect to the Wi-Fi on the day of the observation, thus could not logon to the LMS. He reverted to direct instruction and various questioning techniques to present the lecture. He directed his students to logon to the LMS to access the content material and follow the instructions provided on an activity which the students had to complete at home. This lecturer's unsuccessful connection to Wi-Fi seemed to present an opportunity for a blended teaching approach as students engaged with the lecturer in a face-to-face session, and thereafter did an activity on an online platform, which extended the learning beyond the lecture room. From the observation, it was clear that the Wi-Fi mishap presented opportunities to diversify the lecture methods, a much-needed strategy for teaching in a multicultural context such as South Africa – to lecture and have discussions in class, and thereafter encourage students to go onto the LMS so that they engage with the content.

The third observed participant also presented the lesson in a computer lab. She used a self-directed teaching strategy because students had to complete the pre-designed activities on the LMS in the lecture in order to learn and understand the content. Students had to complete a wiki. This participant acted as the "guide-on-the-side" by facilitating the learning process.

Overall, the findings reveal that these three participants were comfortable with using the LMS in the lecture and outside. They used the LMS for communicating with students and for driving the student activities by getting them to complete a test, task or wiki. These findings tally well with the interview findings because the observed participants have gained from the LMS training evidenced in their implementation of it; created a sense of CoI; tried varied lecturing strategies; and so on.

### 4.3 LMS report

The educational technologist at the research site assisted with the retrieval of the LMS statistics from the LMS for analysis. The statistics revealed different types of the LMS tools that lecturers used in one module that each participant presented. The report indicated the LMS tools that the students used in the module. The students' usage of the LMS indicates how the lecturer has driven them to that space so that teaching and learning could occur and ultimately a sense of CoI achieved. Table 1 and figure 1 illustrate the students' use of the LMS tools and participants' LMS module activities.

Table 1: Students' use of LMS tools

| | **Participants' LMS module activity** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Students' use of LMS tools** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **Total** |
| Total Assignment Submissions | 0 | 1 | 45 | 110 | 0 | 191 | 36 | 383 |
| Total Test Submissions | 222 | 0 | 54 | 0 | 363 | 22 | 163 | 824 |
| Total Discussion Forum Submissions | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 |
| Total Blog Submissions | 90 | 96 | 26 | 109 | 98 | 22 | 59 | 500 |
| Total Journal Submissions | 0 | 0 | 0 | 45 | 0 | 45 | 0 | 90 |

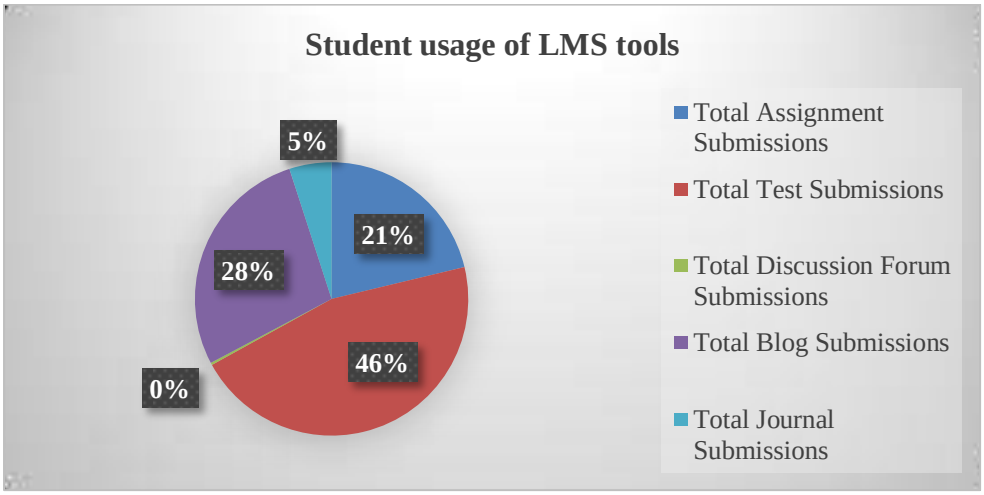


Figure 1: Graphic representation of Table 1

From figure 1 it is evident that lecturers prefer to use the LMS tools such as assignments, tests and blogs. This could be because the participants prefer to use online test because it can be set such that it is auto-graded and provides feedback. In figure 1 discussion forums were not used often. This could be explained by what one participant said in her interview, that she preferred blogs than discussion forums because students are shy of writing their opinions. She

likes using blogs because students could not see each other's responses and thus felt that students were then able to contribute their inputs on this platform.

**Discussion**

Prensky (2001, p. 3) states that "digital immigrant teachers assume that learners are the same as they have always been, and that the same methods that worked for the teachers when they were students will work for their students now." However, Prensky (2001, p. 3) goes on to say that this is not true. Thus, it is crucial to train lecturers on how to use educational technology when teaching so that they can cater for their digitally native student learning needs.

The institution in this study has provided the LMS training and support since the launch of the LMS to lecturers so that they could overcome their challenges in teaching with the LMS. After these lecturers have received training and support, they had a better understanding of what a LMS is and how to use it when teaching. Their understanding is in accordance with Bates (2015, p. 194), which confirms that a LMS is an online platform whereby students can access content material as well as be engaged in online LMS activities.

Bowen (2012, p. 246) emphasises that institutions must equip their lecturers on how to use the educational technology but more importantly that must be trained on the pedagogy to teach with it. A study done by Molotsi (2014, p. 11) indicates that South African teachers are trained to use computers, however, they are not taught on how to integrate educational technology into their teaching strategies. Hence, the LMS training and support assisted in the transformation of lecturers' teaching strategies. This became evident because their teaching strategies have transformed to a student-centred approach to teaching. Garrison and Arbaugh (2007, p. 158) suggest creating a sense of CoI on the LMS promotes an effective way of teaching and learning in an online environment.

**Conclusion**

This study was aimed at exploring how lecturers have transformed from digital immigrants to digital natives after they were provided the necessary LMS training and support. The study shows that lecturers (digital immigrants) can change to digital natives if sufficient LMS training and support are provided. In this regard, the LMS training and support was effective because the lecturers could use, navigate and change their teaching strategies with the use the LMS with relative ease. It would appear that the findings assert John's and Wheeler's (2008, p. 22) recommendation, that the educational technologists should be employed to train lecturers on how to use the LMS, but more importantly how to use the appropriate pedagogy. Also, they could create a CoI by using the LMS tools to ensure the social, cognitive and teaching presence were evident on the LMS. It can be concluded that the findings confirm Al-Busaidi's and Al-Shini's (2010, p.1) claim, that for the LMS implementation to be successful, lecturers should be willing to accept it so that they can promote it to their students. In the end, the study suggests that research be undertaken to assess how the participants' transformed lecturing strategies as a result of undergoing the LMS training has influenced students' performance and throughput.

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# DISRUPTIVE VERSUS SUPPORTIVE USE OF MOBILE TECHNOLOGIES IN THE CLASSROOM

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**Abstract**
The purpose of this conceptual paper is to discuss the effects of disruptive and supportive use of mobile technologies in the classroom. Mobile technologies are increasingly used for a number of purposes by all segments of the society. However, there is a growing discussion on whether to use mobile technologies in the classroom. Conservative educators claim that mobile technologies such as laptops, tablets and smart phones disrupt the teaching and learning process by distracting students' attention. Pragmatic educators indicate that, although mobile technologies may support and enhance learning, they should be kept outside the classroom when they are not solely controlled by the instructor. Liberal educators advocate that mobile technologies may empower learners by providing ubiquitous and virtual learning opportunities. It appears that all of these schools of thoughts have their own educational paradigms that forbid, limit or encourage the use of mobile technologies in the classroom. The focal point of the ongoing debate may be labelled as "mobile technologies versus scholarly lectures." There appears to be an undeclared war with its strong factions. The underlying assumption is that mobile technologies provided by institutions or allowed by instructors are assumed to be a facilitator for learning, whereas mobile technologies brought to the classroom by students without institutional control are perceived to be an interceptor against learning. Considering the complexity and importance of the issue, this paper first analyzes main assertions of these theoretical orientations, then discusses the barriers and opportunities they bring, and finally evaluates the implications for the use of mobile technologies in education.

## INTRODUCTION

We live in a virtually unprecedented era of high technology. Almost all aspects of our lives are either technology supported or technology driven. Technology does not only affect what we do or how we live, but it also has influences on our bodies and souls. We cannot think of anything that does not involve technology today. In this sense, we are fully occupied with physical or virtual technologies both in our social and personal spheres.

Technology in general conjures up different thoughts and feelings for everyone (Tenner, 1996). Based on individual perceptions, we see technology as a positive, neutral or negative constituent of life. If we think that technology plays a positive role by contributing to our existence, we try to increase the use of technology without questioning it much, just because it makes the life easier. Then the implication is that technology empowers us. If we think that the role of technology depends on the purpose it is used for, then we become selective about which technology we prefer or where we use it. If we have a negative perception of technology, we think that it is bad or harmful so it must be avoided as much as possible. Sometimes a total avoidance may not be conceivable since certain technologies are not within our control, then we try to limit their uses to the extent that does not disturb us.

In recent years, a number of exceptional communication technologies have emerged (Borah, 2017). Today the world of communication is not constrained to traditional mass media anymore. In fact, we have relatively liberated ourselves from the centralized media. The long-lasting invader's role of the newspaper, radio, television and other industrial media have diminished. Now it is the time of personal and portable media. In this respect, mobile and ubiquitous technologies have gained great importance. Mobile communication technologies such as laptops, notebooks, tablets, and smartphones are commonly used in all venues of life by members of all generations (Farley et al., 2015). Most of these devices are multimedia and multipurpose tools. For example, a mobile phone is not only a phone anymore. A typical smart phone has at least several dozens of functions and features ranging from taking a picture to measuring blood pressure or editing a recorded video stream to paying traffic fines (Belland & Murphy, 2015). Considering the spectrum of what a mobile phone can do for us nowadays, it is not even fair to call it a "phone" anymore.

Governments, organizations and individuals have high expectations of mobile technologies. A number of governments around the world provide e-services through these technologies (Leach, 2014). They assume that having access to e-government services is highly preferred and valued by citizens. That is because mobile communication technologies help citizens to have access to a number of government services and use them as needed. Similarly, organizations introduce themselves to their target audiences freely and publicly. Marketing their products and services through mobile devices is easier and cheaper for organizations. They also assume that a great majority of their consumers want more of their commercial contents delivered through mobile technologies (Waugh, 2017). Therefore, almost all the big organizations including public, civil and private establishments try to have more visibility on mobile media. At the user end, individuals benefit and expect more ubiquitous contents accessible through mobile devices (Butryn & Machura, 2014). Moreover, individuals themselves create, load, share, discuss, and change such contents anytime and anywhere by employing mobile tools. Much of the Internet access is done with personal mobile devices all around the world, and this figure goes up every year (wearesocial.com, 2017).

Mobile technologies are used in all areas of life with a fast growing speed (Farley et al., 2015). Politics, law, security, transportation, health, communication, publishing, tourism, arts, postal services, banking, sports, marketing, entertainment etc. are just several of them. All these areas benefit from the opportunities that these technologies bring for them. Although they have some challenges and barriers to take advantage of mobile technologies, they try to develop alternative solutions to overcome the hurdles and maximize the benefits (Butryn & Machura, 2014). In general, all these sectors demonstrate a positive attitude toward mobile media and adapt new developments in order to improve their tangible and intangible outcomes.

The field of education, however, is relatively skeptical and purposefully slow about mobile technologies (Alrasheedi & Capretz, 2015). Although there are noteworthy efforts and initiatives to extend and improve educational services through mobile technologies, their magnitude does not appear to be satisfactory when considering the wide scope of education (Alrasheedi & Capretz, 2015). As a consequence, the use of mobile media in education is not at the level that it should be, when in fact these technologies offer a great deal for effective, engaging, and efficient learning experiences (Gao et al., 2017).

## PROPONENTS AND OPPONENTS OF MOBILES IN THE CLASSROOM

History is filled with examples of new technologies that are initially embraced with optimism, but later reveal unanticipated negative consequences (Tenner, 1996). Among many, recent examples include smartphones, netbooks, tablets, and laptop computers. Although they are widely appreciated for their extraordinary features, a considerable level of resistance exists due to their disruptive effects.

In a 2012 study, it was found that "95% of students bring their phones to class every day, 92% use their phones to text during class time, and 10% admit they have texted even during an examination on at least one occasion" (Tindell & Bohlander, 2012, p. 1). In a similar study, nearly 25% of students said that they had sent a text message in almost every class, whereas another 15% had sent 5-10 texts in class per week (Baker, Lusk, & Neuhauser, 2012). Additionally, in a study conducted with a sample of 195 graduate students from Arizona and Illinois campuses, 35% of students claimed to use their cell phones during class time (Burns & Lohenry, 2010). Thomas and Munos (2016) surveyed responses of 628 high school students in a large urban school district to determine their perceptions of mobile phone use in the classroom. Results indicated that 91% of students were using a variety of mobile phone features for school-related work. Student support for instructional uses of phones, however, was not universal; only 71% believed that mobile phones supported learning. Students had serious concerns about disruptions caused by using mobiles in the classroom. The results of another study were that 66% of students reported using a mobile device during the lecture. Of this group, 45% used a mobile phone and 38% a laptop. The most common activity was typing notes on a laptop, followed by accessing lecture slides. The vast majority of mobile device usage was on task and related to the lecture (Roberts & Rees, 2014).

Mobile devices are regarded as essential learning tools (Traxler, 2010; Allen, 2017). It is, therefore, unsurprising to see them proliferate at almost all levels of schooling, particularly in the higher education student population. The current generation of students are "accustomed to operating in a digital environment for communication and information gathering", tend to be "always on" (Oblinger, 2004, p. 2) and are focused on connectedness, social interaction, and sharing. They tend to multitask and, according to McMahon and Pospisil (2005, p.425), they have "lots of things 'on the go' at once." This rise in popularity of mobile devices has led some universities to ban them during lectures because of the wide range of distractions that they give students access to (Baron, 2013; Conway, 2013; Gao et al., 2017). Gilroy (2003), claimed that the opinions of faculty regarding the use of mobile technologies in the classroom are quite diverse, with some faculty members wishing to ban them and others feeling that even the guidelines on cell phone use are overly restrictive and unnecessary. The debate is still hot and will not go away (Gao et al., 2017)

Levasseur (2011) points out that the conflict between computers and schools is really a conflict between educational paradigms. It goes without saying that the same is true for mobile media. The dominant paradigm is rooted in the pedagogy of transmission. Teacher, who have presumably read more books and listened to more lectures than their students, transmit their knowledge to the students in a similar fashion. The students, in return, can capture the transmission and mirror back the teacher what they have delineated. In this model, the lecture is fundamental and the role of technology is cosmetic; thus, the students should listen to the teacher and take notes during the lecture. If they don't do this and try to use their mobiles during instruction –even for learning purposes- they are considered rude, unmotivated, disinterested, and ungracious for the efforts of the teacher.

When it comes to mobile technologies, however, it becomes more difficult for an instructor to supervise and eliminate the assumed detrimental effects of mobile devices on learning. Technology policies are more difficult to implement on personally-owned devices than on school-owned ones (Bryant, 2017). A tablet owned by a school, for example, can come pre-installed with the approved programs and not allow for any outside play. A device that comes and goes with a student, however, can't have the same rules (Lynch, 2015). Therefore, particularly conservative educators tend to ban mobile devices for the sake of reducing distraction for learners (Belland & Murphy, 2015; Baron, 2013). Here the teacher becomes a "police officer" for preventing distracting technology use so they shut down the wireless network, punish students for the use of mobile media, and confiscate devices from students. In short, opponents of students' use of mobile technologies in the classroom contend that mobile media can distract attention during the class, increase off-task behaviors, undermine teacher authority, grant access to improper sites, detract human interaction, avoid note taking, block cognitive processing, and cause cyberbullying (Bryant, 2017). Based on these issues, they believe that schools should either ban or prevent mobile devices.

On the other hand, advocates of using mobile media for educational purposes, who are mostly liberal educators claim that mobile devices can increase student collaboration, encourage more participation, provide quick access to online sources, facilitate the preparation and sharing of hypermedia materials, promote personalization of course contents, help doing research foster independent learning, motivate students, allow students to log in assignments, keep parents, teachers and pupils all on the same page (Allen, 2017; Farley et al., 2015).

A study recently conducted at the University of KwaZulu-Natal revealed that 92% of students said that it was easier to use their mobile device to improve their access to information. The students were also confident that with their mobile devices, they would not be stranded and could find anything right at the time they needed it. Moreover, the students underlined the benefits of technology as easier communication, faster access to information, and more comfortable studying (Adeboye, 2016). Research generally suggests that faculty may view electronic devices as more inappropriate in the classroom than do students (Gao et al., 2017); however, no research suggests either students' or instructors' perceptions toward electronic devices in class are universally positive or negative (Baker, Lusk, & Neuhauser, 2012).

## OPPORTUNITIES AND BARRIERS

A decade ago, Hew and Brush (2007) mentioned 123 barriers to the adoption of mobile learning that could be grouped into six categories: (1) lack of resources such as technology, time, and technical support; (2) a lack of knowledge and skills including technology-supported pedagogical knowledge and technology-supported classroom management knowledge; (3) issues at the institution including a lack of commitment by leadership, timetabling issues and planning; (4) teacher attitudes and beliefs; (5) difficulties associated with assessment such as pressures of high-stake testing and standardization; (6) non-conducive subject culture whereby educators are reluctant to adopt a technology that is not normally associated with the teaching of that subject or discipline. Although this report was written prior to the emergence of many of the current mobile technologies, all of these factors remain as significant challenges (Power, 2014; Sharples, 2013; Terras & Ramsay, 2012).

Given the high level of mobile media ownership and usage among students, schools -particularly universities- need to show serious commitment at various levels in order to fully engage with mobile learning. Maintaining the *security* of the networks and enabling access to *many kinds of devices* and

operating systems is a major challenge. Farley et al. (2015) report that course materials are rarely *optimized* for use on smartphones, navigating websites and learning management systems becomes a scrolling nightmare, and interacting with other students is often impractical using prescribed systems. Most concerning point is that none of the students participate in educator-led mobile learning initiatives. *Financial constraints* are frequently mentioned as a reason for not adopting mobile learning because the cost of purchasing mobile devices for use by instructors and students may be prohibitive (Lynch, 2015). The practice of 'bring your own device' (BYOD) is proposed as a cost-effective alternative (Farley et al., 2015). *Data privacy* concerns are also commonly cited as an issue because research suggests that as many as 60% of mobile applications send information about users to application developers or third parties (Crompton, 2013).

The *lack of appropriate skills* for instructors and students is another challenge (Gao et al., 2017). Instructors should be trained about how the mobile devices can be used to enhance learning. Moreover, many students have their own personal devices, which they are comfortable using; thus, it makes sense to utilize personal devices in education rather than devices that belong to school which students can use only during class hours (Farley et al., 2015). However, they should also be taught to use mobile media for educational purposes and not abuse them or challenge instruction by trying to access materials and activities using these devices. A recent Pew Research Center survey revealed that 91% of teachers agreed that students need digital literacy courses to be successful academically and beyond (Lynch, 2015).

Despite many opportunities and benefits of today's communication technologies, the constant social micromanagement, reachability, and connectedness they grant during class may create certain drawbacks that limit and harm areas of our social lives and our very mental and physical health (Rigely, 2014). About a decade ago, Bugeja (2008) argued that although new technologies including cell phones, laptops, music players, and game consoles keep individuals connected, they also keep them constantly distracted. Therefore, some educators suggest to prohibit the use of mobiles in the classroom. Supporting evidence comes from an interesting report. A relatively recent large-scale study, which was conducted by London School of Economics with the examination results of 130,000 students in 91 schools, found that banning mobile phones improved scores on examinations by 2%. At the first glance, it may look like an insignificant rise but the impact is equivalent to one extra week of school a year (Okolosie, 2015). Similarly, Galluch and Thatcher (2006) reports that when students have access to Internet-enabled applications during class, they tend to be loafing and/or slacking so the Internet becomes an impediment to learning.

The concept of cyberloafing in the classroom refers to students' use of the Internet for non-learning related purposes during instruction (Taneja, Fiore, & Fischer, 2015). Particularly, access to social media are becoming widespread among students, and thus the tendency towards cyberloafing seems to increase even more. There may be a number of factors that cause students involve cyber-deviant behaviors during instruction. *Social loafing* leads to a reduction in motivation and effort when individuals work collectively compared to when they work alone (Karau & Williams, 1993). *Subjective norms* refer to the degree to which an individual believes that people who are important to him/her (i.e. friends, family members, peers) think that they should perform the behavior in question (Azjen, 1991). *Cognitive absorption* means a state of deep involvement with a task (Agarwal & Karahanna, 2000). *Innovativeness* refers to an individual's willingness to experiment with any new technology (Agarwal & Prasad, 1998). *Multi-tasking* denotes the simultaneous or consecutive use of the Internet applications during scheduled class time by a student.

## RESEARCH EVIDENCE ON BENEFICIAL AND DETRIMENTAL EFFECTS

Research generally suggests that the use of digital tools within the classroom can either create new opportunities for enhancing learning (Allen, 2017; Mang & Wardley, 2012) or prove to be a problematic issue that schools cannot ignore (Tindell & Bohlander, 2012). Technology provides a whole new opportunity for doing things in different ways. The powerful features of the mobile technology should be creatively used to make our work effective and to achieve high results.

Galluch and Thatcher (2006) found that personal innovativeness with ICT and multi-tasking with the Internet applications contribute to cognitive absorption, while cognitive absorption and subjective norms give way to the intention to cyber slack. When individuals multi-task, they are no longer aware of outside activities, which encourage the rate of absorption into the Internet technologies. As a result, multitasking with these technologies can interfere with the learning process (Junco, 2012).

Gehlen-Baum and Weinberger (2012) found that students frequently browsed lecture-related websites, played games, involved in social media and watched videos during class. Findings of the same study further revealed that students also used their devices for class-related activities such as annotating lecture slides, taking notes, looking at lecture-related websites and documents. One of the prevalent forms of academic cyberloafing, text messaging via cell phone during class, is a behavior that is relatively hard to ignore or disrupt. In an empirical study, Chaklader and Bohlander (2009) asked college students to respond to zero, one, two, or three text messages while viewing an instructional video. Test performance was significantly lower for the students who received two or three text messages, indicating that the ability to focus on and learn the material was negatively impacted by the texting. Similarly, Rosen, Lim, Carrier, and Cheever (2011) found that memory for a 30-minute videotaped lecture was impaired for a high text message group (sending or receiving an average of 19 texts during lecture) compared with a low text message group (sending or receiving less than 2 texts on average). In addition to the student doing the texting, it is also possible that other students, or the instructor, can be distracted by a student's texting (Tindell & Bohlander, 2011).

Laptops may also offer distraction from learning in the classroom (Roberts & Rees, 2014). Access to desktop computers in class can increase student engagement as they take an active role in learning, especially when the school-provided desktops block access to sites with no educational value (Bryant, 2017). However, personally-owned laptops in the classroom can lead to less engagement because of increased access to off-task activities (Skolnik & Puzo, 2008). Supporting evidence came from Fried (2008), who found that students using laptops frequently engage in multitasking, learning is negatively affected, and laptop use can be distracting to other students. Hembrooke and Gay (2003) focused solely on the effects of multitasking using laptops, and concluded that laptop use decreases the ability to learn. Ironically, Skolnik and Puzo (2008) found that in-class lectures accompanied by PowerPoint slides most often resulted in off-task activities, suggesting that passive learning creates the greatest opportunity for students to be distracted by the laptop technology.

The realization that students are already engaging in mobile learning and an understanding of how students are supporting their learning in this way can prompt educators to examine the way their courses are delivered. The implications for teaching and learning may be far-reaching, requiring educators to move beyond didactic methods which dominate educational

practices at most schools. They need to explore and employ alternative pedagogies such as constructivism or connectivism to accommodate needs of their students. This is a challenging task but nevertheless an achievable one under proper conditions (Farley et al., 2015).

## CONCLUSION

This conceptual paper has highlighted the disruption and support that are brought about by the use of mobile technologies in the classroom. It was mentioned that the mobile and ubiquitous technologies have gained great importance and are used in all areas of life with a fast growing speed. However, it was pointed out that education sector is skeptically slow about the adoption of mobile technologies and it is not at the level that it should be. This was due to the fact of resistance that exists due to the mobile technologies' disruptive effects. This paper also indicated that the pedagogy of transmission as the dominant paradigm is the course of disruption. For this reason, instructors lack the incorporation on mobile technologies in teaching and learning processes. Due to the deficiency in use of mobiles during instruction even for learning purposes, students tend to use mobile devices for other purposes such as social media, texting and Internet search that distract the learning process. It was indicated in this paper that liberal educators advocate that mobile technologies have a potential to increase student collaboration, promote active participation, and provide quick access to online sources with multimedia/hypermedia materials. Overall, mobile technologies in education supports personalized learning. From a pragmatic point of view, banning the use of mobile devices in schools completely or allowing students to use their devices anytime and anyway in the classroom does not appear to be a good policy. Therefore, instead of ignoring mobile media or exaggerating its potential, educators should develop useful policies and practices by focusing on how they can integrate mobiles in their classroom to make learning more effective, engaging, and efficient. It is clear that mobile devices are perceived almost as a bodily part of individuals today and they are considered the best technology for ubiquitous learning so that educators should take advantage of these devices to reach wider audiences and improve the quality of learning experiences.

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# THE USE OF WHATSAPP TO PROMOTE EFFECTIVE COMMUNICATION IN SCIENCE AND TECHNOLOGY EDUCATION

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**Abstract**
Given the availability of *WhatsApp* across multiple mobile platforms and the fact that it has reached a critical mass of users, it is argued that *WhatsApp* provides researchers with an excellent opportunity to investigate how people really use such applications, since our current understanding of *Mobile Instant Messaging* (MIM) applications is very limited. The purpose of the study is to establish and use *WhatsApp* groups with the specific aim of enhancing effective communication in the training of education students in Life Science and Engineering Graphics at the University of the Free Sate.
First the research consisted of a qualitative analysis of the *WhatsApp* messages sent when a Life Science education module was presented to identify recurring themes. These themes were then utilised to construct a structured questionnaire to gather students' views on these themes as well as the possible use of *WhatsApp* in the classrooms. Lastly the questionnaire was administered to Engineering Graphics education students in Technology, since this enabled the researchers to do a quantitative analysis of all the responses.
One of the clear themes that emerged from the research is that the *WhatsApp* groups enabled the students to communicate and know about unexpected developments, information and arrangements concerning the modules. The *WhatsApp* groups in the study also added value to the students' experience. *WhatsApp* groups helped some students to improve their social skills and made them more comfortable with their class mates.

## 1. Introduction

Radovanović, Hogan and Lalić (2015) state that digital literacy is becoming an integral and vital aspect of educational institutions. They regard the following skills as important in the enhancement of digital literacy: the navigation of digital media by using formal operational skills; skills in the retrieval and analysis of information; skills to produce new content; and digital communication skills. Some aspects of digital communication skills at a higher education institution will be explored in this study.
Church and De Oliviera (2013) argue that the *Short Message Service* (SMS) has revolutionized the way we communicate. They point out that in 2011 for example, 7.8 trillion messages were sent by billions of people around the globe. However they have observed that a new wave of mobile communication services called *Mobile Instant Messaging* (MIM) *applications* has gained considerable momentum. This might be the case since *WhatsApp* for example, includes a greater variety of functions, such as text messages, attached images, audio files, video files and links to web addresses (Bouhnik & Deshen, 2014).
Jan Koum, the Chief Executive Officer (CEO) and cofounder of *WhatsApp,* announced on 6 January 2015 that the application has 700 million monthly active users that send more than 30 billion messages daily hence the application's popularity is increasing (Abbruzzese, 2015). From the arguments above it is necessary to establish and use *WhatsApp* groups with the specific purpose of enhancing effective communication.

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Ahad and Lim (2014) employed quantitative based approaches, which primarily made use of an online questionnaire, distributed randomly among the undergraduates at University Brunei Darussalam. An online questionnaire was designed and deployed to explore five variables; (1) *demographics* or profiles of *WhatsApp* users: gender, age group, race and faculty; (2) *appropriation:* the frequency of use or time spent per day, usage types and features, the type of information disseminated; (3) *incorporation:* the frequency of use or time spent per day, usage types and features, the type of information disseminated; (4) *objectification:* the symbolic meaning of *WhatsApp*; and (5) *Conversation:* the challenges encountered and continuity of *WhatsApp* use. A total of one hundred and fifty-eight students responded to the online questionnaire, enabling Ahad and Lim (2014) to do a proper statistical analysis of the responses. Relevant responses from their study will also be referred to in the discussion of our results in section five.

The research question to be addressed in this study is to investigate the use of *WhatsApp* on effective communication in the training of education students in Science and Technology in Higher education.

## 3. Research methodology

The first phase of our qualitative research consisted of a qualitative analysis of the *WhatsApp* messages sent over the period that the Methodology of Life Science module was presented. After this sampling the recurring themes in the communication of the students was identified. As such, the *WhatsApp* group that formed the focus of our research was more structured, with a more limited number of students than the eventual study group of Church and De Oliviera (2013).

During the second phase of our research these themes were then utilised to construct a structured questionnaire to gather students' views on these themes as well as the possible use of *WhatsApp* in their own classrooms once they were teaching. The advantages that were offered to them by the *WhatsApp* group as well as suggestions for future improvement and the disadvantages of the group was also viewed. A simple yes/no/uncertain section was included in almost all the questions to enable us to establish the general levels of agreement or disagreement about the questions amongst the students. Open-ended questions were included after each of these to enable the students to explain or motivate their answers.

In the third phase the questionnaire was validated by twenty-eight Engineering Graphics students in Technology, since this enabled us to do a quantitative analysis of all the responses. In total thirty-nine of the students of the two modules eventually submitted completed questionnaires. The response rate of 75% was thus a satisfactory one. The fact that we had thirty-nine questionnaires returned enabled us to do quantitative and qualitative analyses of the responses of students in an authentic higher educational setting.
We shall now present the responses of the students according to the questions that were included in the questionnaire.

## 4. Results

The following themes were identified and are included in our questionnaire: communication about administrative matters concerning the modules, communication about assessment, communication about social matters, communication about the planning and execution of student presentations and/or practical classes, communication about the content of the

modules, opportunities for extended learning, and the improvement of communication in modules other than the Methodology of Life Science.

In the first item of the questionnaire we asked the students whether it was important to them to communicate with their fellow students and/or lecturer/tutor about administrative matters on the *WhatsApp* group, for example the time of lectures or arranging the unlocking of the laboratory.
All thirty-nine of the students (100%) responded positively to this question (see Figure 1).

Some of them reported that it was important because it established certainty in one's mind about organisational matters – and nobody was excluded in this manner. A number of students said that it helped them when there were uncertainties and one had to find out something, like the times of classes. One could also ask questions and everybody could answer in due time. Other students also placed a high premium on the transparency and clarity provided by the group, by the convenience of having everybody available at all times, and by the speed and directness of the communication.

Other students said that, because everybody's schedules change all the time and because unforeseen circumstances might appear for example the "Fees-Must-Fall" student strikes at many South African universities at the end of 2016, arrangements might change and the *WhatsApp* group then helps to keep everybody up to date and to clarify uncertainties. The group also saved them time and unnecessary effort: "*WhatsApp* made it easier to contact the lecturer before arriving at the laboratory instead of having to look for the lecturer in the offices only to find that he has not arrived yet.

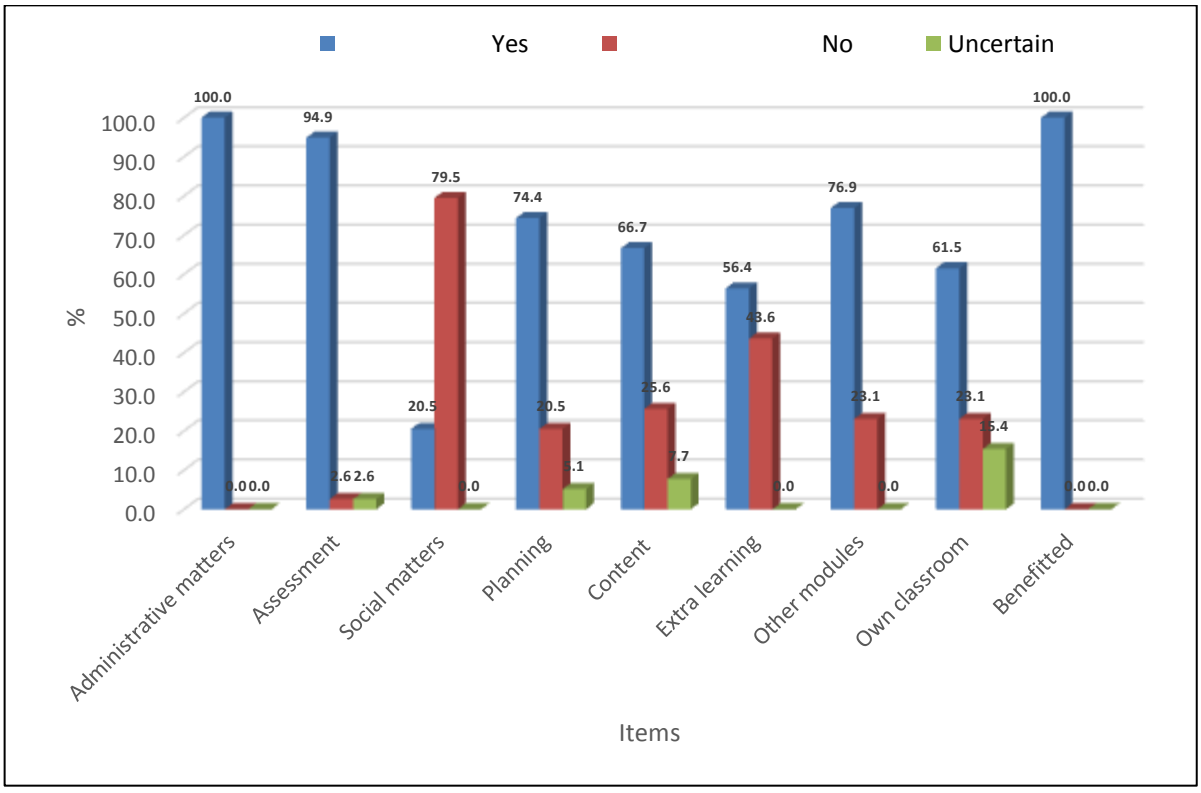


**Figure 1:** Quantitative analysis of the responses with regard to the importance of each item (N = 39).

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Eight students (20.5% - see Figure 1) preferred the "yes" response. Three of them were refreshed by a funny picture or joke that made them laugh. They argued that it created a relaxed atmosphere or bond amongst the students. Another student agreed with this sentiment, but only on the condition that shared photos should be subject related and messages should be inspirational.

In the fourth item we wanted to determine whether it was important to the students to communicate with their fellow students and/or lecturer/tutor about the planning and execution of presentations and/or practical classes on the *WhatsApp* group, for example the planning of lessons or the use of educational aids.

Twenty-nine (74.4% - see Figure 1) of the students responded affirmatively to this question, eight (20.5%) responded negatively and two (5.1%) were uncertain. The majority of those that responded affirmatively reemphasised the importance of the clarification of uncertainty, misconceptions or misunderstandings – either by the lecturer/tutor or fellow students. One of them regarded the availability of such a platform as of importance – this student sometimes needed advice about lesson planning or resources. The student did not use the group for this purpose, though, but has helped other students when they needed to know something.
A recurring theme in the responses of some of the students who selected the "no" or "uncertain" responses was, similar to the previous questions, that if all students attended the classes, there would not have been any gaps in the communication. Those who attended the classes managed on their own - without any assistance from the group.

In the fifth item we asked the students whether it was important to them to communicate with their fellow students and/or lecturer/tutor about the content of the modules on the *WhatsApp* group, for example the content of the different learning units.
Twenty-six (66.7% - see Figure 1) of the students preferred the "yes" response in this case, with ten (25.6%) that selected the "no" response and three (7.7%) that selected the "uncertain" response. It became apparent that the students now responded in a patterned manner: like before, they emphasised the importance of the readily availability of assistance provided by the group when one might have missed something in class, but they also expressed their irritation when people had discussions all the time. They have used the group to share notes, the content of lessons and the work they had to study.

In the sixth item we wanted to establish whether it was it important to the students to communicate with their fellow students and/or lecturer/tutor about what could be viewed as extra learning on the *WhatsApp* group, for example the sharing of pictures or interesting plants and/or animals.

Twenty-two (56.4% - see Figure 1) of the students responded affirmatively to this question and they provided a variety of reasons for their responses. One of them said that someone might share something with them that they have not seen before, or might never see. The photos can be saved and shown to learners in future to broaden their knowledge. Two other students supported this view by regarding this as a charming way to learn about the subjects and to broaden their knowledge. Another student liked it a lot, since it contributed towards the learning process and inspired him to want to learn more. Two of the students reported that it was nice to share information with people in the same subject and situation: for example they received images of the required drawings they had to submit.

One student, while not regarding this aspect as important, discovered that it was interesting to view other plants and animals as they were observed by their peers. Seventeen students (43.6% - see Figure 1) did not want to be exposed to extra learning on the group. Students pointed to the distractive effect of this and some felt that these interesting phenomena should be discussed in class. Students also did not want photos to be shared on the group as they felt that it did not have anything to do with the subject matter, that it was not important enough.

In the seventh item we inquired whether the *WhatsApp* group facilitated improved communication in one or more of the students' other modules.
Thirty (76.9% - see Figure 1) students felt that this group has indeed facilitated improved communication in other modules: many of the students had the same modules and, since not all the modules used *WhatsApp*, this group provided an easy method of communication between them. This resulted in the effective organisation of group work and provided clarity about organisational matters in these modules. One of the students even suggested that, because of the effectiveness of this group, all other modules should have their own groups. Nine of the students (23.1%) did not believe that the group improved communication in other modules. One student, for example, felt that the communication in quite a number of modules was already good enough. Another one did not have other extra modules, with the result that this item was not applicable to him or her.

In the eighth item we wanted to know whether students would use *WhatsApp* in their classrooms once they start teaching. The responses of the thirty-nine students displayed an ambivalent nature in this case: twenty-four (61.5% - see Figure 1) of them preferred the "yes" response, nine (23.1%) selected the "no" option, while six of them (15.4%) were uncertain about the matter.

Those that indicated that they would use *WhatsApp* in their classrooms in future provided a variety of motivations for their opinion: it might give learners a platform to communicate, one could discuss extra classes and content, it is an easy and quick way to keep in contact with the learners and learners might be able to ask questions after school hours. One of them also argued that parents, colleagues and the school principal could be part of the group, and that this would create a safe environment for everybody. Such a group should be managed properly, though: rules for the proper use of the group should be set and applied.

The nine students that would not use *WhatsApp* at school level explained it as follows: they felt that learners would not know how and when to apply a *WhatsApp* group, that such a group might be misused, and that some schools have strict policies about the use of cell phones. One of them anticipated that teachers might be insulted on such groups. The other six students also had clear reservations: they thought that it might be useful, but that participants' privacy might be invaded and that learners might eventually become a burden. One of them could visualise that such a group might be useful for communication, but that would depend on the kind of learners: some learners might think they are funny and could create a mess out of the group. Another one indeed reported about a case like this: as a coach, she had netball girls on a group and it resulted in "chaos". One felt that she would rather encourage learners to use it for effective communication when they have to do group assignments.

In the ninth item we asked whether the students have benefitted from the use of *WhatsApp* in the modules. To us, this was probably the most important item in the questionnaire, since the

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A clear theme that emerged from our research is that the *WhatsApp* group enabled the students to communicate and know about unexpected developments, information and arrangements concerning the modules. This theme is in line with the finding of Church and De Oliviera (2013), who reported that *WhatsApp* was used for chatting, quick catch-ups, coordination and planning. They call it coordination "on the fly". Bansal and Joshi (2014) call it "learning on the move". Rambe and Chipunza (2013) identified a similar multifunctionality of *WhatsApp*: it served as a tool for bridging access to learning resources, rendering peer-based and hierarchical support, leveraging on-task behaviour and enhancing meaningful context-free learning. Bouhnik and Deshen (2014) similarly pointed to collaborative learning, active participation in class, learning any time any place and informal communication. It was found from this study that some of the students mentioned that the *WhatsApp* groups assisted them in passing the modules. However, proper guidelines for the sharing and use of content related information should be communicated to the students. Radovanović *et al.* (2015) found that students commonly accept information uncritically with regards to checking the credibility of the source.

Research shows heavy use of *WhatsApp* for planning and coordination of social events – and even sharing photos linked to silly things or jokes (Church & De Oliviera, 2013). In this study, it was found that the majority of the respondents were irritated by the unnecessary socialisation in groups established specifically for communication about academic matters related to the modules. We therefore agree with those students who suggested that clear rules should be set and applied for groups in these kinds of environments. What remains true, though, is that the *WhatsApp* groups have, like in the study of Bouhnik and Dreshen (2014), contributed to the interpersonal relationship between ourselves and the students since they felt free to approach us at any time, and continued to do so privately when they wanted to know something that they did not want to ask on the group. Like the teachers in their study we felt that our presence on the groups gave the students a sense of security: "… they have someone of whom they can ask questions, they don't feel alone" (Bouhnik & Dreshen, 2014, p.228).

The *WhatsApp* groups in our study also added value to the students' experience. These results were similar to Church and De Oliviera's (2013) study where students revealed that *WhatsApp* groups helped some students to improve their social skills and made them more comfortable with their class mates. This led to an increased sense of community and connection. This was also found in the study conducted by Rambe and Chipunza (2013). Bouhnik and Dreshen (2014) argue that the dialogue between students, whether spontaneous or directed by the teachers, creates and atmosphere of cooperation, solidarity, and coming together to solve problems and deal with challenges.

Results in this study show that the active usage of *WhatsApp* positively influenced student engagement. Results also indicate that students perceive the use of *WhatsApp* as a valuable tool to improve the level of student engagement in their module. However, the use of digital communication technologies may cause structural tension as some lecturers may experience a loss of status power (Radovanović *et al.*, 2015). This aspect and the fact that the e-learning environment is a highly fluctuating and changing one imply that more research is needed to establish the educational value of *WhatsApp* on a broader scale.

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# THE ROLES AND RESPONSIBILITIES OF E-TUTORS IN OPEN DISTANCE AND ELEARNING ENVIRONMENT

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**Abstract**
The success of e-learning depends largely on the choice of a suitable tutor team with appropriate online tutoring knowledge and skills, or the willingness to acquire the relevant knowledge and skills necessary to explore and maximize the designed environments. This does not simply mean selecting a tutoring team with subject matter expertise and or technical skills, but the competence in both knowledge and skills. In light of these, one of South Africa's open and distance learning university has established an e-tutor programme to deliver online courses and support students in diverse geographic location. In the context of the institutional policies, e-tutors are expected to epitomize certain roles and responsibilities in supporting students online. It seems e-tutors do not demonstrate their roles and responsibilities as expected. It is from this view that the present study investigates whether e-tutors portray specific roles and responsibilities in open distance and e-learning environment. A qualitative purposeful sampling technique assisted in the selection of seven e-tutors involved in one of the computer integrated education modules. Interviews and online observations assisted in mining the qualitative data. The selected e-tutors completed structured open-ended questionnaires, which were administered online. For triangulation purposes, online observations were conducted from the e-tutor site in an institutional portal. The collected data was transcribed and analysed qualitatively using themes and codes. Ethical protocols were observed throughout the research project. Despite some challenges, the findings revealed that e-tutors play different roles and are responsible for supporting students academically, facilitate learning and guide. These include the incorporation of information and communication technology tools available on the institution's portal. The study used a small-scale sample, as such the findings could not be generalised to the entire university population. The study recommended a larger scale sample wherein the findings can be generalised to the entire university population.

**Keywords**: e-tutor, e-tutor programme, e-learning, open distance learning, tutoring skills.

## INTRODUCTION

It is not surprising to learn from literature that the roles of tutors in open distance and e-learning environments are voluminous. Bennet and Mash (2002) attest, "To be an effective online tutor, it is clearly not enough to know which buttons to press in order to send an e-mail or which HTML coding is required to insert an image on a web page" (p.14). The implication is that the support provided by e-tutors requires e-tutors to adopt several unique roles depending on epistemological framework and the tasks the learners have to manage (Denis, Watland, Pirotte & Verday, 2004). The roles of e-tutors in an online environment reflect a paradigm shift, that is, from a mere transmitter of knowledge to a more facilitator of learning. To design and animate an online environment, additional roles may also be necessary (Denis, 2003). From a literature review as well as empirical data, the present study investigates whether e-tutors portray specific roles and responsibilities in open distance and e-learning environment.

It is essential that e-tutors demonstrate their roles in online learning space. The underlying reasons are that: E-learning as described, is an approach where the learning process is supported by information and communication technology (Sulčič & Sulčič, 2007); and that the salience of tutoring is emphasized (Ainsworth, Bibby & Wood, 2002) in open distance and e-learning environments. It is in these environments where tutors and tutees communicate through the Internet in e-learning (Chae & Shin, 2015). It has been proved that "technologies when embedded in instruction that was well grounded in cognitive and social processes by which knowledge is constructed, they could offer uniquely powerful learning opportunities" (Kozma, 1994, p.1). For these reasons, tutors are known to mediate learner-computer interactions, which will raise satisfaction with their learning and improve academic engagement and achievement (Chae & Shin, 2015).

In light of the above, the University of South Africa (UNISA) is in the process of migrating learning and pedagogy from face-to-face and blended mode of learning to online learning. Due to its large student enrolment, the university has incorporated the services of e-tutors in learner support in order to increase student success rate. Student support is an essential element of every successful learning institution. Since one of the famous experts in the field of international open and distance learning (ODL), Alan Tait noted student support. Tait (2003a) writes "students want support, student support, especially student guidance and counselling, tutor support, and effective information and administrative systems all provide a range of activity that impacts 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). Croft (1991) shares the sentiment with Tait and denotes the most support services student wants as to help them realize the instructional objective of the course by minimizing the negative effects of isolation and the lack of regular personal contact.

In the context of the institutional policies, e-tutors are expected to epitomize certain roles and responsibilities in supporting students online. The concept of e-learning is fairly new in this institution, and it is not yet clear whether e-tutors portray specific roles and responsibilities as expected by the institution. The question remains, what roles and responsibilities do e-tutors demonstrate in open distance and e-learning environment?

## LITERATURE REVIEW

The concept of e-tutoring arise from the word 'electronic tutoring' or 'Internet tutoring' which refer to individualised learning support provided via the Internet and includes ongoing communication between e-tutor and e-tutee (Flowers, 2007). Literature has identified different and alternative names to describe the e-tutors. These refers to amongst others terms such as leader (Hotte & Pierre, 2002); e-moderator (Salmon, 2000); facilitator (Collinson et al., 2000); motivator, mentor, mediator and production coordinator (English & Yazdani, 1999). Other studies (e.g., Salmon, 2007) focus on online tutoring as provided by an assigned e-moderator. These moderators were divided into institutional interveners, appointed interveners and natural interveners, which specifically refers to tutors, experts, and learners (Hotte & Pierre, 2002). All these terms are used to refer to the same or similar roles.

Several authors (Barker, 2002; Lentell, 2003; Ryan et al., 2000; Simpson, 2002) have described some e-tutor roles. Barker (2002) for example, provides a list of roles e-tutors demonstrate and which describe the e-tutor as "…'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" (P.7). Barker also adds to the list the roles of moderating conferences, acting as mentors to less-experienced colleagues and doing quality control of other e-tutors' work.

Lentell (2003) states the typical duties of a distance education tutor to include ensuring students have grounding in the subject and providing students with academic support in the subject matter. Other roles include assisting students in exploring the links between different course modules and integrating work experience with academic knowledge. For these reasons, Lentell (2003) notes, "Tutors facilitate and guide the learning of their students so that the students gain knowledge and understanding. To achieve this, tutors develop and practice a multitude of skills and strategies" (p.67).

Ryan, Scott, Freeman and Patel (2000) describe the main role of the online tutor as that of an educational facilitator. They further suggest that the e-tutor "contribute specialist knowledge and insight; focus the discussion on the critical points, to ask questions and respond to students' contributions; weave together disparate comments and synthesize the 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" (p.110).

Alternatively, Simpson (2002) identified the role of student support. He further describes two broad areas of tutor support, academic and non-academic and states, "The first is academic (or tutorial) support which deals with supporting students with the cognitive, intellectual and knowledge issues of specific courses or sets of courses. This include developing general learning skills, numeracy and literacy. The second is non-academic or counselling support which refers to the support of students in the affective and organizational aspects of their studies" (p.7). Simpson also include in his description a Rogerian model. Rogers (1951) advocates the approach that 'You can trust the student' and acting on this assumption teachers will be more inclined to create a climate of respect and acceptance which is accepting of the emotionalised situation of educational or group experience and the tutors sees themselves as a member of a learning group, rather than an authority. In this regard, the teacher will make learning resources available; relying based on continuing experience and recognizes that any course is a beginning and not the end of learning.

The given descriptions and discussions from different literature are relevant to this study and provide a lens, which the program of e-tutoring could be considered at an open distance and e-Learning environment. In light of the above descriptions, the current study focused on the institutional interveners – e-tutors who support students throughout their learning process.

## METHODOLOGY

This study employed a qualitative case study research design to gain a richer and deeper understanding of the roles and responsibilities e-tutors epitomize in supporting students who study in open distance and e-learning environment. Qualitative methods allow for written descriptions, analysis, and the interpretation of the phenomenon (Denzin & Lincoln, 1994) of e-tutor programme in open distance and e-learning institution. The case study clearly revealed widespread diversity on a variety of issues, which could not have been explored as thoroughly using other research approaches. This widespread diversity of information on e-

tutor programme provided greater understanding of the dynamics of e-learning in the context of open and distance environment. It is important to understand how e-tutor portray their roles and responsibilities in the delivery of online courses as well as supporting students in open and distance learning.

A qualitative purposeful sampling technique (McMillan & Schumacher, 2006) assisted in the selection of seven e-tutors involved in one of the level five modules. Due to the search for in-depth data, qualitative samples are frequently relatively small (McMillan & Schumacher, 2010). The selection was based on the following attributes: all e-tutors have been contracted by the institution and have been tutoring for a period of one year and above; all participants facilitate computer integrated education course.

The current study focuses on the information gained from the interviews with e-tutors as well as the online observations (De Vos, Strydom, Fouche et al. 1998). The selected e-tutors completed structured open-ended questionnaires, which were administered online. A set of predetermined questions were prepared and used to guide all the interviews. In addition to the interviews and for triangulating the findings, online observations were drawn from the e-tutor site in an institutional portal. The collected data was transcribed and analysed qualitatively using themes and codes. To ensure trustworthiness (Maree 2007), the analysed data were checked for consistency and credibility. In this regard, the transcripts were submitted to the participants to correct errors and to verify the correctness of the shared data. The researcher maintains confidentiality and anonymity in all occasions to observe the ethical protocols. In this regard, the study used pseudonyms and codes throughout.

## FINDINGS AND DISCUSSION

From the analysis of data, the study selected two major themes as e-tutor roles in open distance and e-learning environment. These themes include the e-tutor as academic support; and a facilitator of learning. Table 1.1 indicates the role of the e-tutor in academic support.

**Table 1.1: e-Tutor as academic support**

| Theme | Strategies | Frequency |
|---|---|---|
| Academic support | offering students **guidance towards** their assignments | Benny; Lulu; Molly; Motlalepula |
| | Provide feedback to students | |
| | Provide more resources to explain concepts<br>• YouTube videos<br>• Websites | Benny; Lulu; Motlalepula; Sego |
| | unpacking more challenging subject content matters by using<br>• case studies<br>• advises students on the study content<br>• involve them in discussions | Benny; Lulu; Molly; Motlalepula ; Sego |

The data from the interviews as captured in Table 1.1 indicate that e-tutors offer academic support to students in an online environment. E-tutors explained that they use various strategies to support students in open distance and e-learning environment. Five participants (Benny; Lulu; Molly; Motlalepula; Sego) explained that they support students by unpacking more challenging subject content matters. These include the use of case studies where students have to share their real-life experiences as well as advising them on their study content (Lulu). Students were further advised to work through all the activities posted on the e-tutor site (Lulu; Sego). By doing this, Lulu addresses the subject content over a period in the discussion forums. Benny also explained that he supports students by involving them in discussions.

Four participants (Benny; Lulu; Motlalepula; Sego) explained that they provide students with more resources to explain concepts. Sego for example, used flipped classroom where students have content in the form of a textbook. Sego further explains that, "*I share with them various YouTube videos and relevant website so that they could be able to go through different medium to understand better the concept. I also provided an activity where they should indicate the Software application they use for teaching purposes and the software application for the subject they teach. I also asked them to provide the operating system they use in the computers and laptops, mobile devices such as smartphones, iPad and tablets etc.*"

Additionally, participants were found to be supporting students in more fascinating manners whereby digital tools and media were employed in teaching and learning. To support the notion of using digital tools, the data indicate that the participants also utilise the myUnisa portal to support students' online learning. The portal offer a variety of technological tools used for the discussions (Motlalepula); announcements (Motlalepula; Sego), and the additional resources (Benny; Lulu).

Four of seven participants (Benny; Lulu; Molly; Motlalepula) guide students towards their assignments. Motlalepula elucidated that she offers support to students by answering their questions. On the other hand, Molly provides students with clear explanations to their study content related matters, while Benny explains and give students some relevant examples. Benny further elaborate on this matter, "…*they usually ask about assignments feedback, return dates and faulty marks allocated to them. With content, they asked about differences in as far as definitions are concerned; for example, security measures and safeguard*" (Benny).

The findings from the interview data were triangulated with the observation data whereby participants demonstrated how they use minima tools to support students in open distance and learning environment. Table 1.2 indicates the myUnisa tools used by e-tutors to support the students.

**Table 1.2: myUnisa tools for online support**

| Theme | MyUnisa tool | Description | Frequency |
|---|---|---|---|
| Facilitate and guide learning | Discussion tool | Assignments<br>General discussions<br>Tutorials and study content<br>Typical exam questions<br>Glossary of terms<br>Lesson activities and | ETS1; ETS2; ETS3; ETS4; ETS5; ETS6; ETS7 |

| | | |
|---|---|---|
| | memoranda | |
| Announcement tool | Assignment and examination dates | ETS1; ETS2; ETS3; ETS4 |
| | Availability of tutorial letters | ETS2 |
| | Study guidelines and guidelines on the use of myUnisa | ETS2; ETS4; ETS7 |
| Additional Resources | Chapter content and revisions | ETS1; ETS3; ETS6 |
| | Tutorial letters and prescribed book | ETS1; ETS4; ETS6; ETS7 |
| | Exam guidelines and previous year's exam papers | ETS3; ETS6 |
| | Notes, Tables, Drill and practice activities | ETS1; ETS4; ETS6 |
| | Guidelines on assignment submissions | ETS4; ETS7 |

From table 1.1, it is worth noting that participants (e-tutors) facilitate and guide students learning. These was done through the incorporation of myUnisa tools such as discussions, announcements, and additional resources. All participants (ETS1; ETS2; ETS3; ETS4; ETS5; ETS6; ETS7) used discussion tool to engage student in the discussion of assignments, tutorial and study content. Discussion tool was further used for typical exam question, glossary of terms, as well as the lesson activities and memoranda. Through the discussion tool, e-tutors guide students on how to prepare and complete assignments (ETS1; ETS6); they also orientate and clarify students on the given assignments. Later on, e-tutors give students an opportunity to reflect on their written assignments (ETS3). Four of seven participants (ETS1; ETS2; ETS5; ETS6) state discuss study content and tutorials with their students. This data suggests that the discussion tool is the most utilised tool in e-tutor programme.

Five of seven participants (ETS1; ETS2; ETS3; ETS4; ETS7) demonstrated the use of announcement tool in their teaching. In this regard, four participants (ETS1; ETS2; ETS3; ETS4) verified that they use announcement tool to deliver messages that announce the assignment and examination dates to students. Other three participants (ETS2; ETS4; ETS7) use the announcement tool to provide the students with the study guidelines as well as how to use myUnisa portal.

The data further reveal that five of seven participants (ETS1; ETS3; ETS4; ETS6; ETS7) use the additional resource site to place information that support student learning. Four of these participants (ETS1; ETS4; ETS6; ETS7) indicated that they place resources such as tutorial letters and prescribed books on the site. Other three of the participants (ETS1; ETS3; ETS6) put chapter content and revision on the site as additional information to support student learning. Another three participants (ETS1; ETS4; ETS6) provide students with resources such as notes, tables, drill and practice activities that augment the learning of the study

content. Respectively, two participants (ETS3; ETS6) provide students with examination guidelines and previous examination papers, whereas, participants (ETS4; ETS7) place information that guides students on assignment submission.

## CONCLUSION

The current study explores the roles and responsibilities e-tutors portray in open distance and e-learning environment. The study established that open distance and e-learning could not succeed without the involvement of e-tutors who acquired knowledge and skills to facilitate online courses. For this to materialize, information and communication technology is necessary. In this milieu, the use of technology in teaching and learning makes it explicit for e-tutors to facilitate and support students learning with technology tools available on the institution's portal. These tools include the discussion tool (Ryan et al., 2000); the announcement tool; as well as the additional resource tool (Rogers, 1951) which e-tutors used for different purposes.

The study further concludes that e-tutors in open distance and e-learning environment have more than one role to play. These roles include some of the roles described by literature in this paper. The study therefore, agrees with Lentell (20003), Mitra (2009), Rogers (1951), Ryan et al (2000), and Tait (2003a). It was evident from the study that e-tutors portray the roles and responsibilities of supporting students in an online environment. The support offered assists the students to pace themselves with learning. This concurs Mitra's (2009) views that, "Lack of student support can lead to lack of motivation, feelings of isolation and high levels of frustration and anxiety in students, all compounding to dissatisfaction and attrition" (p. 257).

Student support is crucial for distance learning, with special reference to online learning. This data suggests that students are not left in isolation; they are under the guidance and support of the online facilitator who is socially available online. Furthermore, Tait (2003a) seamed the thought of student support and articulates that "student support, especially student guidance and counselling, tutor support all provide a range of activity that impacts not only in terms of teaching but also reinforcing the student sense of confidence, self-esteem and progress" (p.4). The study employed a small-scale sample of which the findings thereof could not be generalised. It is therefore recommended that a large-scale sample be used to replicate the study, so to generalise the findings to the entire population.

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# AN EVALUATION OF A COMPUTER-BASED TRAINING PROGRAMME FOR MINE WORKERS IN NORTH-WEST PROVINCE: INSIGHTS FROM THE FIELD

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**Abstract**
The purpose of this paper is to report a study that evaluated a computer-based programme to train adult mine workers on functional knowledge and skills in a North-West Province. The programme is perceived as a means to overcome adult functional illiteracy in Own-Time and Full-Time learners. The study creates an understanding about the complexities of training adult learners in a mining context via computer-based programmes; it also helps to adjudge the spinoffs of the programme the mine has invested in, and provides a viewpoint to the Activity Theory (AT), which was relied on to study the contexts of the implementation of the programme. A qualitative single case study approach was used backed up by individual semi-structured interviews, focus groups, participant observation and field notes. These methods were applied on the purposively selected mine workers, their facilitators and centre managers. The findings reveal the constraining effect of the policies regulating the programme, inadequate integration of computers and multimedia for learning, some transformation in the learners for purposes of functionality in their work.

**Keywords:** Adult learning, evaluation, computer-based learning, activity theory, mine workers, mediation tools and programme.

## 1. Introduction

This paper reports a study that evaluated a computer-based programme that was used to train adult mine workers for functional literacy in the North-West Province. The study focused specifically on those mine workers who have the least formal education or training, who are termed elementary workers (unskilled), and machinery operators and drivers (semi-skilled). The mine has a service level agreement with the service provider to use its curriculum for the adult learning and training (AET) studies. This happens through a computer-based and face-to-face training methodologies. This is premised on the fact that computer technology in the workplace has led to the automation of many job tasks as they can do these tasks faster, better and more cheaply than humans (Lai, 2017).

Mining in South Africa dates back to the 19th century when diamonds were discovered for the first time on the banks of the Orange River in 1867 and subsequently in Kimberly (Terreblanche, 2002). Although the mining industry expanded in South Africa, black mine workers were denied formal education – especially during the apartheid era (Smith and Mji, 2012). This legacy still sits with many mine workers, hence a need for training programmes such as one investigated in this study. The mine in the North-West Province realised that retention and personal development were amongst the projects needed to undertake in order to make its employees able to use the computer technology in their work, hence the introduction of the AET studies. The AET teaching and learning programme is offered in two learning environments, which are Own-time (Part-Time) and Full-Time. In Full-Time AET studies mine workers are relieved of their normal duties to attend classes on a full-time basis,

whereas in Own-Time AET studies the workers voluntarily attend AET classes in their own time. The outsourced service provider has designed training programme tailored for this mining context. The nature of the implementation of this programme is however, not yet known given the policy imperatives under which it is implemented. The purpose of this study was thus to evaluate the implementation of the AET computer-based programme given the mine's policy constraints. The findings of the study can create an understanding as to whether this initiative justifies the time and money spent by the mining company, and whether the programme is successful in developing and empowering the mine's employees. The following questions were addressed:

- What are the policy imperatives constraining or enabling the implementation of the computer-based programme?

- How is the programme implemented for purposes of the mine workers' (learners') learning?
- How does the programme improve the knowledge and skills of the mine workers (learners)?

The paper starts by briefly discussing the chosen theoretical framework, accompanied by the relevant literature. This is followed by the discussion on methodology employed. The findings are presented and discussed, and conclusions are drawn ultimately.

**Theoretical framework**

Activity Theory originated from the studies of Vygotsky and Leont'ev on cultural-historical psychology in the 1920s (Verenikina, 2001) and more recently in the human-computer interaction (Mohammadreza, 2017; Zahedi, Tessir and Hawey, 2017). AT is a conceptual framework that claims that "activity is primary, that doing precedes thinking, that goals, images, cognitive models, intentions and abstract notions like definition and determinant grow out of people doing things" (Morf and Weber, 2000, p. 81). Vygotsky's idea of AT is that humans develop through a series of social and cultural interactions with the world, mediated by tools and signs (Kaptelinin and Nardi, 2006; Zahedi et al, 2017). The reason for incorporating AT in the study was that it offered a tool that could be used to design and evaluate technology-enhanced learning interventions. Tool use was seen as an integral factor in both sociocultural interaction and AT. The participants' views and feelings about attending a computer-based AET programme are a central element and a spindle around which this study revolves.

In AT, the subject is the person being studied, the object is the intended activity, and the tool is the mediating device by which the action is executed (Mohammadreza, 2017; Zahedi et al, 2017). Engestrom's AT also includes rules (determine how and why individuals may act) and division of labour (distribution of actions and operations). Figure 1 illustrates these concepts.

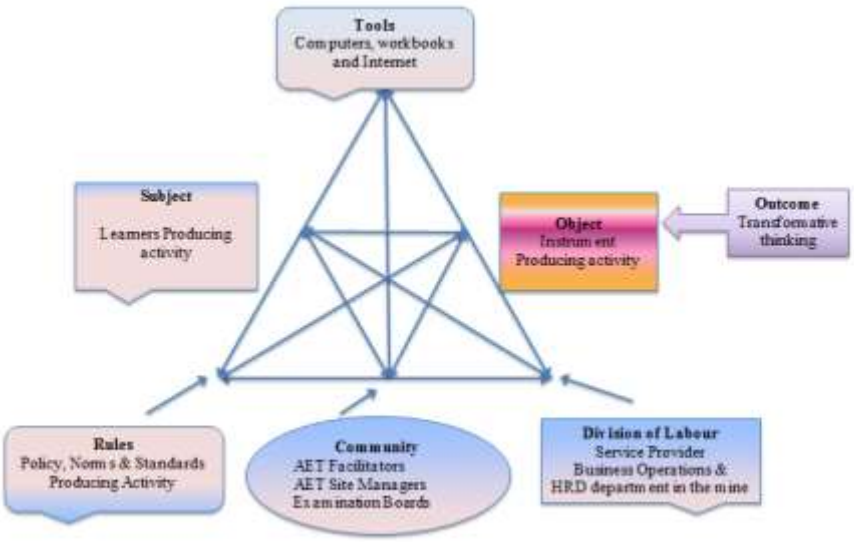


Figure 1: Engeström's expanded AT model (Engeström, 2001, p. 205)

Engeström (2001) argues that it is the projection from object to outcome, no matter how vaguely envisioned, which functions as the motive for this activity, and gives broader meaning to the actions of individual learners. In figure 1, tools and instruments reflect the mediational aspect of human activity through the use of both physical and psychological tools. The object component depicts the purposeful nature of human activity, which allows individuals to control their motives and behaviour when carrying out the activity. The subject component depicts the individual and collective nature of the human activity through the use of tools in a social context so as to clarify the desired objectives. The community component represents the role players as subjects in an activity at hand. A community is a self-identified group of individuals that share a common object (Barab et al., 2002, p. 25). The rules component refers to the explicit and implicit norms, conventions and regulations which are inherent in the classroom. The rules which impact on the activity system in this study include the AET policy for implementing technology in education and technology standards for facilitators. The division of labour component reflects a continuously negotiated allocation of tasks, powers and variations in task roles and responsibilities among the role players or subjects involved in carrying out the activity.

AT is augmented by Mwanza's (2002) framework, which depicts the process of the learning transformation through engagement with computers. Figure 2 shows this framework's applicability in this study.

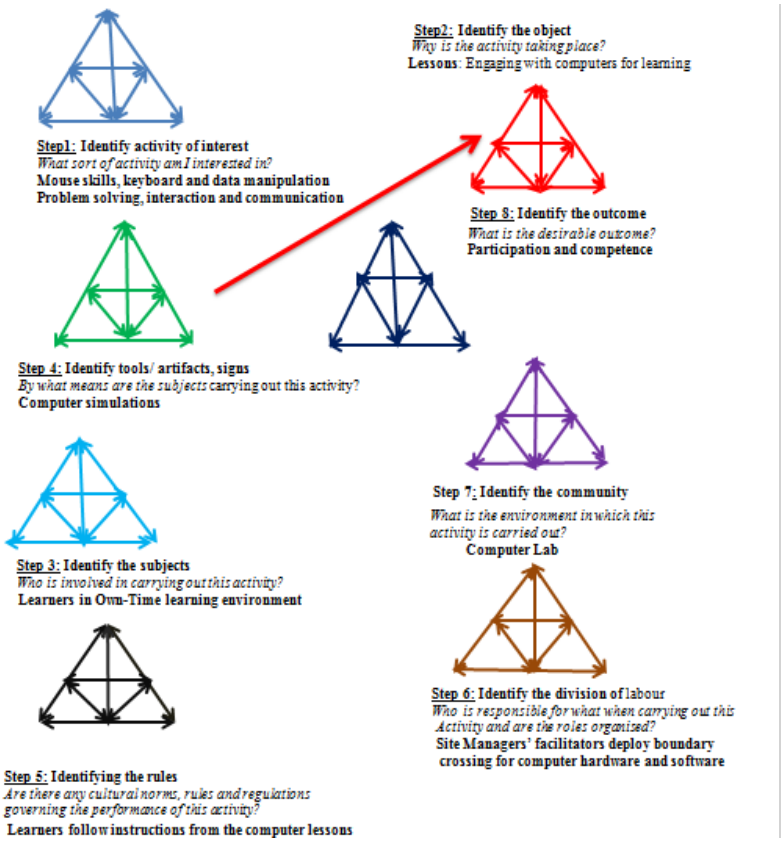

Figure 2: Process of transformation (adapted from Mwanza, 2002, p. 131)

AT is therefore about how subjects transform objects, and how the various components of the system mediate transformation. In this study, the flip side could be how computers have mediated the relationship between the subject (adult learners) and the object (engagement with the computer).

## 4. Research methodology

The case study followed a qualitative research approach, which is a type of social science research that collects and works with non-numerical data and which seeks to interpret meaning from the data to help us understand social life through the study of targeted populations or places. Yin (2003, p. 13) posits that a case study is used to discover beyond that which is currently known about the phenomenon, compared to relying on "derived" data (Shavelson and Towne, 2002). The case study was used to unravel the AET learning process as it unfolded through the use of a technological tool (computer) as enabler for functional literacy in a mining context.

*Participant selection, data collection methods and instrumentation*

A purposive selection method was used to select the participants in the study. The participants were five facilitators, four centre managers and eight learners. The involvement of the participants in the programme either as facilitators/managers and learners was the distinguishing factor for their selection as they would yield the required information through which to understand the phenomenon under study. Data were collected through individual semi-structured interviews with facilitators and managers, focus groups with learners, participant observation and field notes. Through the interviews the participants (subjects) narrated their experiences about facilitating and learning activity (object) via a computer.

Participant observation helped to observe the process and activities as well as the participants' engagements. To observe while participating (at times engaging with learners and computer) enhanced the understanding of the process and activities.

The interview guides were designed in accordance with the activity system and facilitation styles/approaches, and contained open-ended questions about the constraining rules/policy, the process of learning and the transformation that has brought to the learners. The interviews were recorded. Each individual interview lasted about 30 minutes, whereas the focus group lasted about 40 minutes. An observation tool was also designed to note the restrictions of the policy imperatives, facilitation and learning activities. Observation data were reviewed constantly in relation to the new information from the interviews. Field notes were also kept to understand Full-Time and Own-Time practices. Field notes recorded the subjects (who does what in the activity system); rules that constrain and justify the actions inside the department; purpose of actions as determined by the interviews; division and distribution of the tasks and status relations between participants; and disturbances or different opinions and points of view expressed within the department (tensions).

*Data analysis*

Data were analysed, categorised, ordered, manipulated and summarised in a manner which assisted in attaining answers to the research questions (De Vos, Strydom, Fouché and Delport, 2011, p. 335). The analysis facilitated the discovery of patterns, concepts, themes and meanings conceptualised according to the structure grounded in the components of Engeström's activity system (see figure 1). Data units and themes were grouped together into identifiable and interrelated categories. The participants' own voices were used to decipher uncontaminated accounts in the activity of learning.

*Validity*

Trustworthiness of the interpretations and the findings depended on the research methods (LaBanca, 2004), whilst maintaining the acceptable standards of scientific inquiry (Bowen, 2009, p. 27). The multi-method strategy helped added to the trustworthiness of the study as it helped to triangulate the data. Member-checking of the interview data was performed with the participants.

*Ethical protocol*

Permission was obtained from the mines' corporate head office and the research site in response to the application submitted. Choosing the site, gaining permission, selecting key informants, and familiarising ourselves with the setting or culture were thus the activities that preceded data gathering. Consent letters about the purpose of the study were disclosed to the participants for their signing. The letters communicated voluntary participation. Particularly for the mine workers, and extra effort was made to verbally explain what was contained in the letters due to their low literacy levels.

## 5. Findings

Three themes (AET policy, implementation of AET programme and content delivery) related to Engeström's activity system were developed and presented according to their sub-categories, descriptions and participants' codes. Their presentation is preceded by the participants' biographical data in (tables 1 and 2).

Table 1: Facilitators' and centre managers' biographical data

| Participant | Gender | Race | Age Range | Employment status | Qualification | Designation |
|---|---|---|---|---|---|---|
| P1 | M | B | A | Contractor | AET Certificate | Full-time Facilitator |
| P2 | F | B | A | Contractor | Diploma in AET | Own-time Centre manager |
| P3 | F | B | A | Contractor | Cert. in AET and Human Resource Cert. and Train the Trainer Cert. | Own-time facilitator |
| P4 | F | B | B | Contractor | Diploma in AET | Full-time facilitator |
| P5 | M | B | B | Contractor | Diploma in AET (studying towards a B.Ed.) | Own-time facilitator |
| P6 | F | B | C | Permanent Employee | Teachers Diploma, and B.Ed | Own-time Centre Manager |
| P7 | M | B | C | Permanent Employee | Teachers Diploma, and B.Ed. | Own-time Centre Manager |
| P8 | M | B | E | Permanent Employee | Grade 12 | Full-time Centre Manager |
| P9 | F | B | C | Contractor | Diploma in AET | Own-time facilitator |

Key: P1-P9: participants; Age range: A: 30-35; B: 35-40; C: 40-45; D: 45-55; E 55-60; Race: B (Black), C (Coloured), W (White), I (Indian); M: Male; F: Female.

Table 2: Own-Time and Full-Time learners

| **Participant** | **Gender** | **Race** | **Age range** | **Employment status** | **Work Centre** | **Designation** |
|---|---|---|---|---|---|---|
| P10 | M | B | E | Permanent Employee | Underground | Full-time Learner |
| P11 | F | B | C | Permanent Employee | Underground | Full-time Learner |
| P12 | F | B | A | Permanent Employee | Underground | Own-time learner |
| P13 | M | B | C | Permanent Employee | Underground | Full-time Learner |
| P14 | M | B | C | Permanent Employee | Surface | Own-time Learner |
| P15 | M | B | D | Permanent Employee | Surface | Full-time learner |
| P16 | M | B | C | Permanent Employee | Underground | Own-time learner |
| P17 | M | B | B | Permanent Employee | Underground | Own-time learner |

The biographical information of the participants shows a more balanced distribution of the facilitators' and managers' age range from A to C. On the other hand, the age range of the learners is concentrated more in C, which shows that the majority of these learners has advanced in age. Hence, this result show that the learners where facilitated and managed by younger facilitators and managers.

5.1 AET policy

The policy was used as a benchmark for the selection process of the mine workers. The policy appeared to focus more on the Full-Time learners as they were granted absence from work for the entire year to attend to their studies with full benefits, whereas Own-Time workers attended during their own free time was not obligatory (see table 3).

Table 3: AET policy and procedures

| Theme category | Theme description | Participants |
|---|---|---|
| Policy imperatives and reviews | *The business operation human resource development (HRD) managers, through their staff, assume responsibility for annual planning and setting of AET targets and staff requirements to meet the said targets; that when policy is reviewed learners and facilitators are engaged minimally, whereas they are the parties involved in the teaching-learning process.* | P7 |
| Challenges in the implementation of policy | *The policy does not specify the delivery mode of teaching and learning; however, the AET programme consists of multimedia and face-to-face teaching and learning but lessons are mostly delivered via face-to face.* | P8 |

*a) Policy imperatives and reviews*

The policy on the programme set the standards and procedures about the targets, but its reviews tended to stall progress in the activities. The participants' views in this regard are represented by P7 in table 3, who stated thus: …*when policy is reviewed learners and facilitators are engaged minimally, whereas they are the parties involved in the teaching-learning process*. The participants also stated that reviewing the policy does not guarantee that processes and procedures will be followed, though the employees are entitled to requesting full-time education. Their requests are authorised by the line management, but with some degree of favouritism. That means one mine worker's request may be granted for reasons known to the line manager, whereas another may be refused due to some sort of disfavour.

*b) Challenges in the implementation of policy*

Certain challenges were noticed in the policy implementation in some Own- and Full-Time learning environments, *the policy does not specify the delivery mode of teaching and learning; however, the AET programme consists of multimedia and face-to-face teaching and learning but lessons are mostly delivered via face-to-face* (P8). As a result, at the top of the list was lack of computer integration or multimedia for teaching and learning, which deprived the facilitators the opportunity to teach via a computer and learners to acquire computer knowledge and skills. Some learners and facilitators confirmed that every learning centre had a computer lab equipped with unused computers. Added challenges included failure to install hardware and software, technical problems and the information systems policy, which does not allow software to be installed without following the mine's information communication policy.

5.2 Implementation of AET programme

One of the key the key findings was the implementation of the AET programme, which was aligned to the tools and objects as components in Engeström's activity system. The sub-themes in the implementation of the AET programme are learner nominations for AET programme and lesson planning (table 4).

Table 4: AET implementation strategy

| Theme category | Theme description | Participants |
|---|---|---|
| Learner nominations for AET programme | *I have been nominated. I didn't ask much because I just received a message from my supervisor when I was underground. He told me my number is nominated, that I'm supposed to come to Full-Time. At that time, I was attending at Own-Time after work.* | P11 |

| Theme category | Theme description | Participants |
|---|---|---|
| | *I decided it was my own decision to attend this. I was not nominated.* | P12 |
| | *Before I came here I started at Own Time and then they nominated us to come here*. | P13 |
| | *Nobody forced me to come here. I am coming myself to study and read to know something can make my life easy and to continue with my work.* | P17 |
| Lesson planning | *In my class for Own-Time I use computer based teaching and learning I combine it with face-2-face and mostly use computers to fast-track the learners.* | P9 |
| | *In Full-Time it doesn't require you to use a computer.* | P10 |

*a) Learner nominations for AET programme*

The findings revealed that in response to the implementation of the AET programme nominations, employees' potential advancement and talents are assessed through the process of nominations, which were conducted by their respective operations to attend Full-Time classes at particular centres. Studying at an AET Full-Time centre is equivalent to a normal working shift in a day until the completion of the programme. P11 stated in this regard: *I have been nominated. I didn't ask much because I just received a message from my supervisor when I was underground. He told me my number is nominated, that I'm supposed to come to Full-Time. At that time, I was attending at Own-Time after work.* The policy gave preference to the learner employees who were already enrolled on the Own-Time AET stream and had already shown reasonable progress since their initial registration.

Employees who were willing to attend Own-Time AET classes did not have to be nominated, but apply for admission to the relevant centres without any obligation. P17 contended thus: *Nobody forced me to come here. I am coming myself to study and read to know something can be make my life easy and to continue with my work*, whereas P12 responded: *I decided, it was my own decision to attend this. I was not nominated.*

*b) Lesson planning*

Only one Own-Time centre used the combination of face-to-face and multimedia, and the other two Own-Time centres and a Full-Time centre did not integrate computers for learning. P10 confirms, *in Full-Time it doesn't require you to use a computer.* Lack of computer integration for teaching and learning has slowed down the outcome in the activity system. On the contrary, P1 posited that, *in my class for Own-Time I use computer-based teaching and learning; I combine it with face-to-face and mostly use computers to fast-track the learners.*

5.3 Content delivery

The findings revealed that every concept used in figures 1 and 2 bears a significant meaning related to the findings. For example, subject, tools and rules, when presented in terms of the AT terminology, should be understood in the context in which they were used. Gatherings at a computer-based platform was defined as a vehicle for higher order thinking. The result of learners' initiatives depends on how the group interactions go, who takes the lead, who is attentive and who drops out from the process. It seems those who struggle the most contribute

by a self-conscious input of menial abilities at the level of object construction. They dutifully complete each step of an interactive process.

Those who contribute to productive group interactions generate professional thinking by the way they instantiate the object of inquiry. During the process of transforming to the actual shared learning object there seems to be a delicate balancing of isolated individual and collectively shared needs.

Engaging with computers for learning was the target interest in this paper. Every participant's active role in the activity of interest was identified as the activity system of learning in a particular learning by engaging with computers (table 5). One sub-category was distinguished, i.e. motivation to learn category.

Table 5: Motivation to learn

| **Theme category** | **Theme description** | **Participants** |
|---|---|---|
| Engagement with computers for learning | *I think the use of computer is much, much better than doing face-to-face, but depending on the group of learners that you have. Uh, so somehow face-to-face is also good but the computers are also good if they can use them after face-to-face or before face-to-face; we are using it as a supplementary.* | P5 |
| | *It's like now, all things for this book, communication book; I know how to work on the computer. To see the questions at the computer. Computer is nice! I like the computer! I love the computer!* | P17 |
| | *We don't use the computer at Full-Time, I don't know I heard our head it says we didn't have many things to do on the computer and then they wait for the person who come to set the programmes.* | P10 |
| | *I used the computer in Level 2 Own-Time. Here at Full-Time we don't use computers but they are there in the lab.* | P15 |
| | *Yes, on the computer I can open the computer and I can put the password and I can start with the first lesson until where I can stop and if something is different, then I can call the facilitator to come and show me something and the computer is the access for everything to me. That's why I want to learn it.* | P12 |

The findings reveal that it is actually the projection from the subjects to the object when carrying out an activity, which produces an outcome as indicated in figure 3. Therefore, figure 3 presents a reversed version of Engeström's (1987) theory in terms of the subject-object-outcome relationship or interpretation. The subjects in this study are adult learners who function as the motive for the activity. The findings seem to differ with Engeström's (1987) opinion that it is the projection from the object to the outcome that functions as the motive for this activity, and that giving broader meaning to the actions of individual learners attracts the need for modification.

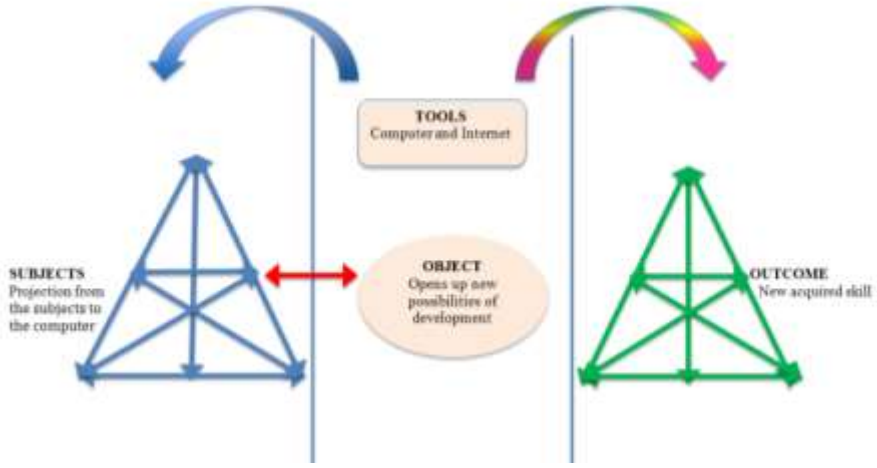

Figure 3: Engeström's revised expanded triangular model (adapted from Engeström, 2001)

The findings reveal that learners are motivated to learn especially via computers (those that actually got to learn hands-on). However, the facilitators experienced a rush-against-time to introduce computers, forced by many learners against the number of computers in the computer lab. Every computer lab had ten learners' workstations and one facilitator's workstation. Therefore, all the classes running Full- or Own-Time simultaneously could not make use of the single lab per centre, a possible reason why they appeared comfortable with face-to-face teaching. Subjects in the Own-Time class did not find it hard to use the computer, but did not have enough time because of their knock-off time and shift work. There was tension between their type of work as shift workers and attendance of training. In most cases they missed classes because they worked over-time. Fatigue from work and voluntarism caused them not to attend class at times. The findings specifically from the observation reveal that older learners were more challenged by the object of the activity system, while younger learners were more interested in the computers and were excited to use them. They could send text and multimedia messages and had accounts on social media. The findings from the focus group interviews reveal that the AET policy favours Full- rather than it does Own-Time programme or learners.

## 6. Discussion

Computers are tools that best describe and support learning in the 21st century. The AT with its focus on accumulating factors provides a useful leans through which to understand the ways in which human experience, needs and creativity shape the design and effectiveness of emerging technologies. However, the findings of this study show that the mine does not take full advantage of the implemented computer-based programme to empower the mine workers for effective execution of their work. This is evidenced in the fact that the Full-Time facilitation and learning still rely more on face-to-face interaction; computers accumulate dust in the labs because they are not being used maximally. It is only in certain Own-Time learning centres that this is fully used. While the implementation of any programme should be guided by policy, there is evidence of some contradictions/constraints between the mine's policy and the programme which are exacerbated by the fluidity of the policy's implementation and reviews. For instance, there is favouritism in the nomination of the mine workers for participation in the Full-Time programme; sessions are stopped/delayed by policy reviews; the emphasis of policy implementation goes to the Full-Time rather than Own-Time programme; the policy is not very clear about this programme. Another

contradiction is that there seems to be enough computers to can match the numbers of enrolled learners in the programme. But this sufficiency is counteracted by many leaners crowding around one computer in the computer lab. Adult learners especially those in Own-Time learning appreciated the transformation that the use of computers has brought in the work lives – communicating via e-mail, use some multimedia applications, etc. In the light of the findings, age differences play a role in easiness or challenge nature of the computer-based training – older learners are more challenged compared to the younger ones. The AT was useful in relating the multi-faceted system of information and its users through mapping the learning and participants onto its concepts and linking people to technology (Morf and Weber, 2000; Engeström, 2001 Mwanza, 2002). The learners in this mine context can develop through mediatiation by tools and signs (Engeström, 2001; Mwanza, 2002; Kaptelinin and Nardi, 2006). An important point to mention with respect to the AT is the disagreements that the study shows with Engeström, 2001 in terms of the relationship between the subject, object and outcome.

## 7. Conclusion

This study set out to evaluate the computer-based training programme tergeting the mine workers in the stated mine setting. The stated research questions helped to illuminate the problem that was investigated. It is now known as to what policy constraints affect the implementation of the programme, how the programme is implemented, and the transformation that it brings to the mine workers participating in it especially those in Own-Time classes where the computer was used fully. If the computer-based learning programmes are taken seriously and the polies guiding them are much clear, with additional technical and administrative support given, they can be more successful in training adult learners, thus giving a value for money and resources invested in them. This shows that a computer-based training can also benefit Full-Time learners if it is not sacrificed for other modes of training such as face-to-face. The face-to-face mode of teaching implicate the facilitation competency of the facilitators. Many of them are lowly qualified (see table 1), which might explain their incompetency. The main contribution of the study is the insight into the implementation of the computer-based programme; creation of awareness about disturbances/constraints that policy can make against the programme; and most importantly, the impact of context on the AT with a resultant modification (figure 3). The following recommendations are made:

- The policy regulating the training should be reviewed so that it does not compromise Own-Time classes; is not applied on the basis of favouritism; it is devoid of weaknesses in its coverage of the programme.
- The available computers should be taken full advantage for the implementation of the programme.
- The qualification and training of the facilitators should be relooked to ensure they are better qualified and are knowledgeable and skilled in teaching with computers.
- Future studies should consider studying the contents of the programme more intensely.

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# ADOPTING A BLENDED LEARNING APPROACH IN THE CAPS CURRICULUM: CHALLENGES ENCOUNTERED BY LIFE SCIENCES EDUCATORS IN THE NORTH WEST PROVINCE

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**Abstract**
The paper examines challenges experienced by educators in applying a blended learning approach (BLA) in the teaching and learning process of the Curriculum Assessment and Policy Statement (CAPS) for Life Sciences curriculum, Grades 10-12. It is based on the case study of the experiences of 365 Life Sciences educators in the Bojanala District of the North West province. The CAPS Life Sciences curriculum is designed in such a way that teaching and learning should not be a one-way system (traditional way), but a combination of different learning techniques, for example using laboratory equipment or computers to complement the class sessions. A qualitative research approach was used, where data were collected through one-on-one and focus-group interviews. Findings of the study indicated that most schools do not have laboratories – neither computer nor science laboratories – and therefore educators are unable to adopt the blended learning approach in their daily teaching. The researcher therefore recommends that the Department of Basic Education provide schools with resources and train the educators to provide an environment that is conducive to the practice of a blended learning approach.

## INTRODUCTION

Universities and colleges worldwide complain about the large proportion of students who enter either college or university academically underprepared (Panagiotakopoulos, 2012). This lack of preparedness, coupled with the introduction of new technologies in learning situations, calls for schools to engage in effective education practices to make the transition from schools to institutions of higher learning easier for learners (Kuh, Kinzie, Schuh & Whitt, 2011). The call for preparedness is also made by the labour market, following the findings that there is a growing mismatch between labour market demands and the skills that the youth are taught in schools (Egbenta, 2015). According to Panagiotakopoulos (2012), these skills include soft skills (e.g. communication skills and teamwork) and technical or "hard skills" (e.g. IT skills). To fulfil the need for such skills, countries worldwide have had to respond positively to globalisation and rapid technological advancement by organising skill-formation policies to respond to the uncertainty of global capitalism (Panagiotakopoulos, 2012).

In the school context, which is the focus of this study, adopting a BLA would help to a certain extent to provide such skills. In trying to define “blended learning”, Hoic-Bozic, Mornar and Boticki (2009) regard a blended learning approach as a methodological approach supporting the evolution from traditional teaching to a mixture of different methods of learning. In support of this definition, Elliot Masie (cited in Rossett, 2002) declares that people are not single-method learners. The author therefore supports the fact that learners should not be exposed to a traditional face-to-face method only, since a differentiated approach to teaching and learning would enhance not only understanding, but also the retention of the subject content. The South African government has responded positively to

the call for skills development by introducing CAPS policy, which, according to the Department of Basic Education (DBE), facilitates the transition of learners from education institutions by encouraging teachers to use various curriculum differentiation strategies (DBE, 2011) – adopting the so-called blended approach to teaching and learning. The CAPS Life Sciences curriculum lays the foundation for further studies by developing scientific skills and scientific thought processes in learners (DBE, 2011). This is achieved through the use of a blended classroom learning approach.

For a BLA to be effective, schools need educators who possess the necessary skills to do the job (Dahlkamp, 2013). The literature has already indicated that educators are experiencing challenges in teaching the Life Sciences subject. For example, according to De Villiers (2011), Life Sciences educators complain that teaching Life Sciences as a subject (especially at Grade 10 level) is difficult. This study examines challenges experienced by Bojanala District Life Sciences educators in the North West province with regard to the implementation of CAPS policy, which requires a BLA. As posited by Kenney & Newcombe (2011), adopting a blended learning approach becomes a mirage in a limited-resource environment. Findings in this research indicated that schools lack resources, which makes the majority of educators unable to provide a blended learning approach to teaching and learning.

## THEORETICAL FRAMEWORK

This study is underpinned by Carman's theory of blended learning (Carman, 2005). Carman's theory outlines five key elements for providing a blended learning approach, namely live events, self-paced learning, collaboration, assessment and performance- supporting materials. Exposing learners to live events, such as getting them to perform hands-on exercises (experiments) in a laboratory, increases learners' interest in the subject, since they all participate in the process of learning. In most traditional forms of teaching and learning, the attention span of learners is reduced because they are not actively involved. The traditional form is a one-way process that reduces people to the status of passive recipients of information, who are not given a chance to air their views, nor to ask questions if they do not understand something (Servaes, 2008). Using live events to enforce a BLA in a teaching and learning environment will not only capture the attention of learners and keep them focused, but will also help learners to gain confidence by doing things on their own, which will culminate in learner satisfaction. As posited by Whiting (2015), live events such as simulation are a critical foundation of science.

Carman's theory also mentions self-paced learning as a characteristic of a blended learning approach. According to Roth (2012), self-paced learning activities, such as using graphics and audio learning aids, promote autonomy and independence, which entail a move away from the traditional teaching and learning approach to one that sees a teacher as a facilitator of learning (Kenney & NewCombe, 2011).

According to Carman's theory (2005), humans are social beings who are capable of developing new understandings and knowledge through social interactions. Hoic-Bozic et al (2009) support Carman by stating that a blended learning approach is a collaborative form of learning. Collaborations among students can be enhanced by the creation of an environment where learners and their peers, or learners and their educators, can collaborate using e-mail or group discussions. Carman (2005) posits that a group can accomplish meaningful learning and solve problems better than an individual can alone.

Carman's theory also advocates the application of different assessment methods using Bloom's (1956) levels of cognitive learning, namely knowledge, comprehension, application, analysis and synthesis. Using the above levels ensures that assessment is not only content-based, but also assesses skills.
The theory is relevant to the topic under discussion because using a variety of teaching and learning strategies in the Life Sciences subject will not only increase learner engagement and involvement (Reynard, 2007), but will also help learners to understand the subject. Using BLA may improve the teaching of the subject because emerging from De Villiers (2011) research, Life Sciences educators found the subject difficult to teach.

## RESEARCH QUESTIONS

The main research question for this paper is: What are the challenges experienced by educators in adopting a blended learning approach in the teaching and learning of Life Sciences?
The sub-questions are as follows:

- Which resources do educators require for the effective application of a blended learning approach?
- Which competencies are developed in the learners when a blended learning approach is adopted?

## METHODOLOGY

This study was qualitative in nature. It used semi-structured individual interviews and a focus group to collect data from participants about the challenges faced by educators in applying a blended learning approach. A purposive sampling technique was used to select 25 educators who teach CAPS Life Sciences (Grades 10-12) in the Bojanala District of the North West province. Both one-on-one and focus-group interviews took place on separate dates. The phenomenon of a blended learning approach was the object of the study. Therefore, an attempt was made to understand people's perceptions, perspectives and understanding of a particular situation (Leedy & Ormrod, 2005).
The target population for this study comprised all Life Sciences educators in the Bojanala District of the North West province. Only Life Sciences educators who were teaching CAPS Life Sciences (Grades 10-12) at the time of the study formed the sample of this study. Participants were informed about the nature and consequences of the research and their confidentiality was assured as the primary safeguard against unwanted exposure (Denzin & Lincoln, 2013).

**Table 1: The demographics of the sample**

| No. of participants | Age range in years | Life Sciences teaching experience | Level of education | Race | Gender |
|---|---|---|---|---|---|
| 25 | 48–60 | 23–30 years | • 18 (Diploma | • 22 blacks<br>• 2 whites | • 18 females |

| | | | | | |
|---|---|---|---|---|---|
| | years | | with Life Sciences as a major subject)<br>• 5 (BA degree)<br>• 2 (honours degree) | • 1 Indian | • 7 males |

**Data collection**

Permission to conduct research was requested from the Department of Basic Education in the Bojanala District. The project participants were interviewed at convenient places suggested by them, namely in schools, homes and private places such as community halls. Two focus groups were held with educators and were named focus group A and B respectively. Group A comprised 8 members (2 males and 6 females) and group B comprised 7 members (3 males and 4 females). The use of focus groups was important in this study because they helped to bring out new perspectives on the issue around BLA, as the participants challenged, persuaded and influenced one another (Jensen & Laurie, 2016).

Individual interviews were held with 10 participants, 2 males and 8 females. A semi-structured interview strategy was used in the development of questions because this technique allows the researcher to ask probing questions to explore what participants say in more detail (Jensen & Laurie, 2016; Hoets, 2012). The interview guide consisted of open-ended questions that included follow-ups.

A journal was used to write notes during the interviews and a tape recorder was used as a back-up to provide information that the researcher might have missed. The focus-group interviews took between 20 and 30 minutes, while the individual interviews took 15 minutes each.

The researcher engaged in thematic analysis of data using the Saldana method of qualitative analysis. Firstly, data were broken down into codes. Saldana (2016:8) describes coding as the "critical link" between data collection and their explanation of the meaning. Coding was thus done through the identification of patterns, which demonstrated habits, salience and importance in people's daily lives. Data were then categorised by grouping, reorganising and linking the codes in order to consolidate meaning. Finally, themes emerged from such categories and were used to discuss the findings of this research.

**Credibility and trustworthiness**

The credibility and trustworthiness of the study refer to the truth of the data or the participants' views and the interpretation and representation of them by the researcher (Polit & Beck, 2012). In order to provide the criticality and thoroughness (Cope, 2014) of data used, the researcher gave a detailed description of data analysis and used thick and rich quotes to confirm that issues of researcher bias were adequately dealt with.

All material used during data collection (interview transcripts, notes and tape recorder) were used and revised many times to ensure that the themes developed emerged from participants' comments. An audit trail was also created by giving the same material to the researcher's

mentor to ensure that the themes were authentic and relevant. Finally, the researcher used member checking to confirm the trustworthiness of the data, whereby the summary of the data was given to participants to check before the researcher could finalise the report.
The researcher used both one-on-one interviews and focus-group interviews to cater for a further requirement of trustworthiness, namely triangulation.

## FINDINGS

### Insufficient training

All the participants indicated that they tried to comply with CAPS policy with regard to applying a blended approach to teaching and learning, but owing to insufficient training in, for example, how to perform experiments, they were unable to do so. The age cohort, years of teaching experience and the level of qualifications of the sample under study stated in the methodology part of this paper indicated that most participants were products of the old curriculum, which differs significantly from CAPS.

One participant said:

> *The curriculum of Life Sciences has been changing from time to time and as teachers we are struggling to cope because of many changes. The worst thing is that we are not trained enough for the new policy, we attended a 3 days' workshop which according to me is not enough. During the 3 days training the subject advisors seemed not to have enough information to empower us. We need more training.*

According to most of the participants, the department embarked on a number of professional development programmes to bridge educators' content gaps, for example the ACE programme. However, 95% of the participants indicated that the ACE programme, which intended to provide in-service training for promotional development (Fatima, 2017), failed to reach its objectives.

One participant said*: "The department of education tried to help us by introducing the ACE programme, but ACE taught me the teaching methodology only and not the difficult content about for example evolution, which I hoped to get clarity on."*
The above comment indicated that despite using multiple pathways to improve professional skills of teachers, the effectiveness of professional development programmes remains questionable (Gomez, Kagan & Fox, 2015).

### Lack of resources

As many as 75% of the participants asserted that a lack of resources hindered them in adopting a BLA. According to them, in CAPS there is a standing assessment on practical work where learners in a group of not more than five people must perform experiments. Yet most schools do not have functional science laboratories, that is, they lack the apparatus and chemicals necessary to perform such experiments.

One participant said:

> *The room called a laboratory in my school has got no chemicals or apparatus. I used to borrow laboratory tools from a neighbouring school to do the compulsory practical work, but the teacher is no more willing to help because the practical tasks are done at the same time according to the work schedule. So I simply give learners a written test for practical work. Because I do not have resources to perform the experiments.*

Part of the school-based assessment is a research project where learners are given a topic to research, which requires access to computers and the internet. Most schools were in rural areas and although there is a supply of electricity, there are insufficient computers for learners to search for information on the internet. In some schools, the government had supplied computers, but because of the high crime rate in the area, many had been stolen. So most schools have only three or four computers to serve approximately 900 students. One participant had this to say:

*"Because learners cannot access information themselves (from the internet) due to lack of computers, I usually teach them the topic they need to research about so that they can write the assignment. So you will find that almost all the students are writing the same thing because it was not an individual exercise."*

All the participants said that overcrowded classrooms prevented them from adhering to the CAPS policy in terms of which groups of four to five learners are required to do practical tasks. Therefore, in order for them not to take a whole month to complete a practical task, the teachers divided the learners into large groups.

One participant said: "*I teach four classes and have a total of 280 learners who must do the practical work within a given time, how possible can this be? I just group them in groups of 25 to 30 and you will find that only 3 to 4 students are active, the majority are just making noise and doing nothing."*

From the participants' point of view, overcrowding in small schools is caused by a shortage of classrooms, whereas in schools with more learners, it is caused by a shortage of educators.
One participant said: "*According to CAPS policy, a teacher must teach a class of 30-35 learners, in one of my classes I teach 70 learners and it is difficult to maintain discipline in such a class. I complained to the principal but he said the Post Provisioning Model (PPM) does not allow him to hire an additional teacher*."

The PPM refers to a system used by the Department of Education to determine the number of educators per school, which is influenced by the number of learners enrolled in a school. As many as 95% of the participants also indicated that facilities, such as a library, play a very important role because they promote independent study. Nevertheless, it appeared that those schools that did have a library contained mostly old and outdated books, which failed to provide learners with current information.
One participant said*: "My school library is just a joke, the books are of the old versions and offer no help to students. A few learners go to the library because most students lack the skill of searching for information and there is no librarian who teaches them that skill."*

**Tight work schedules**
CAPS policy provides schools with work schedules and pacesetters in all the subjects. The pacesetters provide time frames for the completion of tasks that count towards learners' year marks. Educators are expected to administer tasks as per the period stated in the pacesetters; unfortunately, such practices do not make allowance for to slow learners, since all learners are treated the same. Participants commented that performance in the subject is generally poor because they rush through the syllabus in order to meet the deadlines.

One participant said: "*Learners do not cope especially the Grade 10's. There are many topics which must be covered within a very short space of time. In final exams, these learners are not faring well, they are boosted by their year mark. The work schedule should cater for slow learners."*

All participants claimed that most learners lack understanding of the Life Sciences subject content, which is partly due to the language barrier. As a result, the educators prefer grouping these learners together to provide an enabling environment where students can collaborate with one another. However, the tight work schedules, coupled with overcrowded classrooms, usually makes this impossible. This results in learners' being left alone without any support from either their peers or the educators. The lack of support from the educators is due to a shortage of free periods, which would allow them to engage with the slow learners.
One participant said: *"I have only one free period per day and I use it to mark learners' books and to do other administrative work, there is too much paperwork to deal with in CAPS, I really do not have enough time for slow learners."*

**Unfavourable timetable**
CAPS policy dictates the nominal contact time of teachers with learners to be four hours per week for Life Sciences. Depending on the number of classes a teacher teaches, this means that the teacher has only one double period per week where they can engage in activities that need more time, such as experiments or investigations.
One participant said: "*Sometimes learners understand better when someone else who is not their subject teacher teaches them. I like exposing them to animations but before the activity is completed time run out."*

## DISCUSSION

From the findings above, the researcher noted that there are various obstacles within the school environment that make it difficult to apply a BLA, including insufficient training of educators, lack of resources, tight work schedules and an unfavourable timetable. As a result, the benefits of CAPS policy are not reaped. CAPS policy recommends live events such as experiments, animations and simulations, but because of the time constraints, teachers are left with no option but to engage in the traditional form of teaching, namely a one-way approach that differs markedly from a BLA. This is unfortunate, since if the latter approach were adopted, it would increase learners' interest in the subject because they would all participate in the process of learning (Carman, 2005). The complete absence or lack of resources such as science laboratories, apparatus and chemicals makes the issue of practical work a nightmare for educators. In addition, learners are denied the opportunity to engage in hands-on activities, which, according to Carman (2005), captures their attention and keeps them focused. In instances where experiments are being performed, learners do not acquire the expected skills because, as stated previously by the participants, learners are grouped into large groups because there are simply too many learners per class. Consequently, the majority of learners in a particular group are just observers and remain uninvolved. To help prevent the learners from performing poorly, the participants claimed that they turn everything into theory, which obviously favours the traditional way of teaching and learning more than the blended learning approach. As a result, when these learners enter institutions of higher learning, they do not cope because they lack the background knowledge and practical skills needed at tertiary level. According to Panagiotakopoulos (2012), these learners are not

“work ready” when they finish school and will most likely just add to the ranks of the unemployed.

Even in schools where there are sufficient resources, however, the findings showed that learners’ practical skills are not developed adequately owing to the teachers’ lack of expertise in teaching the subject. The sample under study indicated that the participants received only three days' training, which did not include carrying out the prescribed experiments for the different grades. For learners to master a particular skill, they need an expert teacher to empower them, otherwise the situation amounts to one blind person leading another. Thus the educators failed to provide proper learner guidance and mentoring.

In so far as classrooms are concerned, learners did not have access to an unoccupied classroom or computer and science laboratories where they could engage in self-paced learning, which is one of the requirements for a BLA to teaching and learning. This private space would not only give the slow learners an opportunity to catch up on the work they had not yet covered, but it would also instil a sense of autonomy and independence in the learners (Carman, 2005). Nevertheless, even in schools that do provide such resources, the teachers often fail to supervise learners’ self-paced/autonomous learning because of an unfavourable timetable. Most teachers claimed to have only one free period per day, which they use for marking learners' work. Lack of supervision of learners’ self-study leads to what Carman calls "overload where a student study lacks discipline and focus". For example, a learner may watch something on a TV while struggling to read about a particular topic from a book. At the end of the day, the learner masters neither animation nor reading text from a book.
From the findings, learners were unable to acquire research skills because of a lack of libraries or relevant up-to-date books. Such a situation led to learners’ relying solely on the information from their educators and prevented any independent study, which Carman also refers to as “self-paced learning”. This situation is aggravated by a lack of access to the internet, where learners could otherwise access recent sources of information. Because we live in a technocratic world, when learners lack computer skills, it creates a mismatch between what is offered in schools and what is needed in the job market (Egbenta 2015).

Carman’s blended-learning approach (2005) proposes that learners are social beings that do well when they interact with other people (peers or educators). Yet a shortage of space due to overcrowding, insufficient time allocation and a tight work schedule do not promote group work. Educators indicated that they find it challenging to complete the syllabus by the deadline; as a result, they tend to avoid engaging in any activities that are time-consuming, for example dividing the learners into smaller groups to perform activities.
In government schools, unlike in private schools, teachers use textbooks as the primary source of content to be mastered in a particular grade. A shortage of performance-supporting materials, such as charts, models or pictures that capture the learners’ attention, makes the lessons uninteresting. Consequently, participants indicated that the Life Sciences learners – especially the Grade 10s, whose content is said to be difficult – struggle to master the content. Using teaching aids, programmed lessons and animation would not only promote a BLA to teaching and learning, but would also enhance understanding and retention of the subject matter.

## CONCLUSION

The study investigated challenges experienced by educators in the adoption of a BLA to teaching and learning. Insufficient training, lack of resources, tight work schedules and time constraints are some of the major obstacles to adopting this approach. As a result of these obstacles, educators were unable to provide an enabling teaching and learning environment where learners could engage in live events, collaborate with both peers and educators and engage in self-paced learning, all of which are requirements for a BLA.

## RECOMMENDATIONS

Based on the findings of this study, the following are some recommendations to education stakeholders.

The Department of Basic Education should provide the resources needed to enable educators to implement a particular policy change successfully. The PostProvisioning Model needs to be revisited because it does not take into consideration the repertoire of skills required to teach learners holistically. It focuses only on the number of educators available and not their expertise. The subject advisors need to be more empowered in terms of the subject they coordinate so that they are able to provide rigorous training to the educators. Apart from human resources, schools must be provided with resources such as science and computer laboratories to enhance self-paced and independent learning on the part of learners; this will undoubtedly promote a BLA to teaching and learning. The nominal time for a science period should be increased (four hours per week is too little) to make allowance for practical work and investigations. The learner:educator ratio (1:35–40) must be revised andq98 educators should have at least one-and-a-half hours' free time to engage in supervision of independent studies and attend to challenges encountered by slow learners.

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# THE STATE OF EDUCATIONAL TECHNOLOGIES ON AN INFORMATION AND COMMUNICATION TECHNOLOGY MODULE: THIRD-YEAR STUDENTS' PERSPECTIVES

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**Abstract**
The purpose of the research in this paper is disseminating the results of a Student Module Evaluation (SME) undertaken in September/October 2014, in answer to the research question: How can challenges related to teaching an Information and Communication Technology (ICT) module in an open and distance e-learning context be addressed? The aim was to monitor progress and highlight limitations and areas for improvement. The objective of the survey, used to pilot the data collection instrumentation in terms of validity and reliability, was to focus on students' views and experiences of the module, in order to provide improvement data. The research methodology used was a mixed-method study, with the main results being quantitative - qualitative comments were, however, also obtained. Recommendations of this module to other students were also obtained from more than three-quarters of respondents.

## 1. Introduction

The purpose of the research is to disseminate the results of the pilot phase of a Student Module Evaluation (SME) undertaken by the Directorate of Institutional Research in September/October of 2014. Towards effective teaching and learning at the University of South Africa (UNISA), this **aim** was targeted in order to provide answers to the **research question**: How can the challenges related to teaching an Information and Communication Technology (ICT) module in an open and distance e-learning context be addressed? This research was further related to monitoring progress and highlighting limitations and/or areas for improvement through student feedback.

Cant and Bothma (2010) discussed the educational technology conundrum from educators' perspectives. Goosen and Naidoo (2014) therefore indicated that they were of the opinion that further research ought to be conducted, in order to better understand the views of students, as to which educational technologies they felt were most suitable to facilitate instruction amongst third-year ICT students.

In line with this suggestion, the Senate Teaching and Learning Committee requested the introduction of a more frequently applied SME. The **objectives** related to these surveys not only included piloting the data collection instrument for the SME system, but also to provide an overall picture, by focusing on students' views and experiences of the modules, in order to provide data for improvement.

In agreement with Goosen and Pieterse (2005), it is believed that by analysing this information, together with ideas for best practice as provided in applicable related literature, suggestions will be formulated for improving the instruction of a third-year ICT module.

## 2. Theoretical frameworks

According to Oblinger (2003), it is important to understand the generation of students coming into institutions of tertiary education these days. In this regard, Wilson and Gerber (2008) showed how generational theory can contribute towards student support for retention and success, by proving strategies for working with the 'millennials' generation.

Simpson (2013) asked whether students in an open and distance e-learning context were being failed regarding supporting them in terms of retention and success. More specifically, the latter author, citing Moore, mentioned the 'Transactional Distance' theory, suggesting that there is an intrinsic distance between students, institutions of tertiary education and their e-tutors, which contributes to a lack in terms of communication between them - thus making dropout more likely. Simpson (2013:111) went on to explain that if this "theory is part of the explanation for the" open and distance e-learning deficit, "then the theory implies that improved interaction between" students, their e-tutors and the institution of tertiary education would improve student retention. He, however, is of the opinion that many open and distance institutions of tertiary education confuse teaching with learning: Institutions of tertiary education "have focused too much on the provision of teaching materials, especially online, and too little on motivating" students to actually learn. There are benefits to "proactive contact for overcoming dropout", together with "the importance of making that contact motivational."

Further towards student support for retention and success, Stevenson, MacKeogh and Sander (2006:139) worked with student expectations of e-tutor support in an open and distance e-learning context to test an expectations-led quality assurance model. These authors explained that students come to open and distance e-learning modules "with variable expectations of the levels of service and support they will receive from their" e-tutors. Earlier work by these authors further suggested that a detailed expectations-led quality assurance procedure, which could enable the sharing of such expectations before a module starts could be mutually beneficial to the both students and the e-tutor. They also argued that this ought to have advantageous effects, as student dropout could be reduced and module completion rates increased.

## 3. Literature Review

The affordances and acceptance of both established and especially emerging technologies towards student support is explored, as well as what can be done in terms of curriculum development, pedagogy and assessment, to improve student support for retention and success.

Boyle, Kwon, Ross and Simpson (2010:115) observed student-student support, in the form of mentoring, as this "may still have much to offer when it comes to increasing" retention, engagement and success in an open and distance e-learning context. Students in their study "valued the opportunity to have regular contact with knowledgeable mentors … . They found the contact encouraging and motivational; it enabled them to deal more

effectively with the demands of study and to feel part of a learning community. This contact, which occurred at key decision-making points in" students' progress through their modules, "assisted in the identification of issues that might have been a barrier to successful completion and provided opportunities to resolve these in a timely manner" (Boyle et al.:127).

Fung and Carr (2000) investigated how students' needs in terms of support for retention and success could be met by using face-to-face tutorials in an open distance e-learning system. According to these same authors, a successful open and distance e-learning system typically includes "an element of face-to-face tuition" (Fung & Carr, 2000:35). This "forms an important component in supporting" student progress through the instructional materials." The United Kingdom Open University "advocates that tutorials should be participatory events, not straight lectures. This approach reflects the educational philosophy that deep learning requires" students "to be active in the process of learning, not passive recipients of transmission teaching" (Fung & Carr, 2000:36). In their research, Fung and Carr (2000:44) found that students valued academic support from their e-tutors. These tutors enhanced students' understanding of the module materials and provided "general guidance on their assignments".

Another piece of related literature, which presents opportunities for further investigation, included Onyancha (2010), who indicated how students could be profiled via an institutional information portal. Although this research was carried out at the University of South Africa, that population consisted of Bachelor of Arts degree students, as opposed to the Bachelor of Science degree students for this research.

## 4. Research methods and techniques

An application for ethical clearance for the survey discussed in this paper had been approved, ensuring that the research project adheres to the values and principles expressed in the UNISA Research Ethics Policy.

### 4.1 Research Design

Regarding the appropriateness of the methodology, although a mixed-method study was used in the research reported on in this paper, resulting in both quantitative results regarding, for example, students' demographic characteristics, as well as some qualitative results, the scope of this paper unfortunately did not allow for the latter to be reported on. Previously, Onyancha (2010) also used a descriptive study.

### 4.2 Data Collection Instrument

For the pilot, an online survey technology, Qualtrics, was employed. The technology is not specifically designed for module evaluation, but serves as an interim measure until a dedicated technology is secured through a procurement process. The datasets and reports generated were automated, each specific to a particular module.

A PDF version of the **data collection instrument** could be accessed online for the module educator's convenience and to support interpretation processes and data analysis.

Educators were free to share the data collection instrument with their colleagues, who wished to conduct their own SMEs.

### 4.3 Sample and Sampling Technique

The surveys were conducted online across all colleges at the institution of tertiary education, encompassing a total of 81 modules and generating 6800 responses. The applicable modules were all second semester and year ones. Similar to the study reported on by Goosen and Pieterse (2005), this paper also represents students' perceptions.

The population for the module specifically discussed in this paper consisted of all students registered for the module at the time when the survey was carried out (57), who were all invited to take part in the survey. Using a self-selection sampling technique, from these students, nineteen responded (appear in the corresponding data file) - no more than sixteen, however, supplied data for any specific item in the survey. It should be noted that as the surveys were conducted online, not all students registered for the module could necessarily be contacted.

### 4.4 Validity and Reliability of Instrument

Whereas Maree and Van der Westhuizen (2007:38), quoting Cohen et al., argued "that in qualitative data collection," the "in-depth responses of individuals secure a sufficient level of validity and reliability", another argument is "that these grounds are insufficient for ensuring validity and trustworthiness." As suggested by a number of authors, we paid particular attention to dimensions including "credibility, transferability, dependability and confirmability", in order to increase the trustworthiness and/or **reliability** of especially the more qualitative aspects of this study.

Especially those aspects related to the qualitative parts in this research required "the use of various strategies" for enhancing **validity**, which included "obtaining the services of an external coder to verify the qualitative results". For this study, as described by Maree and Van der Westhuizen (2007:38), quoting Merriam, reliability regarding the qualitative results are those that "are consistent with the data collected".

### 4.5 Data Analysis

As indicated earlier, very few responses were collected - this was either due to the small number of registered students for the particular module and/or no email details being available for some of the students. It was, however, felt that the data, particularly qualitative feedback, may still be of use to the module coordinator(s), and were therefore provided – it is noted that this data should be analysed and interpreted with caution.

## 5. Results and Discussion

Demographic details obtained regarding the students who participated in the survey indicated that all responding students (16) indicated their country of residence as South Africa, and all students (15) who indicated whether they were studying full-time or part-time, indicated the latter.

**Table 1. Students' Regions**

| Options | Number of Responses | Percentage |
|---|---|---|
| Gauteng | 11 | 69% |
| Limpopo | 3 | 19% |
| Mpumalanga | 1 | 6% |
| Kwazulu-Natal | 1 | 6% |

**More than two-thirds of responding learners were from Gauteng province (see Table 1), while Table 2 shows that almost a third of responding students' closest learning centre was in Pretoria, while another six students indicated other centres also in Gauteng.**

**Table 2. Students' Closest Learning Centre**

| Options | Number of Responses | Percentage |
|---|---|---|
| Thutong (Pretoria) | 5 | 31% |
| Benoni | 2 | 13% |
| Florida | 2 | 13% |
| Johannesburg | 2 | 13% |
| Polokwane | 2 | 13% |
| Don't Know | 1 | 6% |
| Nelspruit | 1 | 6% |
| Durban | 1 | 6% |

**Table 3. I am repeating the module**

| Options | Number of Responses | Percentage |
|---|---|---|
| Yes | 2 | 13% |
| No | 13 | 87% |

Only two (13%) of the students indicated that they were repeating the module (see Table 3).

Almost two-thirds of students (9; 60%) indicated that the mark they received for their first assignment, or their average for the activities they had completed that far, had been 75% or more (see Table 4). The fact that none of these students indicated that they had not yet received their marks could be seen as an indication that students' assessments are being marked and returned to them timeously. The fact that none of these students indicated that they had not handed in any assignments or completed any activities could be taken as evidence that all participating students were active in the module.

Seven (47%) of the students expected a pass mark for the module (between 50% and 74%), while a further six (40%) of them expected a distinction (75% or more) – see Table 5.

**Table 4. What mark did you receive for your first assignment or what is your average for the activities you have completed so far?**

| Options | Number of Responses | Percentage |
|---|---|---|
| 50-60% | 3 | 20% |
| 61-74% | 3 | 20% |
| 75% or more | 9 | 60% |

**Table 5. What final mark do you expect for this module?**

| Options | Number of Responses | Percentage |
|---|---|---|
| Less than 50% | 2 | 13% |
| 50-60% | 5 | 33% |
| 61-74% | 2 | 13% |
| 75% or more | 6 | 40% |

**Table 6. Did you participate in any tutorial activities?**

| Options | Number of Responses | Percentage |
|---|---|---|
| Yes | 3 | 27% |
| No, there were no online tutorial activities for this module | 3 | 27% |
| No, I was not interested | 2 | 18% |
| No, I experienced technical problems when trying to participate | 2 | 18% |
| No, I was never assigned to an e-tutor for this module | 1 | 9% |

Almost three-quarters of students (8; 73%) indicated that they did not participate in any tutorial activities.

**Table 7. What percentage of the online tutoring activities did you participate in?**

| Options | Number of Responses | Percentage |
|---|---|---|
| Less than 25% | 1 | 33% |
| About 50% | 2 | 67% |

No students indicated that they participated in about 75% or almost all of the online tutoring activities, while two-thirds (2; 67%) participated in about 50% of these activities.

**Table 8. How did you communicate with your e-tutor?**

| Options | Number of Responses | Percentage |
|---|---|---|
| Discussion Forum (myUNISA) | 7 | 64% |
| Email | 6 | 55% |
| Telephone | 2 | 18% |

Almost two-thirds of students (7; 64%) indicated that they communicated with their e-tutor using the discussion forum educational technology on myUNISA (the institutional learning management system), while more than half of them (6; 55%) used email for this purpose.

Only a single student indicated that (s)he attend discussion classes, practicals or contact sessions for this module, and provided further details in terms of statements relating to discussion classes, practicals or contact sessions for this module - this student agreed that:

- the sessions helped her/him understand the content,
- the educator(s)/facilitator(s) was well prepared,
- there was useful interaction during the session(s),
- the educator(s) used effective examples to explain difficult concepts,

and strongly agreed that overall, (s)he found the session(s) worthwhile.

No respondents indicated having attended any face-to-face tutorial sessions for this module.

All responding students (14) indicated that they used myUNISA for this module, as well as indicating that they submitted their assignments and/or activities for this module online.

All students (14) responding indicated that they used the educational technologies on myUNISA to download resources and study materials, as well as to view announcements.

Responding students used a fairly large variety of educational technologies to communicate with their educator, including email (8; 33%), the discussion forum on myUNISA (7; 29%), telephone (3; 13%) and SMS (2; 8%). Students were encouraged to select all that apply.

Students' opinions regarding whether their e-tutor responded to their communication within 48 hours varied widely, with equal numbers agreeing and strongly agreeing vs. disagreeing and strongly disagreeing (see Table 9). Other results reported regarding e-tutors included:

- Although two students (20%) strongly disagreed with a statement relating to their e-tutor responding to their communication in a meaningful way, half of the students (5; 50%) either agreed or strongly agreed with this statement (see Table 9 item 2).
- Even though almost a third of responding students (3; 30%) strongly disagreed with a statement relating to their e-tutor having sound knowledge of the subject matter, the remainder of the students was more positive about this statement.
- While a third of responding students (3; 33%) strongly disagreed with a statement relating to their e-tutor explaining difficult concepts well, the remainder of the students was more positive about this statement.
- Even if two students (20%) strongly disagreed with this statement, half of the students either agreed or strongly agreed that their overall evaluation of their e-tutor was positive.

Some results regarding learning materials included (see Table 9):

- Half of the responding students (7; 50%) strongly agreed that they could easily find all the materials, resources and information required for this module on myUNISA!
- Half of the responding students (5; 50%) also strongly agreed or agreed that myUNISA was used effectively by staff to support this module.
- More than half of the responding students (8; 57%) did not specifically agree that myUNISA down times had an impact on their studies.

Results reported regarding the educator of this module included (see Table 9):

- Almost two-thirds of responding students (6; 60%) agreed or strongly agreed that their educator responded to their communication within 48 hours.
- Students' opinions regarding whether the educator responded to their communication in a meaningful way varied, with half of them (5; 50%) neither agreeing nor disagreeing with the statement.
- Although students' opinions regarding whether the educator has sound knowledge of the subject matter varied, more than half of them (6; 60%) agreed or strongly agreed with this.
- Exactly two-thirds of responding students (6; 67%) agreed or strongly agreed that their overall evaluation of this educator was positive.

More results regarding learning materials included (see Table 9):

- More than three-quarters of all responding students (11; 79%) agreed or strongly agreed that they received the mailed module material within a reasonable time.

- With only one exception, all other responding (13; 93%) students agreed or strongly agreed that the textbook and/or prescribed material for the module was relevant.
- More than three-quarters of all responding students (11; 79%) agreed or strongly agreed that the module was well structured.

Table 9. Regarding students' e-tutors and educators, etc.

| | **Strongly Disagree** | **Disagree** | **Neither Agree nor Disagree** | **Agree** | **Strongly Agree** |
|---|---|---|---|---|---|
| My e-tutor responded to my communication within 48 hours | 3 (30%) | 1 (10%) | 2 (20%) | 3 (30%) | 1 (10%) |
| My e-tutor responded to my communication in a meaningful way | 2 (20%) | 0 (0%) | 3 (30%) | 3 (30%) | 2 (20%) |
| My e-tutor has sound knowledge of the subject matter | 3 (30%) | 0 (0%) | 3 (30%) | 3 (30%) | 1 (10%) |
| My e-tutor explained difficult concepts well | 3 (30%) | 0 (0%) | 2 (20%) | 2 (20%) | 2 (20%) |
| My overall evaluation of the e-tutor is positive | 2 (20%) | 0 (0%) | 3 (30%) | 4 (40%) | 1 (10%) |
| I could easily find all the materials, resources and information required for this module on myUNISA | 0 (0%) | 1 (7%) | 0 (0%) | 6 (43%) | 7 (50%) |
| myUNISA was used effectively by staff to support this module | 0 (0%) | 1 (10%) | 4 (40%) | 3 (30%) | 2 (20%) |
| myUNISA down times had an impact on my studies | 1 (7%) | 4 (29%) | 3 (21%) | 2 (14%) | 4 (29%) |
| My educator responded to my communication within 48 hours | 1 (10%) | 0 (0%) | 3 (30%) | 3 (30%) | 3 (30%) |
| My educator responded to my communication in a meaningful way | 0 (0%) | 1 (10%) | 5 (50%) | 2 (20%) | 2 (20%) |
| My educator has sound knowledge of the subject matter | 0 (0%) | 0 (0%) | 4 (40%) | 4 (40%) | 2 (20%) |
| My overall evaluation of the educator is positive | 1 (11%) | 0 (0%) | 2 (22%) | 5 (56%) | 1 (11%) |
| I received the mailed module material within a reasonable time | 2 (14%) | 0 (0%) | 1 (7%) | 6 (43%) | 5 (36%) |
| The textbook and/or prescribed material for the module was relevant | 0 (0%) | 0 (0%) | 1 (7%) | 6 (43%) | 7 (50%) |
| The module was well-structured | 0 (0%) | 1 (7%) | 2 (14%) | 8 (57%) | 3 (21%) |

| | | | | | |
|---|---|---|---|---|---|
| The objectives and learning outcomes of the module were clearly stated | 0 (0%) | 0 (0%) | 1 (8%) | 10 (77%) | 2 (15%) |
| I have met the stated objectives and learning outcomes for the module | 0 (0%) | 0 (0%) | 2 (17%) | 8 (67%) | 2 (17%) |

- With only one exception, all other responding students (12; 92%) agreed or strongly agreed that the objectives and learning outcomes of the module were clearly stated.
- With only two exceptions, all other responding students (10; 84%) agreed or strongly agreed that they had met the stated objectives and learning outcomes for the module.

Table 10. More results regarding learning materials and assessment

| | **Strongly Disagree** | **Disagree** | **Neither Agree nor Disagree** | **Agree** | **Strongly Agree** |
|---|---|---|---|---|---|
| The learning units provided useful guidance for the module | 1 (9%) | 0 (0%) | 0 (0%) | 7 (64%) | 3 (27%) |
| The tutorial letters provided useful guidance | 2 (14%) | 0 (0%) | 1 (7%) | 7 (50%) | 4 (29%) |
| The module workload was appropriate for the time allocated (per semester) | 1 (8%) | 2 (15%) | 3 (23%) | 4 (31%) | 3 (23%) |
| The module provided a valuable learning experience | 0 (0%) | 1 (7%) | 2 (14%) | 6 (43%) | 5 (36%) |
| I learned to think critically about this module | 1 (7%) | 0 (0%) | 1 (7%) | 8 (57%) | 4 (29%) |
| The module material was available on myUNISA when I registered | 0 (0%) | 2 (15%) | 1 (8%) | 4 (31%) | 6 (46%) |
| The overall mark allocation for the module was clearly explained | 0 (0%) | 1 (7%) | 3 (21%) | 6 (43%) | 4 (29%) |
| The guidelines for assignments were adequate | 0 (0%) | 0 (0%) | 1 (7%) | 10 (71%) | 3 (21%) |
| The guidelines for portfolio preparation were adequate | 3 (21%) | 0 (0%) | 2 (14%) | 7 (50%) | 2 (14%) |
| The assessment tasks provided valuable learning experiences | 1 (8%) | 0 (0%) | 3 (25%) | 4 (33%) | 4 (33%) |
| I received feedback on my marked assignments promptly | 2 (14%) | 2 (14%) | 2 (14%) | 6 (43%) | 2 (14%) |
| The feedback I received on my marked assignments was useful | 0 (0%) | 0 (0%) | 4 (21%) | 8 (31%) | 2 (11%) |
| The marking process was fair | 0 (0%) | 0 (0%) | 5 (45%) | 5 (45%) | 1 (9%) |
| The procedure to query marks was adequate | 0 (0%) | 1 (14%) | 4 (57%) | 2 (29%) | 0 (0%) |
| My overall experience of the assessment was positive | 1 (8%) | 0 (0%) | 4 (33%) | 6 (50%) | 1 (8%) |

| | | | | | |
|---|---|---|---|---|---|
| My overall experience of the module was positive | 0 (0%) | 3 (21%) | 2 (14%) | 7 (50%) | 2 (14%) |

The last set of results reported regarding learning materials included:

- With only one exception, all other responding students (10; 91%) agreed or strongly agreed that the study guide and/or learning units provided useful guidance for the module.
- More than three-quarters of all responding students (11; 79%) agreed or strongly agreed that the tutorial letters provided useful guidance.
- Just more than half of the responding students (7; 54%) indicated that they either agreed or strongly agreed that the module workload was appropriate for the time allocated (per semester).
- More than three-quarters of all responding students (10; 77%) agreed or strongly agreed that the module material was available on myUNISA when they registered.

With only two exceptions, all other responding students (12; 86%) agreed or strongly agreed that they learned to think critically about this module (see Table 10). Further, more than three-quarters of all responding students (11; 79%) agreed or strongly agreed that the module provided a valuable learning experience.

Regarding assessment in the module (see Table 10):

- Almost three-quarters of respondents (10; 71%) agreed or strongly agreed that the overall mark allocation for the module was clearly explained.
- With only one exception, all other responding students (13; 92%) agreed or strongly agreed that the guidelines for assignments had been adequate.
- Almost two-thirds of students (9; 64%) indicated that they either agreed or strongly agreed that the guidelines for examination/portfolio preparation had been adequate.
- Exactly two-thirds of students (8; 67%) indicated that they either agreed or strongly agreed that the assessment tasks provided valuable learning experiences.
- More than half of the responding students (8; 57%) indicated that they either agreed or strongly agreed that they received feedback on their marked assignments promptly. The variation in students' options indicated here is in contrast to no students indicating that they had not received their marks, reported previously.
- Almost three-quarters of students (10; 71%) indicated that they either agreed or strongly agreed that the feedback they received on their marked assignments had been useful.
- None of the responding students indicated that they either disagreed or strongly disagreed that the marking process had been fair.
- Students' opinions regarding whether the procedure to query marks had been adequate varied, with more than half of them (4; 57%) neither agreeing nor disagreeing with the statement.
- More than half of the students (7; 58%) indicated that they either agreed or strongly agreed that their overall experience of the assessment had been positive.

Almost two-thirds of students (9; 64%) either agreed or strongly agreed that their overall experience of the module was positive (see Table 10).

Students' opinions about the amount of communication they received for this module varied widely, with just over a third each (5; 36%) respectively indicating that it was 'far too little' vs. 'about right'.

More than three-quarters of responding students (11; 79%) would recommend this module to other students.

Students were just about equally divided between those who preferred that this module was presented as a year module (7; 54%), compared to those who did not (6; 46%).

## 6. Conclusion

The results from the SME provided answers to the research question, on how the challenges related to teaching an Information and Communication Technology (ICT) module in an open and distance e-learning context could be addressed. Similar to what was described for the paper by Goosen and Breedt (2012), the merit of this research also proved to be of relevance to this South Africa International Conference on Educational Technologies (SAICET '18), by being justified in terms of the frequent changes associated with educational technologies, which educators have to contend with. These results also show the implications that the affordances and acceptance of established and emerging educational technologies have, towards a **depth of research** and **originality** that makes a **contribution to the field**, in terms of academic debate regarding the improvement of student support for retention and success. Regarding possible future work, following the outcome of the 2014 pilot, a full-scale roll out of student module evaluations can be planned employing an automated technology. This, however, is contingent on a successful tender process.

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# ADAPTIVE LEARNING TECHNOLOGY IN HIGHER EDUCATION: LESSONS FROM AN ECONOMICS CLASSROOM IN SOUTH AFRICA

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## Abstract

Many public universities in South Africa have increased their use of technology assisted learning tools in a bid to improve student retention and success. One such tool is adaptive learning technology, which aims to customise a learner's learning path to suit their individual learning needs using technology-assisted learning. Despite the growing popularity of adaptive learning technology in the global educational technology industry, little research has been done into adaptive learning and adaptive technology to prove its effectiveness on student learning in higher education and, more specifically, in the South African higher education environment. The aim of this study is to contribute to the growing literature on adaptive learning and adaptive learning technology by examining whether adaptive learning technology, in the form of McGraw Hill *Connect*, influences the learning experiences of first year Economics students in South Africa. The study begins by providing an important summary of the literature related to adaptive learning and adaptive learning technologies. Subsequently, the need for adaptive learning technology at the studied university is contextualized. Thereafter, the study's methodology is described and a univariate analysis is applied to survey data from a 2016 cohort of first year Economics students at a South African residential university, where adaptive learning technology was used as part of the Economics 1 teaching strategy. Results support the study's hypothesis that adaptive learning technology has a positive influence on the learning experience of students. The study also provides some useful insights on the operational aspects of adaptive learning technology that could be used to improve teaching strategies, which encompass adaptive learning and learning quality, at the studied South African residential university.

## Introduction

Guiding students to shape their own thought at the onset of their studies at university seems both sensible and efficient when thinking about human capital development within the context of higher education. After all, "the educational function of a university is to shape thought and conscience" (Anderson, 1993). However, the tools that exist in higher education spaces are not always used to encourage student engagement (Butler, 1992). Moreover, the present commercialisation of higher education has encouraged students to "have a degree" as opposed to "be a learner" (Molesworth, Nixon and Scullion, 2009, p.277).

One way to encourage students to "be learners" would be to promote student learning and enhance institutional effectiveness (Krause and Coates, 2008, p.493). Because students are individuals and usually learn as individuals, each student has their own learning path and learning style and this should be accounted for in their learning environments (Jacobson, 2001). Regardless of this, it remains common practice to present discipline-specific material

and apply generic assessment techniques to gauge generic student success. Very little is done to tailor-make learning or assessment per student, especially in large classes (Basitere and Ivala, 2017**)**.

Adaptive learning presents the opportunity to "tailor-make" learning according to the needs of each student. And in an age where technology can be used and creatively adapted in the classroom, adaptive learning technology presents an even bigger opportunity to "tailor-make" learning per student. One example of adaptive learning technology is McGraw-Hill *Connect*, a digital learning environment that integrates a module's eBook, course content, assessments and grading to make the process of teaching and learning unified for educators and students. The eBook is not simply a portable document format (pdf) version of the hard copy prescribed textbook. It is a *SmartBook* which adapts to each users' learning pattern and establishes this pattern as each user progresses through the course material (McGraw-Hill, 2016).

Despite the innovative technology used in McGraw-Hill *Connect*, little is known about the role that the system plays in students' learning experiences. While McGraw-Hill's own effectiveness study does argue that *Connect* leads to a 10% improvement in student success, there is no independent research that evaluates its role in the learning process (McGraw-Hill, 2016). Subsequently, this research question is prompted: "Does adaptive learning technology affect the learning experience of first year Economics students in blended-learning environments?" In response to this research question, the purpose of this study is to examine whether adaptive learning technology, in the form of McGraw Hill *Connect*, affects the learning experience of first year Economics students in blended-learning environments at a South African residential university, hereafter referred to as "the university". In light of the aim, the objectives of the study are twofold: firstly, to establish whether adaptive learning technology proved useful to students in learning economics and secondly, to determine whether the adaptive learning technology was efficiently rolled-out to students. This study hypothesises that that adaptive learning technology has a positive influence on the learning experience of students and makes a significant contribution to the growing body of knowledge on adaptive learning and adaptive learning technology in the "developing" world.

## Theoretical framework

This study is grounded in adaptive learning theory. Adaptive learning theory postulates that learning is improved when instruction is personalised (Murray and Perez, 2015). Adaptive learning gained popularity from the work of behavioural psychologist, Burrhus Frederic Skinner in the 1950s and 1960s, whose theories aimed to help elementary school-goers. Skinner's theory of learning advocated for "learning by doing" and his theories argue that teachers should use creative teaching techniques to encourage learning in small segments and should adapt learning to each student's skills level, among other things. Skinner's own teaching strategy made use of a "teaching machine", designed to assist students with programmed learning (Skinner, 1961). The teaching machine used by Skinner, was a device that relied on a student tapping to the sound produced by the mechanical instrument as they answered short and focused questions which "self-managed" their learning. Each question was a build up to the next question and at the end of a session, each student's unique rhythmic pattern was produced as a printed score (Skinner and Holland, 1961).

While Skinner's teaching machine is commonly seen as one of the first forms of adaptive learning technology, it was Sidney Pressey who actually outlined a system of adaptive learning in 1921 long before Skinner's teaching machine gained popularity. Pressey, also a behavioural psychologist, assembled an "automatic teacher" from old typewriter parts which presented students with multiple choice questions that were ordered from least to most difficult. If a student answered a question correctly, they could move to the next question. If not, the machine would not move until the student answered the question correctly. Despite its immense potential to assist with learning, the automatic teacher was too expensive to manufacture and deploy to public schools. As a result, Pressey's automatic teacher was not actively used on a large scale at the time, but re-emerged in popular literature, as a result of the work by Skinner (1961) and a review of programming techniques by Klaus (1965). Pressey and Skinner's studies suggest that adaptive learning technology is an important part of the adaptive learning process.

### *The Benefits of Adaptive Learning Technology*

According to McGraw-Hill (2016), adaptive learning and its associated technology can be seen as beneficial for a number of reasons. Firstly, adaptive learning technology usually adjusts to the learning pace of a student based on their answers to the multiple choice or short questions built into the learning management system. This ensures that students master basic concepts, often a precursor to more advanced concepts. Secondly, a student's prior knowledge is often taken into account by the instructor, who programmes questions at varying levels while aiming to accommodate different kinds of students and their diverse learning. Thirdly, adaptive learning technologies usually use each students' answers to the various questions to create diagnostic information. This diagnostic information helps educators and course convenors become familiar with their students' abilities and learning patterns. Moreover, this helps to empower educators to identify students who are falling behind or giving up. Lastly, adaptive learning technology allows for lecturers to focus on more advanced concepts in the (online or face-to-face) classroom and also provides an opportunity for increased and focused synchronous or asynchronous student engagement.

### *Modern Critics of Adaptive Learning Technology*

Audrey Watters is probably the most well-known, modern-day critic of adaptive learning technology but not of adaptive learning itself. Watters (2005) supports adaptive learning but believes that adaptive learning technologies are impersonal and devalue the processes of learning, labour and care. Watters (2005) argues that educational technology companies exaggerate the potential of adaptive learning technologies and claims that the algorithm used in educational technologies does not adapt to each learner's individual learning needs. Instead, the algorithm serves as a "robot tutor" that simply allows a student to proceed to different levels of very narrow multiple choice questions. In addition, Watters (2005) argues that educational technologies do not necessarily help students to understand why the answer that they chose is wrong. They usually come to this realisation on their own after they have selected a few incorrect answers. Furthermore, educational technologies are not able to account for students' misconceptions in a particular discipline nor are they able to actively engage with students without the presence of a synchronous and attentive tutor. Watters (2005) also emphasises that "computers do not care".

### *Modern Literature on Adaptive Learning and Adaptive Learning Technology*

Modern literature on adaptive learning presents mixed evidence to merit its implementation. Papert (1980) argues that while computers are an important tool in the process of learning, they are designed to repeat prevailing educational practices. Likewise, Akbulut and Cardak (2012) present findings from over 70 studies on adaptive learning and find weak evidence in support of its effectiveness. Similarly, Murray and Perez (2015) and Reich and Ito (2017) suggest that adaptive learning has minimal benefit in higher education. Reich and Ito (2017) argue that "some rigorous studies show no effects of adaptive systems as compared to traditional instruction, and others show small to moderate effects". In addition, the authors argue that "most of what computer assisted instructional systems can evaluate are student computational skills, which are exactly the kinds of things that computers are much better at doing than human beings". On the contrary, Basitere and Ivala (2017) find that adaptive learning technology assists students with building their proficiency and effectively managing their time in the first year physics classroom.

### *Education equality at the university*

In light of the "embarrassingly low" transformation of higher education in South Africa, some universities aim to improve education equality through their teaching and learning strategy, among other things. The university has one of the worst education equity efficiency indices (-10.4) among the 26 public higher education institutions in South Africa. This means that student graduations at the university are a poorer match to the national demographic profile than its student enrolments (Govinder, Zondo and Makgoba, 2013).

In 2009, the university embarked on a number of strategic campaigns to increase student retention and success in order to improve its overall education equality profile. The university initiated a number committees whose aim is to identify and explore the factors influencing retention and success of new and senior students at the university. The university also relaunched its academic development division and began promoting technology-assisted learning and analytics management in its attempt to provide greater academic support to its students.

### *Economics 1 and McGraw-Hill Connect at the university*

In 2015, the university sought to meaningfully integrate technology with their teaching and learning strategy in a bid to improve student retention and success. Their argument was that present-day students show immense technology competence and thus, would benefit from using technology as part of their learning process. This idea received some criticism from academics who argued that technology use in the classroom would be "less exciting" than social use and that students would use the Wi-Fi to roam social media during class time. Others argued that youth at the university may not necessarily be as technology savvy as expected granted that many students at the university are from socioeconomic backgrounds where exposure to technology use is less likely. Nevertheless, the university continued to host seminars and workshops through faculties and the academic development division to encourage engagement among academics regarding technology as a tool for teaching and learning. Over time, many different tools and platforms were explored by a number of academics from diverse disciplines at the university. Google classroom and Blackboard were among the more commonly mentioned platforms in teaching and learning spaces among academics at the university and are known for providing a diverse range of teaching and

learning tools in addition to analytics features that could be used to analyse student success for the duration of a particular module.

Academics with larger classes began to examine tools that could also be used to innovatively attract more engagement with the content. Larger classes are typically characterised by large spaces filled with tightly packed seats which makes discussion in smaller groups undesirable for students and uncontrollable for instructors. Students find discussion in the larger group daunting and subsequently become passive observers in the large classroom. Instructors have to find a balance between crowd control and student engagement and are typically inaccessible to students until after the class has ended (Geske, 1992). This arrangement usually leaves the students to study large parts of the course material without any structured guidance outside of class time. While this may encourage students to take control of their own learning, it does leave room for students to under-engage with the material.

The Economics 1 classroom at the university has the stereotypical large classroom setup. Enrolment into the course usually exceeds 2000 students per semester as the course services students from diverse disciplines. The course follows a 14 week timetable per semester, with each student attending a compulsory lecture (90 minutes) and tutorial (45 minutes). 12 themes are covered over 12 weeks, leaving 2 weeks in between for semester assessments. The same lecture takes place 6 times in 1 week and the same tutorial takes place over 15 times in 1 week. Lectures take place in large halls and theatres, with the smallest venue holding up to 500 students and the largest up to 900 students. Tutorial sessions hold 50 students. Students may choose which lecture and which tutorial they attend depending on their timetable and, perhaps later on in the semester, the instructor. Economics 1 usually has 6 instructors and 12 tutors per semester.

Economics 1 is worth 12 credits per semester which is equivalent to 120 notional hours. The South African Qualifications Authority (SAQA) uses a system of credits to attach a value to every course registered with SAQA and the CHE. 1 credit is equal to 10 notional hours. Notional hours of learning are defined as "learning time that it would take an average learner to meet the outcomes defined. It includes concepts such as contact time, time spent in structured learning in the workplace, individual learning and assessment." (SAQA, 2000, p.12). First year students usually take about five courses per semester at the university and each one is usually worth 12 credits each. This means that each student has to spend 600 notional hours per semester and, when divided by the standard academic calendar of 14 weeks, has to spend 42 hours per week on their studies. In South Africa, a full time student should be able to dedicate 42 hours a week to their studies, considering that a standard work week is approximately 40 hours. Based on this calculation, a student is required to spend 8.6 notional hours on each course per week. It is very difficult to monitor whether a student is meeting their weekly notional hours outside of class and assessment times.

In 2015, the Economics 1 team was given a McGraw-Hill *Connect* demonstration and the product had the components needed to encourage student engagement with the Economics course material. The platform could also serve as a learning management system as it contained diverse assessment and analytics capabilities. McGraw-Hill *Connect* also comes with a *SmartBook*. A *SmartBook* is very different from an eBook in that the adaptive learning tasks are synchronised with the *SmartBook*. The adaptive learning component of McGraw-Hill *Connect* works similarly to the Skinner's teaching machine. It asks each student a series of multiple choice questions, known as *LearnSmart*. If a student answers incorrectly, they are automatically directed to a highlighted part in the eBook containing information specific to

that multiple choice question. A voice prompts the student to read the highlighted section and the student needs to place their cursor over each word to prove that they have read the word. Only after all the words have been read, will the student be directed to another multiple choice question. If the student answers the new question correctly, the next multiple choice question appears on the screen. If not, the student will again be redirected to the interactive eBook. As the student completes the *LearnSmart*, analytics are being processed in the background which are available to instructors. Every week, each student is required to complete a *LearnSmart* for the relevant theme or chapter. Thereafter, each student is given a weekly tutorial worksheet and a semester assignment. It is usually advised that the student completes the *LearnSmart* before the lecture or at least before the weekly tutorial worksheet. Analytics generated from the *LearnSmart* were used to engage with students who didn't complete the weekly *LearnSmart* or seemed to be falling behind. Because *LearnSmart* appeared to be a tool with the potential to encourage engagement with the course material outside of class and assessment time, accompanied by built-in analytics features, the Economics 1 team chose to begin using the McGraw-Hill *Connect* system in 2016 as part of their teaching and learning strategy.

**Methodology**

In September 2016, members of the Economics teaching team wanted to examine the role that the McGraw-Hill *Connect* system played in the learning experience of Economics 1 students. Thus, a voluntary questionnaire was issued in lectures and tutorials and students were encouraged to anonymously share their experiences of the McGraw-Hill *Connect* system. Students were free to leave their completed questionnaires in a folder after class at the front of the venue. The lecturer or tutor in the session was not permitted to discuss aspects of the questionnaire with the participants. The study made use of a descriptive research design and the questionnaire issued to participants contained 11 questions. Table 1 below outlines the structure of each question:

Table 1: Author's own adaptation

| Question | Answer structure |
|---|---|
| 1. Did McGraw-Hill LearnSmart assist you with learning Economics? | Yes or no |
| 2. If yes, what was it about this system that assisted you in learning Economics? If no, what was it about this system that did not assist you in learning Economics? | Open-ended: participants were provided with 4 lines of space to respond. |
| 3. Did the weekly tutorial worksheets assist you with learning Economics? | Yes or no |
| 4. If yes, how did tutorial worksheets assist you with learning Economics? If no, why do you think the tutorial worksheets did not assist you with learning Economics and how can tutorial worksheets be improved to aid | Open-ended: participants were provided with 4 lines of space to respond. |

| | |
|---|---|
| deeper learning? | |
| 5. Did the weekly homework worksheets assist you with learning Economics? | Yes or no |
| 6. If yes, how did the weekly homework worksheets assist you with learning Economics? If no, why do you think the weekly homework worksheets did not assist you with learning Economics? | Open-ended: participants were provided with 4 lines of space to respond. |
| 7. How difficult was it to download the Economics 1 textbook? | Difficult, somewhat difficult or easy |
| 8. How difficult was it to submit homework/tutorial worksheets on the McGraw-Hill Connect online system? | Difficult, somewhat difficult or easy |
| 9. If you had trouble with your eBook and obtained assistance, how quickly was your problem rectified? | Within 3 days, within 1 week or within 2 weeks |
| 10. If you had trouble with McGraw-Hill Connect and obtained assistance, how quickly was your problem rectified? | Within 3 days, within 1 week or within 2 weeks |
| 11. Which eBook did you use more – the offline or online eBook? Why? | Open-ended: participants were provided with 4 lines of space to respond. |

Based on the validity criteria specified by Sullivan (2011) - mainly content and response process in this instance - the questionnaire used in this study is sound. In terms of the content, the questions were developed by the course designers interested in ascertaining whether students in the course were benefiting from the adaptive learning technology. Moreover, the student responses matched the questions.

Non-probability sampling was applied in this study as survey responses were voluntary. Out of approximately 2200 enrolled students, 308 students volunteered to participate in this study by completing the questionnaire. Responses to each questionnaire were processed and all responses were collectively used to conduct a descriptive analysis of each question. The data does not contain enough general demographic information over time, such as age, race, final course grades for Economics 1 and course grades for other courses, schooling quintiles and home language, to conduct meaningful bivariate and multivariate analyses. Furthermore, the questionnaire responses need to be matched to other measures of adaptive learning satisfaction to allow for sensitivity measures and robustness checks. Nevertheless, the univariate analysis does provide a useful starting point for measuring the learning experience of student participants who used adaptive learning technology.

**Results and Discussion**

The first question of the survey asked students whether they found *LearnSmart* activities to be useful in Economics 1. Results from the survey suggest that 217 participants (70%) found weekly *LearnSmart* activities to assist them in Economics 1 while 90 participants (29.2%) indicated that *LearnSmart* activities did not assist them. 1 participant chose not to respond to the question regarding usefulness of *LearnSmart* activities. In response to the study's first

objective, the response rate to this question suggests that most participants in the study had a positive learning experience with respect to the weekly *LearnSmart* activities. The *LearnSmart* activities proved useful in the process of learning economics for most of the participating students.

The second question asked participants to provide reasons for their answer in the first question. 130 student participants (42%) found *LearnSmart* activities relevant and important for assessment preparation. 51 (16.5%) student participants felt that *LearnSmart* activities were too lengthy and too difficult and 25 (8%) student participants felt that the *LearnSmart* activities were irrelevant because they did not count towards their semester mark nor did it help them prepare adequately for assessments. 33 (10.7%) student participants chose not to provide reasons for their answer in the first question. This result suggests that a large proportion of the participating students found it beneficial in preparing for assessments. The result also suggests that *LearnSmart* could be included in each student's semester grade in order to motivate them to participate. In line with the study's first objective, most participating students felt that adaptive learning technology assisted them in learning economics.

Thereafter, participating students were asked how quickly their McGraw-Hill *Connect* queries were resolved. 121 students (39%) reported that their McGraw-Hill *Connect* queries were resolved within 3 days. 42 student participants (13.6%) and 50 students (16%) had their McGraw-Hill *Connect* queries were addressed within 1 and 2 weeks respectively. 95 (30.8%) students chose not to answer the question. It appears as though a large proportion of queries were resolved within 3 days which is a relatively quick response time. This could be a key contributor to the positive learning experience of the student participants. In line with the second objective of the study, responses here suggest that most participating students had their queries addressed fairly quickly.

Lastly, students were asked whether they preferred an online version of the eBook or the offline version. 198 student participants (64%) of students preferred the offline eBook while 58 student participants (18.8%) preferred the online eBook. 52 student participants (16.8%) chose not to indicate their preference. This finding illustrates the importance of offline material. This could also be an indication that student participants do not have access to the internet or have access to limited internet outside of the university.

In relation to theories of adaptive learning, the results of this study suggest that learning is improved when instruction is personalised. In relation to similar studies, such as Basitere and Ivala (2017) and Akbulut and Cardak (2012), results from this study suggest that McGraw-Hill *Connect* appeared to assist student participants in learning economics, proved useful in terms of assisting them in preparing for assessments and was rolled out efficiently.

**Conclusion**

This study finds that McGraw-Hill *Connect* adaptive learning technology contributed positively to the learning experience of first year economics student participants at a South African residential university. Considering that *LearnSmart* activities per week can be pre-programmed to take up to two hours, McGraw-Hill *Connect* can assist in facilitating greater engagement with the course material while helping students to meet their weekly notional hours for Economics 1 at the studied university.

Furthermore, while adaptive learning technology does not typically tell a student why the answer that they chose is wrong, McGraw-Hill *Connect* comes a step closer to guiding

students more specifically with the *SmartBook* as students are automatically directed to a highlighted part in the eBook containing information specific to the question that they answered incorrectly. More research needs to be conducted to improve the adaptive functionality so that it may provide more precise feedback.

Research-guided practice is critical for the development of effective adaptive learning technology solutions in any context. While it is important to implement strategies that may seem necessary or effective to improve student retention and success, it is important to follow the implementation up with research into the effectiveness of the strategy, especially when student retention and success is a priority. The survey used in this study was by no means comprehensive and does not necessarily imply that adaptive learning technology is superior to any other learning tool. Furthermore, the role that adaptive learning technology plays in improving student success and retention directly is yet to be determined. A logical next step would be to analyse the value that adaptive learning technology adds to student learning objectively and its impact on student retention and success by means of a questionnaire that encompasses important demographic variables (such as age, race, final course grades for Economics 1 and course grades for other courses, national benchmark test (NBT) scores, schooling quintiles, home language, household income, province and area) over and above questions on adaptive learning technology.

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# BEYOND FAMILIAR TERRITORIES TOWARDS EDUCATIONAL TECHNOLOGIES: FRAMEWORK FOR HIGHER EDUCATION INSTITUTIONS AND E-SCHOOLS PARTNERSHIPS

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**Abstract**
This paper reports on a framework for establishing partnerships between higher education institutions and e-schools, supporting and enhancing these schools' success along various dimensions. The focus of the study was on adopting educational technologies. The theoretical framework used the Information Diffusion Theory, the Technology Acceptance Model, and the Levels of Teaching innovation framework. The study followed a multiple case study approach. Primary data collected from stakeholders included practitioners. Secondary data included success factors and barriers to educational technology integration identified from literature, forming an important part of the data collection instruments. The purpose of this study was to develop the framework, based on analysis of secondary data. The dimensions identified for the framework were derived from major activities in schools, including management, administration, effective teaching and meaningful learning, and enabling factors, including infrastructure and connectivity. Results show the framework developed, based on the theory that diffusion happens at different rates. It was divided into three phases, relating to classifying barriers to educational technology integration - these are Readiness (reflecting creating enabling environments), leading to Implementation and Sustainability.

## 1. Introduction

The educational landscape in South Africa has faced many obstacles for numerous years, and continues to be plagued by marked inequalities, and poor achievement and success rates. This culminates "in a generally ineffective and expensive education system", which does not adequately prepare learners for higher education and the world of work (Vorster & Goosen, 2017:118). This is further compounded by the poor quality training of many educators in the system, and socio-economic factors on learners and communities (Makgato, 2014). The adoption rate of educational technologies at different schools by different educators also shows disparities, tending to reflect socio-economic inequalities in broader society.

Integrating educational technologies at all levels presents a significant opportunity for transforming the efficiency and productivity of effective teaching and meaningful learning in the school and post-school systems (Department of Education (DoE), 2004; Department of Higher Education and Training (DHET), 2014). Across the African continent, it is recognised that significantly investing in developing e-education, e-learning and integrating educational technologies is a strategic imperative to facilitate developing knowledge societies, and African countries participating in the knowledge/digital economy (Vorster & Goosen, 2017). This is evident in initiatives like the New Partnership for Africa's Development (NEPAD, 2015) e-schools initiative across Africa, and the establishment of the iKamva National e-Skills Institute (iNeSI, 2013) in South Africa.

The policy goal of the White Paper on e-Education (DoE, 2004:17) stated that every "South African learner in the general and" Further Education and Training (FET) bands would be

Information and Communication Technology (ICT) capable by 2013. This means that they use educational technologies "confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community".

All schools in the country would transform into e-schools, i.e. use educational technologies for enhancing effective teaching and meaningful learning, plan, manage and administer themselves, and support curriculum delivery.

*Aim and objectives of the paper*

The policy goal focused largely on the general and FET bands, but the same concepts and objectives could arguably be applied to Higher Education Institutions (HEIs). With both of the authors having been involved in schools and HEIs, their personal motivation for this study support the provisions of the DHET White Paper (2014), which also expressed the need for closer cooperation between HEIs and schools, to develop the skills required by educators and learners.

Even though the goal of the White Paper on e-Education (DoE, 2004) has not been realised, there are several indicators that the strategic objectives are relevant, and related processes should be accelerated (iNeSI, 2013; Vandeyar, 2013). The **aim** of this study is therefore to answer the **research question**: What should a framework for partnerships between HEIs and e-schools look like?

Based on the aim described, the **objectives** of this study include identifying the:

- relevant set of success factors and barriers to integrating educational technologies in schools, as these relate to applicable dimensions, and
- criteria along each dimension where HEIs can partner with e-schools to support and enhance the establishment and ongoing success of e-schools.

## 2. Conceptual/theoretical frameworks

The study referenced various conceptual/theoretical frameworks as part of its background, as described below.

*The Innovation Diffusion Theory (IDT)*

The Innovation Diffusion Theory (IDT) has become a widely used theoretical framework applied for studying innovation in various disciplines (Sahin, 2006), and is seen as highly relevant for investigating adopting educational technologies. It is particularly useful in the early stages of technology integration, and change processes (Hsu & Sharma, 2010). The IDT was used in this study, as it relates to educational technologies' adoption and integration in e-schools.

For the purpose of this paper, only two ideas from the IDT are highlighted. The first relates to **diffusion** being defined as a process, during which an innovation is communicated between members of a social system through the use of certain communication channels over time (Yucel & Gulbahar, 2013). This notion is often popularly called the critical mass, but could be more accurately described as the tipping point. This theory can be applied in schools at two levels: at macro level, individual schools may adopt educational technologies at different times, while at micro level in each school, educators adopt educational technologies at different times. Secondly, **adoption** is a process involving various adopter categories (Hsu & Sharma, 2010:43). Certain parts of the population, including "innovators, early adopters, and

early majority" are seen to readily adopt a proposed innovation. On the other hand, late majority and laggards "show resistance to the process" of adopting a new innovation. The IDT suggested that innovations are first adopted by small numbers of adventurous pioneers, and only taken up by the majority once the innovation's value became apparent.

Schools, which were successful in integrating educational technologies could serve as models, providing inspiration and motivation to other schools, particularly where these innovations are communicated and shared. Likewise, educators, who are champions of educational technologies integration in their schools, could serve as role models, supporting other educators, particularly in their own schools. Where there are networks for communicating and sharing experiences, they could also extend this influence to educators at other schools.

*The Technology Acceptance Model (TAM)*

According to Surendran (2012), the Technology Acceptance Model (TAM) was first proposed by Davis (1989) and has since been widely applied in Information Systems (IS) research related to acceptance of various technologies in a variety of settings, including educational ones. A review of 50 papers published between 1999 and 2010, using TAM as theoretical framework, found that these were mostly in educational fields, covering a wide range of areas, such as online learning, internet, educator attitudes, Web 2.0, interactive whiteboards, tablets, etc. (Yucel & Gulbahar, 2013).

The TAM was intended specifically for explaining user acceptance of IS and technologies, by predicting the acceptability of a technological innovation and identifying the modifications that should be made to systems, so that these become acceptable to users. Two main factors serve as predictors. These are Perceived Usefulness (PU: the degree to which a person believed that using a system improved their performance) and Perceived Ease of Use (PEoU: the degree to which a person believed that using a system was easy). Studies have demonstrated that perceived usefulness is the most important predictor of user intention (Yucel & Gulbahar, 2013). In their review of TAM, Lee, Kozar and Larsen (2003:759) added to PU and PEoU behaviour and Behavioural Intention (BI) as major variables, while their summary of the variables used in the TAM included self-efficacy, end user support, computer anxiety, perceived enjoyment, system output or information quality, compatibility and prior experience. Based on the original model, further extensions to TAM have been proposed by several researchers, in order to introduce additional variables as antecedents to PU and PEoU (Chuttur, 2009; Yucel & Gulbahar, 2013). Apart from other external factors, which affected perceived usefulness, "TAM2 extended TAM by including subjective norm as an additional predictor of intention" (Venkatesh, Morris, Davis, & Davis, 2003:428).

In the Information Technology (IT) field, Yi, Jackson, Park and Probst (2006) combined the IDT, TAM and the theory of planned behaviour, to add the latent constructs of personal innovativeness in IT, result demonstrability, image, subjective norm and perceived behavioural control.

Other significant variables in educational fields had been identified in a review of TAM studies by Yucel and Gulbahar (2013). Their analysis identified four themes, with related variables, as shown in Table 1, as well as identifying which variables were respectively the most effective and the least significant.

The classifications shown in Table 1 have an important bearing on this study, as the variables are important in guiding the collection and analysis of data. However, it is important that

caution be taken to not allow the indicated significance of these variables in limiting the study. It is, for instance, surmised that in the setting of an e-school organisational effects are significant, given the social contexts of schools.

*The Unified Theory of User Acceptance and Use of Technology (UTAUT)*

Venkatesh, Morris, Davis and Davis (2003) reviewed eight diffusion theories and acceptance models (including IDT and TAM), in order to empirically compare these models to formulate the UTAUT. Research based on the use of the UTAUT has shown that prior models, such as the TAM, were able to explain approximately 40% of user acceptance of technology, while the UTAUT succeeds in explaining approximately 70% (Venkatesh et al., 2003; Yucel & Gulbahar, 2013).

*Table 1. Themes and variables in TAM (adapted from Yucel & Gulbahar, 2013)*

| **1. Effectiveness** | 2. **Learner/ Educator** | 3. **Software and Educational Technologies** | **4. Course/** 5. **Content** | 6. **Organisational Issues** |
|---|---|---|---|---|
| 7. (1) | 8. Perceived usefulness | 9. | 10. | 11. |
| 12. (2) | 13. Perceived ease of use | 14. | 15. | 16. |
| 17. (3) | 18. Intention | 19. | 20. | 21. |
| 22. (4) | 23. | 24. Examination of system and technologies | 25. | 26. |
| 27. (5) | 28. Technological competency | 29. | 30. | 31. |
| 32. (6) | 33. Attitude | 34. | 35. | 36. |
| 37. (7) | 38. Subjective norm | 39. | 40. | 41. |
| 42. (8) | 43. | 44. Usage of system and technologies | 45. | 46. |
| 47. (9) | 48. Demographic characteristics | 49. | 50. | 51. |
| 52. (10) | 53. Perceived Enjoyment | 54. | 55. | 56. |
| 57. (11) | 58. Satisfaction | 59. Satisfaction | 60. Satisfaction | 61. |
| 62. (12) | 63. | 64. | 65. | 66. Organisational effects |
| 67. (13) | 68. Anxiety | 69. | 70. | 71. |

This would indicate that the UTAUT is a useful theory to apply as the primary theoretical framework for the current study, although it has to be supplemented by using other models and theories for addressing the research question, which had been set. In fact, Venkatesh et al. (2003) encouraged future researchers to include antecedents identified in prior research on the various models, in order to derive a richer understanding of technology adoption and usage, particularly with reference to moderating influences, different educational technologies and user groups, and other organisational issues. The UTAUT includes variables, "which are believed to influence user acceptance and usage" (Yucel & Gulbahar, 2013:98), such as performance and effort expectancy, facilitating conditions and social influence, as well as factors such as age, experience, gender and voluntariness of use. Venkatesh et al. (2003) theorised that the constructs of attitude toward using technology, anxiety and self-efficacy would "not to be direct determinants of" BI.

*The Levels of Teaching innovation (LoTi) framework*

A major criticism applied to studies based on the TAM is that system usage was frequently measured by self-reporting that is a subjective measure. Several researchers have cautioned against this approach as it introduced common method bias (Chuttur, 2009; Lee et al., 2003). For the purpose of this study, it is also useful to note a further criticism by Lee et al. (2003) where they indicated that TAM studies were often applied to tasks too broad in nature, while research indicated that perception of an educational technology varies according to the task type. Based on these shortcomings, this study used the levels of the Levels of Teaching innovation (LoTi) framework as a basis to investigate the educational technologies being used in schools, and evaluate the integration level of such technologies. This should reduce the effect of self-reported use, as evaluating technology integration is assessed from primary data gathered.

The LoTi framework was first introduced in 1994 as a tool for helping to quantify the use of educational technologies in classrooms (Moersch, 2010). LoTi included three aspects, supported by several different measurement technologies. Given the focus of this study on educational technologies, two of these were employed. The first was the original LoTi framework, for measuring the use of educational technologies in classrooms, with level zero denoting non-use, to level six denoting seamless integration into educational activities. The second aspect measured the fluency levels of educators in using educational technologies for effective teaching and meaningful learning, from level zero, describing educators having little skill or confidence in using educational technologies, to level seven, describing expert users.

## 3. Methodology

The design of the data collection instruments were based on exploring the variables identified in the UTAUT, and other relevant antecedents, towards gaining an understanding of the factors influencing stakeholders at e-schools to adopt and use educational technologies. An important part of this process was investigating the enablers and barriers, which stakeholders in schools experienced, and how they overcame identified barriers.

The study took the form of a multi-case study, where around ten schools from each of two provinces were used as individual cases – with **sampling** based on purposive selection from the **population** of all schools. In each of these cases, it was necessary to investigate the current state of educational technologies integration into effective teaching and meaningful learning, as well as the management and administration of the school.

Secondary data in the form of existing literature and policy documents were used in this

study for identifying the envisaged uses of technology in e-schools, and the success factors and barriers identified by other researchers. Success factors and barriers to successful educational technologies integration has been studied by a large number of researchers, as can be seen from the review of literature undertaken by the British Educational Communications and Technology Agency (BECTA) review (Jones, 2004) and Bingimlas (2009). For the purposes of this study, it is necessary to examine how schools achieved success and overcame barriers, which potentially existed. This understanding informs the inclusion of activities and interventions in the framework.

While it is important to gather qualitative opinions with regard to success and barriers from classroom-based educators, the BECTA study (Jones, 2004) also stressed that opinions from other stakeholders, such as educational leaders, are important, as they could offer alternative perspectives.

Primary data gathered from each of the schools in the case study included:

- Semi-structured interviews with
    - principals and/or educational technologies specialists, which included school-level information, such as budgets, policy and training related to educational technologies, and the availability of educational technologies for various uses by stakeholders in the school community. Important here is how a conducive environment for educational technologies integration was (or could be) established, and to explore the facilitation of conditions for this.
    - educators (about five from each school), used for gathering information on their skills and attitudes towards educational technologies, and the availability and use of educational technologies for teaching, learning and administration. Of particular importance here is exploring the barriers experienced by educators, and the approaches enabling (or which could enable) those barriers to be overcome.
    - School-level data can also be found by observing and recording available resources, as well as from the analysis of school documents, such as policies, budgets, floor plans, etc.

Especially quantitative data needs checking regarding **reliability**. Both in case and cross-case data analysis helped in identifying how schools achieved success in overcoming barriers and integrating educational technologies. These insights were then used for populating further detail into the framework. An empirical evaluation of the framework also serves towards **validity** of the criteria included.

## 4. Results

In terms of establishing an initial set of dimensions used to characterise e-schools, according to the White Paper (DoE, 2004:18), such institutions have:

- learners utilising educational technologies for enhancing effective learning;
- qualified and competent leaders, using educational technologies to plan, manage and for administration; and
- qualified and competent educators, using educational technologies for enhancing effective teaching and meaningful learning.

Furthermore, e-schools also engage with their communities.

Various stakeholders, who were therefore considered while developing the framework, as activities/interventions would be designed for specific groups, based on the characteristics of

e-schools, include:

- Learners.
- Leaders, including e.g. principals, as well as those at higher levels of the education hierarchy, such as districts, provinces and national government, who are relevant in relation to policy and establishment of large-scale initiatives (such as Gauteng Online), which schools participate in.
- Educators, including e.g. the so-called educational technologies champion. It is important that the roles of early adopters and champions of educational technologies integration be recognized, as seen in the IDT.
- Community members, as schools represent a social environment, within a societal context (including the wider community where the school is situated).

Some strategic objectives set out in the White Paper (DoE, 2004:25,27) offer useful insight into activities included in a partnership framework, relating to the following:

- Professional development for management, effective teaching and meaningful learning;
- "Electronic content resource development and distribution";
- Access to educational technologies infrastructure;
- Connectivity; and
- Research and development.

These objectives were helpful in adding to the set of dimensions used in the framework, derived from various sources, including theories referenced, existing literature, and policy documents:

- The first set of dimensions relates to creating and sustaining an enabling environment for educational technologies integration to take place. These include the role of leaders, such as the principal, professional development for management and administration, effective teaching and meaningful learning, access to educational technologies infrastructure and connectivity, community engagement, policy and budget, knowledge sharing and technical support.
- The second set of dimensions relate to where and how educational technologies are used in e-schools, including research and development, as well as electronic content resource development and distribution for curriculum delivery.

This study represents work in progress, and therefore preliminary results at this point are based on an analysis of literature and secondary data. Insights gained from the case studies inform how schools overcame barriers/challenges, and how successful e-schools turned these around, leading to the identification of enablers for educational technologies integration, as is indeed suggested in the BECTA report (Jones, 2004).

The BECTA review (Jones, 2004) and Bingimlas (2009) discussed various approaches for classifying barriers to educational technologies integration. The former study, similar to this one, was focused at the school level, and success factors and barriers were therefore usefully classified as either being school-level factors or educator-level factors summarised as shown in Table 2.

*Table 2. Barriers influencing educational technologies integration in schools*

| **72. School-level factors** | **73. Educator-level factors** |
|---|---|
| 74. | 75. LACK OF EDUCATOR CONFIDENCE AND EDUCATORS' COMPUTER ANXIETY |

| **72. School-level factors** | **73. Educator-level factors** |
|---|---|
| 76. | 77. LACK OF EDUCATOR COMPETENCE<br>o "Lack of time for training" (Jones, 2004:9)<br>o Lack of pedagogical training<br>o Lack of skills training<br>o Lack of educational technologies focus in initial educator training |
| "LACK OF ACCESS TO RESOURCES" (Jones, 2004:11)<br>o Lack of hardware<br>o Poor organisation of resources<br>o Poor quality hardware<br>o Inappropriate software<br>o "Lack of personal access for" educators (Jones, 2004:14) | |
| 78. LACK OF TIME | |
| TECHNICAL PROBLEMS<br>o "Fear of things going wrong" (Jones, 2004:15)<br>o Lack of technical support | 79. RESISTANCE TO CHANGE and NEGATIVE ATTITUDES |
| 80. | 81. NO PERCEPTION OF BENEFITS |

It is not the intention to elaborate further on these factors. Schools successful in integrating educational technologies have put in place a number of measures for addressing these and other barriers. In the context of this study, the importance of these factors are that the framework identified actions and interventions where HEIs can partner with schools to overcome these barriers, and turn them into enablers.

Based on the IDT, it is also clear that the framework should include a longitudinal perspective regarding the different collaboration and intervention activities taking place. The needs of schools and stakeholders are different in the early stages of technology adoption, compared to schools where educational technology integration is well established. The three phases included in the framework are:

- The readiness phase (establishing a conducive and enabling environment)
- The implementation phase (staff start integrating a basic set of educational technologies into e.g. administration activities); and
- The sustainability phase (technology integration becomes well established, with significant numbers of adopters, and experimentation with technologies becomes viable).

## 5. Discussion

Based on these results, the study proposed the framework for HEI partnerships supporting technology integration in schools as in Figure 1. The framework is being refined, based on the results generated, and as further data analysis takes place.

<table>
<tr><td rowspan="3">INPUT FACTORS:</td><td colspan="3">• Pre-service educator training</td></tr>
<tr><td colspan="3">• National policy</td></tr>
<tr><td colspan="3">• Provincial funding, infrastructure, programmes</td></tr>
<tr><td colspan="4">Define partnership parameters</td></tr>
<tr><td colspan="4">Stakeholder and benefit analysis</td></tr>
<tr><td>PHASES:</td><td>READINESS</td><td>IMPLEMENTATION</td><td>SUSTAINABILITY</td></tr>
<tr><td>Leaders</td><td colspan="3">Develop and monitor plans for educational technologies integration and promotion</td></tr>
<tr><td rowspan="2">Professional development for</td><td colspan="3">Train staff in using educational technologies, devices, pedagogy</td></tr>
<tr><td></td><td colspan="2">Mentoring</td></tr>
<tr><td>• management and administration</td><td>Identify educational technologies and systems</td><td>Implement basic educational technologies/systems</td><td>Introduce new systems/educational technologies</td></tr>
<tr><td rowspan="2">• effective teaching and meaningful learning</td><td colspan="3">Develop approaches for educational technologies integration and pedagogy</td></tr>
<tr><td>Identify educational technologies and resources</td><td>Promote use of basic educational technologies</td><td>Experiment with new educational technologies</td></tr>
<tr><td>• Access to educational technologies infrastructure<br>• Connectivity</td><td>Budget and Resource Plans</td><td colspan="2">Monitor Relevance/Usage and Adapt</td></tr>
<tr><td>Community engagement</td><td>Strategies for buy-in</td><td colspan="2">Provide educational technologies and support to community members and businesses</td></tr>
<tr><td>Research and development</td><td colspan="3">Assess and develop practice, educational technologies and techniques supporting educators and administrators</td></tr>
<tr><td>Policy and budget</td><td colspan="3">Develop policy and budget relevant to each phase</td></tr>
<tr><td rowspan="2">Knowledge sharing</td><td rowspan="2">Share best practice</td><td>Establish lead innovators</td><td>Communities of Practice and Portals</td></tr>
<tr><td>Use Open Educational Resources (OERs)</td><td>Develop and use OERs</td></tr>
<tr><td rowspan="2">Technical support</td><td colspan="3">Train support staff in educational technologies</td></tr>
<tr><td></td><td colspan="2">Place learners to support educators</td></tr>
<tr><td rowspan="4">OUTPUT FACTORS:</td><td colspan="3">• Inform broader policy development, programmes and resources</td></tr>
<tr><td colspan="3">• Resource sharing</td></tr>
<tr><td colspan="3">• Impact pre-service educator training</td></tr>
<tr><td colspan="3">• Research outputs linked to analysis and informing practice</td></tr>
</table>

*Figure 1. Framework for HEI partnerships to support educational technologies integration*

The framework recognized that pre-service educator training, as well as national policy and provincial funding, infrastructure and programmes, play important roles in the promotion of schools' readiness for educational technologies integration.

## 6. Conclusion

The framework presented relied on the existing policy goal, objectives and literature for deriving a set of dimensions and the phases considered in relation to partnerships between HEIs and e-schools. It also considered perspectives relating to integrating educational technologies in schools, including the Innovation Diffusion Theory, the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology.

This framework was developed based on a South African context, in that an important

departure point was the White Paper (DoE, 2004), and the expectations it set out for e-schools, as well as the wider continent. It is envisaged, however, that the concepts reflected in the framework could be transferred to other educational systems.

It should be noted that the Technological Pedagogical Content Knowledge (TPACK) model (Koehler & Mishra, 2009) has not been referenced earlier, even though it is a useful (and popular) model to describe educational technologies integration. The two main reasons for this are that the TPACK model:

- focused on contexts specific to the curriculum, while this study considered broad factors, including policy and school environments, as well as school activities beyond effective teaching and meaningful learning. As such, the models informing the study were chosen towards a broader perspective.
- included three different contexts relating to curriculum development, i.e. Technological, Pedagogical and Content Knowledge, and the various intersections between these three contexts. The focus of this study is primarily on the technological knowledge context, as the disciplinary area underlying this study is the field of IS, as well as on educational technologies diffusion and adoption (in this case, particularly in the school context). The intent did not include subject-area **recommendations** for curriculum development, although these could be fertile areas for future inclusion in this framework.

**Future research** on this framework includes subject-specific applications/versions, and its usage to introduce specific educational technologies in schools. Testing and extending the framework for adaptation to educational systems outside of South Africa also offer future topics of interest.

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# INFLUENCE OF BLENDED LEARNING ON OUTCOMES OF STUDENTS IN A RURAL CHEMISTRY CLASS

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## Abstract

The merging of several teaching methods and pedagogic tools is a recurrent technique that is geared towards meeting the needs and expectations of students with varying dispositions, learning styles and intelligence styles. This study investigated the effects of blended learning on the outcomes of Ordinary Level students in a rural chemistry classroom in Zimbabwe. The study adopted a quasi-experimental research design with a non-equivalent control group. Purposive sampling technique was used to select two intact chemistry classes from two equivalent co-educational secondary schools that were distantly located from each other within rural schools in Gweru district. The instrument used for the data collection was a Chemistry Achievement Test (CAT). The internal consistency of the instrument was obtained as 0.81 using the Test Retest method to establish the reliability. Intact classes were used and in all, 67 students participated in the study (35 in the experimental group taught with the blended learning and 32 in the control group taught using the traditional method). Data collected for the study was analysed using ANCOVA. The obtained results indicated a statistically significant increase in the students' outcomes after being exposed to the blended learning approach. Recommendations were made that the blended learning strategy should be given more emphasis during teaching and learning of chemistry and be integrated into other related subjects in secondary schools.

**Keywords**: Teaching strategies, e-learning, blended Learning strategy, achievement, chemistry

## Introduction

Advances in technology have seen institutions of higher learning consider more attractive and successful models of teaching and learning (Howard et al. 2014). The quest to deliver learning experiences that address societal needs have seen institutions of higher learning offering more online and blended learning (sometimes referred to as hybrid) courses that utilize computer technology and compel more active participation of students ( Luna & Winters, 2017). This represents a shift in education from teacher centred instructional strategies (eg, lecturing) to learner centred instructional strategies (eg, active student engagement) (McLaughlin et al. 2015). As a pedagogical approach, blended learning involves the integration of online learning in a computer mediated environment with face-to-face learning, with the notion being that the elements work together as a single, integrated course. As further noted by Sarabadani & Berenjian (2017), the blended learning approach entails the provision of fundamental course content online for the students to be learned prior to their classroom attendance. The majority of the classroom lecture time will then be devoted to active learning practices and discussions (Gülbahar, 2008). The benefits of blended learning

derived from both online-learning and face-to-face teaching environment provides a platform for improved student outcomes and the acquisition of competencies that may not be achievable otherwise (Gray & Tobin, 2010). In addition to improved student outcomes, blended learning also enhances the development of critical-thinking skills and increases student engagement with the learning process (Persky & McLaughlin, 2017).

Blended learning fits with the constructivist approach to learning, which recognizes the role of the learner in constructing knowledge rather than receiving knowledge passively from the teacher (Lee, Lau &Yip, 2016). This approach entails the provision of a learning environment that is conducive to self-directed learning that fits with the learner's own experience and cognitive ability (Condie & Livingston, 2007). By integrating both on-line and face to face learning, students are provided opportunities to experience the curriculum in a variety of ways; thereby, constructing knowledge in a way that best meets their needs (Shroff & Vogel, 2009).
The provision of learning opportunities that allow students to construct their meaning is a practice based on the theory of constructivism. In the constructivist perspective, knowledge is not seen as a finite and defined body of facts and concepts, but as ever-evolving and dynamically constructed by the learner in interaction with others and with the environment (McLaughlin et al. 2015).In practical terms, the constructivist view of learning fosters use of active learning to absorb students in the learning process through meaningful activities that prompt them to reflect on ideas, self-assess content mastery, gather information, and apply it to solving problems(Michael, 2006; Prince, 2004).

Consistent with blended learning is flipping the classroom sometimes called flipped pedagogy. The flipped classroom (also called reverse, inverse, or backwards classroom) is a pedagogical approach in which basic concepts are provided to students for pre-class learning so that class time can apply and build upon those basic concepts (Persky & McLaughlin, 2017). Providing students with key foundational content prior to class enables students to engage with content at their own pace, controlling when and how much content they view. Since the students will have already been exposed to the content, it allows for easier application of content while the teacher is present as opposed to the students initially being introduced to the content through a face-to-face lecture (Heinerichs, Pazzaglia & Gilboy, 2016).

In their argument Latchem & Jung (2010) highlight that the flipped classroom helps to motivate student learning and make the purposes of learning more explicit and clear to the learner. By blending e-learning with conventional classroom learning, students could "take advantage of much of the flexibility and convenience of an online course while retaining the benefits of the face-to-face classroom experience (Heinerichs, Pazzaglia & Gilboy, 2016). Moreover, blending the two different learning modes is highly flexible and can be tailored to the specific needs of different learning or subject contexts such that learners can take control and personalize their learning (Condie and Livingston, 2007) in an environment also oriented toward developing their self-regulation and metacognition.

There is limited research to date on how secondary school students construct knowledge using different elements of the blended learning environment as they learn chemistry. The goal of this study is to examine whether blended learning employing a flipped pedagogical approach that is centred on active learning, as compared to traditional lecture, in a rural O' level chemistry class is a more effective learning experience in promoting learning and

improving student outcomes. The study attempted to answer the following research question: Does blended learning affect the educational performance rural secondary school students in chemistry?
The study hypothesised that:
H0 : There is no significant difference in the performance of students taught using blended learning technique and conventional method in chemistry.

**Methodology**
The study was conducted in rural secondary schools in Gweru district. It employed a quasi-experimental design with the pre-test, post-test control group design. The current study involved two groups, one experimental group and one control group. Both the groups were given an achievement pretest of their baseline knowledge and understanding of the electrochemistry unit content. The experimental group was latter exposed to the blended learning teaching experience consisting of a combination of the face-to-face classes, with access to an e-learning environment while the control group received the usual teaching, which was a face-to-face approach. Differences between the two groups were then identified in terms of achievement.

The population of this study was made up of all rural secondary schools in Gweru district. Two secondary schools with internet facilities were purposively selected and randomly assigned to experimental and control groups. The experimental (blended learning) group had an intact class of 35 students while the control (conventional instruction) group had an intact class of 32 students, making a total of 67 students.

The instrument used in this study for data collection was the Electrochemistry Achievement Test (EAT). The internal consistency of the instrument was obtained as 0.81 using the Test Retest method to establish the reliability. Analysis of Covariance (ANCOVA) was used to test all hypotheses formulated at the 0.05 level of significance. The data were run with a Statistical Package For Social Sciences (SPSS 21.0) windows version.

Educational materials about electrochemistry in two classes (32 students) were presented as a lecture to the students by the researcher for 2 weeks during six 30-minute weekly sessions. Educational contents were simply presented through PowerPoint slides at each session. In the other group (35 students), educational materials were presented as a combination of lectures and e-learning method. In this group, in addition to teaching the content through lecture, other materials were uploaded onto computers in the computer lab as well as via e-mail. The students were also able to share their comments and questions on a what's app forum with the instructor and other students.

**Results**
The independent sample t-test was used to measure the mean score difference between achievement scores of the control and the treatment group on pre-test. Examination of Table 1 shows that there is no significant difference between the achievement pre-test scores of the experimental and control group. It means that both groups were on equal level of achievement before intervention. Thus the two groups were suitable for this study.

**Table 1: Independent-sample t-test comparing means of students' achievement pre-test scores**

| *Group* | *N* | *mean* | *St dev* | *df* | *t* | *P* |
|---|---|---|---|---|---|---|
| **Blended learning** | 35 | 38.95 | 3.32 | 65 | 0.47 | 0.672 |
| **Conventional instruction** | 32 | 38.58 | 3.13 | | | |

Independent-sample t-test was conducted in comparing the chemistry achievements post test scores of the two groups. The post-test mean scores of students' chemistry achievement for the experimental group taught by the blended learning approach was 74.98 (sd = 2.98), and that for the control group taught by the conventional teaching it was 48.84 (sd = 2.66). Table 2 shows that the mean for the experimental group was greater than that for the control group . The difference between these two post-test mean scores was significant t (65) = 38.13, $p < 0.05$ in favour of the experimental group, which revealed that the performance of experimental group was significantly better than control group. As such, blended learning positively affects students' chemistry achievement.

**Table 2: Independent-sample t-test comparing means of students' achievement post test scores**

| *Group* | *N* | *mean* | *St dev* | *df* | *t* | *P* |
|---|---|---|---|---|---|---|
| **Blended learning** | 35 | 74.98 | 2.98 | 65 | 38.13 | 0.000 |
| **Conventional instruction** | 32 | 48.84 | 2.66 | | | |

To test the hypothesis of no significant difference in the performance of students taught using blended learning technique and conventional method in chemistry, the covariance analysis technique was used. Table 3 indicates the results of covariance analysis of the impact of using blended learning on the educational performance of students.

***Table 3:*** **Result of ANCOVA analysis of the difference in the academic performance of students taught chemistry using blended learning strategy and those taught using conventional method**

| **Source** | **Type III Sum of Squares** | **df** | **Mean Square** | **F** | **Sig** |
|---|---|---|---|---|---|
| **Corrected model** | 5821.112 | 2 | 1961.107 | 43.204 | .000 |
| **Intercept** | 10427.021 | 1 | 10427.021 | 238.115 | .000 |
| **Pretest** | 2462.115 | 1 | 2462.115 | 52.317 | .000 |

| | | | | | |
|---|---|---|---|---|---|
| **Main Effect** | 894.867 | 1 | 894.867 | 20.223 | .000 |
| **Error** | 2993.402 | 64 | 42.324 | | |
| **Total** | 266230.000 | 67 | | | |
| **Correted total** | 8365.318 | 66 | | | |

The analysis of covariance presented in Table 3 shows that there is a significant difference in the performance of students taught with blended learning technique. Therefore, the hypothesis was rejected. Students taught with the blended learning method performed better than those taught with the conventional instruction method.

**Discussion of Findings**

This examination of the relative effect of using a blended versus a "traditional" approach to delivering course content in an ordinary-level chemistry class revealed that the performance of students taught using blended learning was higher than those taught using the traditional approach. The finding of the study showed that students gained better understanding of electrochemistry concepts using blended learning technique than with the conventional teaching strategy considering the fact that they had high mean achievement score as compared to their counterparts. This showed that blended learning facilitated students' understanding of the concept of electrochemistry.

This finding is in agreement with the findings of Kiviniemi (2104) who noted that implementing the blended learning approach leads to an increase in student learning as assessed by exam performance and overall course point totals and if well implemented blended learning approaches may have strong potential for improving student learning outcomes in health sciences courses. The finding is also in agreement with Sarabadani & Berenjian (2017) who demonstrated the positive role of blended learning and computer mediated teaching environment on student engagement and academic performance. Bridges, Chang, Chu & Gardner (2014) also found that the implementation of a blended learning teaching technique would improve students' learning.

The results of the present study on the application of the blended learning method in a unit of the Ordinary level chemistry curriculum was found to be a promising learning method to enhance the students learning desire and improving their learning outcomes.

**Conclusion**

Based on the research findings, it can be concluded that implementing blended learning has a significant role in academic performance of students and its application in schools could cause enthusiasm and improvement in students' academic performance and its use should be encouraged in schools. Since blended learning is becoming a predominant classroom component in many institutions of education to actively engage students in the learning process. There is therefore need of integrating online courses with face to face classroom settings in improving student's active learning in the secondary school.

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# QUALITY ASSURANCE OF TUTORIAL LETTERS IN AN ODL SETTING: THE SHIFT FROM HARDCOPY SUBMISSIONS TO ELECTRONIC SUBMISSIONS

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**Abstract**
Quality assurance in higher education is crucial for the maintenance of standards and the recognition of qualifications of an institution. Therefore, the quality assurance processes have to be executed well in order to avoid any compromise of standards and procedures. The purpose of this paper is to report on the procedures of submitting and quality assuring Tutorial Letters 101 (TUT101s) in the Higher Certificate (HC) programme of the Department of Adult Education (ABET). The submission and quality assurance procedures of ten modules of the HC programme were observed over a period of two years, during which the submission procedures for purposes of quality assurance of these TUT101s shifted from hard copy, paper submission to electronic submission. The logistical implications of the shift were investigated. The primary lecturers and the members of the Quality Assurance Committee (the quality assurers) participated in this study. Semi-structured interviews, observation and document analysis were used to collect data. The primary lecturers and the quality assurers were interviewed; and the documents used to record the submissions TUT101s, the reports of the quality assurers and the distribution lists were carefully studied. The reactions of the participants as they performed their duties were observed over a period of time. It was found that the shift from hard copy submissions of TUT101s to electronic submissions eliminated a number of technical problems such as spelling mistakes, lack of space for comments and unclear recommendations. The shift also eliminated a number of time-consuming activities such as printing, hand deliveries and compilation of submission lists. In addition, the costs of producing TUT101s were reduced, quality assurance improved, the time taken to correct and finalise these documents also improved, and the late submissions of TUT101s was dramatically reduced. It is recommended that the electronic submission of documents be investigated further before it is fully implemented.

**Keywords**: Quality assurance, Open Distance Learning, Adult Education, Higher Certificate, Electronic submissions.

## INTRODUCTION

Quality assurance is a system that is used not only to enhance the quality of education, but also to ensure that the system of education does not deteriorate (Shin, 2018).Quality requires that processes are put in place by all stakeholders to ensure its realisation. In an open distance setting the delivery of learning material needs to be done extremely well, in order to do away with the negative perception that courses offered at a distance are inferior to those provided through the conventional face-to-face teaching mode. Shah and Do (2017) state that quality

assurance has to be tightened to avoid negative criticisms and a lack of recognition of an institution's qualifications. In order to erase the wrong perception among some sections of the public, right from the conceptualisation to the writing of study materials certain standards should be met to ensure that the material that goes out to students is of a better quality. Shah and Do (2017) view quality as the centre stage of the academic project in an open distance environment, and that all managers in an institution should be the 'watch dogs' of quality courses to avoid embarrassment to the university and its image.

Quality assurance in open distance education is the bedrock of the institution's offering and image. It helps to clarify instructions and content for distant students; ensures that the quality of document going to students meets standards laid down by the institution (Shin, 2018). This paper reports on the procedures for ensuring quality of Tutorial Letters 101 in the Higher Certificate (HC) programme offered by the Department of Adult Basic Education and Training (ABET), at the University of South Africa (UNISA), particularly the shift from paper submission to electronic submission. The procedures and processes of quality assurance for all the ten modules of the Higher Certificate programme were observed and studied for two years. The researchers critically studied adherence to deadlines, submission procedures of both hard copies and electronic submissions of Tutorial Letters 101. Observation and document analysis were used as tools for data collection in the study.

## THE CONTEXT OF THE STUDY

The University of South Africa is an open distance educational institution. This study was undertaken in ABET, one of the ten departments in the College of Education. The study was conducted in this particular department because of the large number of students. For instance, in the 2018 academic year the ABET department has enrolled over 100,000 students. The department also has 58 active modules which are taught mostly by emerging academics. The ABET Department has 24 permanently appointed lecturers, and four fixed-term contract appointments. It is for this reason that quality assurance becomes crucial in the development of study materials. Quality assurance in the department is the responsibility of the Quality Assurance Committee (QAC), which comprises 14 members. The members of the committee are often allocated modules to quality assure, with each member handling three or four modules. The QAC members use a checklist to quality assure the TUT101s. When the hard copies of the TUT101s were used, the distribution of these hard copies was as follows: The primary lecturers, after designing TUT101s, printed the TUT101s and physically submitted them to Programme Mangers (PM). The Programme Manager compiled a list of all the TUT101s submitted to him, perused them and submitted them to the Chairperson of the QAC. The Chairperson would then distribute the TUT101s among the members of the quality assurance committee for quality assurance. The committee members would quality assure the hardcopies of TUT101s, by making notes on the document in a red or green pen; and return them to the Chairperson with comments, suggestions and recommendations for improvements. After receiving the documents the chairperson of the quality assurance committee would return the quality assured TUT101s to the Programme Managers, who would, in turn, return them to the primary lecturers for corrections. On completing the amendments to the tutorial letters the primary lecturers would electronically submit the TUT101s to the secretary, who would format and upload them onto myUnisa.

The abovementioned process of handling the TUT101s was changed from hard copies to electronic copies. The primary lecturers designed the TUT101s, then submitted them electronically to the QAC member responsible for quality assuring the TUT101 in question. The QAC member would quality assure the TUT101 and send it back to the primary lecturer, with comments, suggestions and recommendations for improvements. Once the recommended changes were effected, the primary lecturer would electronically submit the TUT101s to the secretary, who would format and upload it onto myUnisa.

## THEORETICAL FRAMEWORK

This paper is grounded in the stakeholder participation theory of Freeman (Freeman, 1984). The theory asserts that all people, be they individuals or groups, with specific vested interest in an organisation are called stakeholders. These are people who affect or are affected by the organisation (Mansell, 2013). Stakeholders are individuals or group of people who have direct or indirect impact on an organisation. They are the people who patronise or ensure the success of the organisation. Freeman (1984) intimates that without the support of stakeholders an organisation would cease to exist. Stakeholders, as the theory posits, include employers, employees, shareholders, clients, suppliers, clients, communities served by the organisation (Phillips, 2003). As individuals or group of people who have a stake in the organisation they actively get involved by working as a team for the success or achievement of the goals of the organisation. When all stakeholders work together roles are shared and expertise put the service of the organisation and this can maximize the organisation's productivity or service to its clients. As people who matter in the organisation, stakeholders have a say in its activities and management. Indeed organizations are dependent on their stakeholders for their successes or failures (Phillips, 2003).

The theory mentions two types of stakeholders; these are primary and secondary. The actors or people who are involved at the production level are the organisation's primary stakeholders. The organisation's clients or the broader community it serves are regarded as its secondary stakeholders. These may include suppliers, consumers, customers, communities, parents, students and the taxpayer. Thus for any organisation to achieve its goals it must ensure that major stakeholders are involved in its activities or are satisfactorily served. The theory focuses on management approaches that emphasize the importance of stakeholders when making leadership decisions (Freeman, 1984). It adheres to the principle of what or who really counts in any organisation (Mansell, 2013) be they business or educational institutions.

The theory has implications for quality assurance in the development of study materials for distance education environment. In developing study materials for distance education students both the lecturers and the institution must ensure that all important role players such as the quality assurance committees at the department, college and institutional level are involved and the best interest of the clients- students, the public and the department of education are taken into consideration. Needs analysis must be conducted to understand who the students are, where they live and their background so that appropriate language is used in writing the study materials to ease comprehension and to avoid ambiguities in the wording of instructions to assignments or learning tasks. The collaboration with all stakeholders can create the sense of common ownership among the major role players and also ensure quality in the materials sent out to students.

## RESEARCH DESIGN

### Methodology

Semi-structured interviews, observation and document analysis were used in this study. Semi-structured interviews were appropriate for the study since they allow probing, which enables the participants to express their experiences, feelings, and observations (McMillan & Schumacher, 2010). The views of the participants, as people who have first-hand experience of the changes, are very important to the study, and the semi-structured interviews adequately enabled this process.

Observation is a systematic data collection approach in which researchers use all of their senses to examine people in natural settings or naturally occurring situations (Smart, Peggs & Burridge, 2013). As senior academics in the department the researchers used participant observation to get in-depth information for the study. In participant observation the researchers do not observe the experiences of the individuals as detached outsiders, but experience them first-hand as insiders (Welman, Kruger & Mitchell, 2006). In this study naturalistic observation was used. Naturalistic observation involves studying the spontaneous behaviour of participants in natural surroundings (Smart et al., 2013). Naturalistic implies the minimising of the pre-suppositions with which the researcher approaches the phenomenon under study as well as a close and searching description of the mundane details of everyday life (Smart et al., 2013). The researchers simply record what they see in whatever way they can record it. Since observation involves prolonged engagement in a setting or social situation the researchers were able to observe the reactions, changes and other behaviours of the participants over a period of time, and in their normal way of engaging in their work of compiling, typing and submission of the TUT101s.

Document analysis means interpreting documents in order to give voice and meaning around a topic (Bowen, 2009). Analysing documents involves coding content into themes. The researcher can create codes for conditions in the field notes to make the analysis manageable (Welman et al., 2006). In this study, certain themes were formulated, and TUT101s were analysed in relation to the identified themes.

### Participants

The lecturers who were involved with the Higher Certificate modules and the Quality Assurance Committee members participated in this study. Three lecturers and three QAC members were selected for the study. The sampling technique was purposive since only Higher Certificate lecturers and quality assurers who had been involved with lecturing and quality assurance in the Higher Certificate programme for at least two years, and who participated in both the hard copy and electronic preparation of TUT101s were selected. The reason for selecting lecturers who had a minimum of two years in lecturing was that these lecturers had already mastered the processes of preparing TUT101s, and it was easier for them to compare the hard copy and electronic submission procedures. Consequently, their responses were rich and informative. Of the six participants, four were male and two were female. Each of the participants had been employed in the ABET department for more than five years. Their ages ranged between 45 and 57 year.

**Data collection**

Appointments were made with the participants for purposes of conducting the semi-structured interviews. The interviews took place in one researcher's office. The office was selected due to its size and availability of extra chairs and tables. Each interview session took about 30 minutes, and included probing, in order to obtain clarity. The documents that were analysed included the distribution lists, electronic and hard copies of TUT101s, the minutes of the QAC and the reports of the quality assurers. A naturalistic observation, which is unstructured observation, was also used. The behaviour of participants was studied in their natural surroundings, meaning that the reactions of the lecturers and quality assurers were closely observed during the normal process of carrying out their duties (Smart et al., 2013). Notes were taken and the process continued for a period of two years.

**Data analysis**

The data collected through the semi-structured interviews was analysed by studying the responses carefully while making notes, coding, determining patterns from the codes, determining themes and delineating predominant themes and evaluating the extent to which they responded to the research question (Welman et al., 2006).

Document analysis requires that data be examined and interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge (Corbin & Strauss, 2008; Rapley, 2007). Document analysis yields data—excerpts, quotations, or entire passages—that are then organised into major themes, categories, and case examples specifically through content analysis (Browen, 2009). In this study the documents were analysed and organised into themes; these themes were considered in relation to the themes emerging from the semi-structured interviews.

The observational notes were very helpful in the analysis of data, since the observed reactions helped to confirm the emerging themes – by providing additional information and perspectives which could not be obtained through the interviews and document analysis.

## RESULTS

**Results of the semi-structured interviews**

The interview schedule was as follows:

1. Which of the two systems of quality assurance is preferable to you?
2. How has the preferred system made your work easier?
3. How has the less preferred system made your work difficult?
4. What is the impact of the shift on your work?
5. What improvements have you noted since the shift?

With regard to which system was preferred, all participants preferred the electronic submissions. One participants said, *"I prefer the electronic system since it is easier to work with".*

The participants reported that the electronic system has made their work easier since it involved no moving out of office to print and submit, and provided more time to work on the TUT101s. One participant said, *"I am relieved from the ever present printing problems*". The other participant said, *"The hard copies were very difficult to work with due to lack of space for comments".*

The hard copy system was the less preferred system and the participants reported that walking, the printing process and the time involved in walking and printing made their work very difficult. One participant "*We spent a lot of time in the printing venue*".
The participants reported that the shift from hard copies to electronic copies had a positive impact in their work, since they stressed less about TUT101s, and actually enjoyed preparing these documents. One participant said, *"I enjoy preparing Tutorial letters as they no longer involve the tedious process of printing".* The other said, *"Evaluating the Tutorial Letters is fun as your work is in the computer system, and no longer working with paper"*.
The participants reported that the shift from hard copies to electronic copies improved the quality of their work, since it was easier to take time and do the right thing. One participant said*, "I no longer work under pressure as I have adequate time to work on the document*". Another participant said, "*I see my comments have become more complete and I can review them and change them as I wish – which was difficult with hard copies".*

**Results of document analysis**

The following documents were analysed:

***Distribution lists*:** With the hardcopy submissions, the distribution lists indicated who quality assured which Tutorial letter, when it was taken, when it was returned to the QAC Chairperson, and when it was returned to the Programme Manager – all with signatures and dates.
With the electronic submissions, there was no need for all the dates and signatures. An electronic copy of the distribution list was sent to lecturers for them to know who was responsible for quality assuring their Tutorial Letter 101. Then lecturers directly emailed the Tutorial Letters to the relevant quality assurer.

***Hard copies of TUT101s*:** The hard copies of TUT101s analysed had handwritten remarks or comments from the quality assurers – all squeezed into small spaces. Some comments were too brief to make sense – due to lack of adequate space for comments. The documents were untidy.

***Electronic copies of TUT101s*:** The electronic copies of TUT101s were neat, with comments in different colours. There was adequate space for comments, thus making all comments clear and complete.

***Minutes of the QAC during hardcopy submissions*:** These minutes included discussions around the submission processes, such as when to submit to the Programme Manager, how to submit, how to compile a list of lecturers as they submitted and how the Programme Manager submitted these TUT101s to the QAC Chairperson.

***Minutes of the QAC during electronic copy submissions*:** The discussions in these minutes were around ensuring lecturers checked the electronic and emailed their TUT101s to the relevant quality assurer and by when these should be submitted, quality assured and emailed back to the lecturer.

***Reports of the quality assurers during hard copy submissions*:** The quality assurers' reports included complaints about late submissions, poorly prepared documents, cut-and-paste from previous documents and lecturers not adhering to comments or recommendations.

***Reports of the quality assurers during electronic copy submissions*:** These reports were more on the quality of the TUT101s such as typing problems, clarity of instructions and questions in the assignments, as well as the format of the document.

**Results of observation**

The observations were classified under the following subheadings:

***Meeting due dates*:** There was significant improvement in meeting due dates among lecturers.
***Mistakes on documents*:** An average of 5 mistakes per TUT101s were noted with hard copy submissions, while an average of 2 mistakes per TUT101s were noted with the electronic submissions.
***Rush*:** The work was done under rush since too many activities were involved in hardcopy submissions. These activities included walking to the printing venue, printing and walking to the Programme Managers' office to hand over the documents. All these processes were time-consuming. The situation was worse if printers were broken.
***Quality of the TUT101s*:** The quality of the TUT101s improved since lecturers had more time to spend on the document – as compared to the era of hard copy submission.
***Printing problems*:** During hard copy submissions most of the time printers were not functional, but the electronic submissions eliminated these printing problems.
***Time taken to do quality assurance*:** The QAC members quickly worked on the documents and sent them back to the lecturer, thus improving the time taken to do quality assurance of the document and to give feedback.
***Quality of quality assurance*:** The quality of quality assuring improved, since more time was available for quality assurance, and more space was available for making clear comments.
***Paper usage***: The saving in the usage of paper was noted.

## DISCUSSION

The shift from the hard copy submission of TUT101 to electronic submissions had a positive impact on the process of quality assuring these documents. Specifically, the removal of the printing process brought about a lot of improvement in the processes of submissions and quality assuring theTUT101s. The printing process can only happen when the lecturer is on campus – unlike electronic submission which can be done at any time when the lecturer is done with the compilation of the TUT101.The printing process is frustrating due to the continuous failure of the printing machines: the toner needs to be replaced, the paper has jammed in the machine, some printing work was not completed and your paper is used to complete the outstanding printing work, and the printer is off-line. In addition, the document may shift during the printing (sometimes due to the incompatibility of margin settings between the computer and the printer).These problems were minimised with the electronic documents. Moreover the spell check programme of the computer helps the lecturer to immediately realise incorrect words, sentence constructions and fonts.
The TUT101 is a fairly elaborative document which requires a lot of time to complete. It also requires references to a number of documents and policies, such as the assessment plan, the syllabus, the prescribed books, the reference techniques and the assignment and examination structures. Hence the document has to be checked several times before it is finalised. The printing process was an unnecessary time-wasting addition to these processes.
The electronic submissions saved a lot of time for staff members, since they no longer had to spend time on printing and physically delivering the hard copies to the various offices. For instance, the lecturer delivered to the programme managers; who, in turn, compiled a list of TUT101s submitted and physically delivered, to the office of chairperson of the QAC, who also followed the distribution list and delivered to the various members of the QAC. In terms of numbers, the physical deliveries implied that the lecturer had to deliver to two or three programme managers, the quality assurer had to deliver to four lecturers, and the QAC chairperson to 15 members of the QAC. The delivery process implied making several trips to some offices since not always would all people be in their offices when deliveries were done.

To avoid not finding people in their offices, one would have to make time and call all members of staff to be delivered to – a process that could also add more time to the delivery time. The physical deliveries already wasted time, and this could be worse if other colleagues stopped the messenger along the corridors and engaged them on some topic (which may not even be related to the work at hand).

The quality of TUT101s and that of quality assurance also improved dramatically. While during the hard copy submissions a number of mistakes and shortcomings were noted, the electronic submissions had fewer mistakes and shortcomings. This could have been due to the fact that the removal of the printing and delivery processes made more time available for focusing on the document. Because the document is sent in a word format, the quality assurer may make adequate space for comments – which was difficult with hard copies since comments had to be brief and squeezed between lines, thus making some of the comments confusing and illegible. In addition, the time taken to quality assurance process no longer took a long time – since the quality assurer avoids clogging their computer memory (space) with these documents. When the hard copies were used, the quality assurers took longer with TUT101s – probably because it was easy to postpone working on the documents. Therefore, feedback and further processing of the TUT101s was stalled.

While the shift to electronic submissions saved time and improved quality, it also saved resources, especially the use of printing paper. The quantity of printing paper used by each staff member was less than when the hard copy submissions were done. The implication is that the need for other resources related to printing, such as the printing machines, the toners, the maintenance costs and labour was also reduced.

## CONCLUSION

The study set out to emphasis the importance and processes of quality assurances of study materials in an Open Distance Learning context. The study found that the shift from hard copy submissions of TUT101s to electronic submission brought about a great relief among lecturers since it reduced the time, costs and anxiety related to the physical management of these documents. The members of the QAC also reported that the electronic submissions made their work lighter and allowed them direct communication with the primary lecturers. Therefore, the electronic submissions of TUT101s and the accompanying relief could be a confirmation that technological developments may play a major role in improving quality assurance in institutions of higher learning.

## RECOMMENDATION

Based on the findings from the study, the electronic submissions seemed to have more advantages than the hard copy submissions. It is recommended that the electronic submission of documents be investigated – in order to determine its sustainability and the extent to which it can improve quality assurance in an ODeL setting.

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# INCREASED STUDENT INTAKE, REDUCED FUNDING, HOW SHOULD ENGINEERING DEPARTMENTS REACT? A CASE STUDY ON THE IMPLEMENTATION OF A REMOTE LAB PLATFORM

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**Abstract**
The Department of Electrical Engineering at the Central University of Technology (CUT), Free State, South Africa has seen phenomenal growth in class sizes over the last few years without a corresponding increase in funding, raising pedagogical concerns pertaining to student access to practical exercises. The traditional practical class is proving inadequate, as the students must work in large groups for limited periods of time leading to compromising the quality of the practical work. The paper presents a program effects case study approach on the application of a remote laboratory in the department, for the delivery of the practical component of electrical protection courses. A blended learning theoretical framework guides the study in highlighting that the remote lab can deliver better effective practical experience to large classes, at reduced cost. To collect data, an online close-ended survey which uses a questionnaire as a data collection tool was used. The results indicate that the remote lab strategy creates a learning environment that seamlessly integrates the theoretical and practical components of a course. In addition, the strategy supports pre- and post-laboratory work, enabling students to engage more with the course content which has led to a better cognitive understanding of electrical protection principles and concepts.

**Keywords:** Engineering education, remote laboratory, online practical class, blended learning

## 1. Introduction

It is generally accepted that engineering laboratories are essential for the educational experience (Feisel & Rosa, 2005). The practical work they offer enables students to achieve specific learning outcomes by aligning the learning processes with learning theories of constructivism, where the students are expected to learn from their observations and experiences (Corter et al., 2007) (Gravier, Fayolle, Bayard, Ates & Lardon, 2008). Institutions of higher learning have seen an increase in student intake (Grobler, 2013) resulting in phenomenal growths in class sizes for some programmes. This has led to students failing to get adequate access to the laboratory to perform practical work. Inaccessibility of the lab has compromised the quality of the practical work and impacting the students' appreciation of scientific concepts through experimentation (Melkonyan, Gampe, Pontu, Huang & Akopian, 2014).

Having noticed the limited availability of the traditional laboratory, an alternative approach for the delivery of laboratory work was needed, hence the establishment of an interactive remote lab that was meant to complement the traditional lab. Remote labs have been

successfully used in electrical engineering education in measurements and control systems laboratories (Sivakumar, Robertson, Artimy & Aslam, 2005). According to Salaheddin, Shatha and Mahasen (2015:33), a remote lab is 'a lab accessed via a communication network to execute a lab experiment, whose usage involves real devices and equipment. The lab server communicates between the user and the physical experiment in the lab'.

The obvious solution to the large class problem would be to increase the laboratory space, procure additional laboratory equipment and engage additional staff. However, these are costly measures considering funding from government is expected to decline in the future (Butler-Adam, 2015) and universities should open other streams of funding, such as contract research and other services to industry and the community. Hence, an alternative delivery model that can enhance the practical experience of many students without huge investments in space, equipment and staffing levels must be adopted to replace, or compliment, the traditional practical class.

## 2. Problem statement

The student enrolment in the Department of Electrical Engineering at CUT has increased significantly over the last few years without a corresponding increase in funding since higher education expenditure has been declining alarmingly per capita terms (Butler-Adam, 2015). This has created challenges regarding the delivery of practical exercises as the current practice of splitting the class into groups that perform the practical sessions within scheduled timeslots is proving inadequate – the groups are getting larger and the timeslots shorter, reducing accessibility and the practical experiences of the students. Under these conditions the students are deprived of the ability to apply theoretical knowledge to industrial knowledge. This has been evidenced in their laboratory performance and laboratory marks. Hence, an alternative delivery model that can enhance the practical experience of a large number of students without huge investments in space, equipment and staffing levels must be adopted to replace, or compliment, the traditional practical class.

## 3. Aims and objectives of the study

The main aim of the study presented in this paper was to investigate whether the remote laboratory is a catalyst for educational achievement as evidenced by the trend in their semester marks.

### 3.1 Objective

The main objective was to increase student participation and access to practical experiments for large classes with minimal staff effort.

The study explored three research questions:

1. Does the use of remote lab extend access for all students to lab facilities?
2. Does the remote lab improve student ability to understand course concepts as measured through course marks?

3. Is there a relationship between the remote lab learning environment and the final lab marks?

### 3.2 Hypothesis

The study is based on the following hypothesis: The remote lab instructional concept opens possibilities for increased access and student performance in practical work.

## 4. Literature review

### 4.1 Remote Labs Background

Recently, the rapid advances in a variety of technologies, including electrical engineering hardware and information and communication systems, have led to the adoption of the concept of a remote laboratory (Tawfik et al., 2013). The remote lab is being promoted as an alternative model that offers possible solutions to pedagogical issues relating to delivery of the practical experience to large classes and geographically dispersed students (Ionescu, Fabregas, Cristescu, Dormido, & De Keyser, 2013. In this study the remote lab is used to complement the traditional lab since distance education is not offered at CUT.

The remote lab is designed to provide real-time experiments with computer-controlled physical equipment to obtain real world experiences and results. Remote labs are in development and use at many universities worldwide (Gustavsson et al., 2009) (Tawfik et al., 2013), though no reference was found in the literature about such developments at institutions in the Republic of South Africa. This paper therefore also serves to promote the concept of the remote lab in South Africa.

There is active debate in the literature as to the effectiveness of the remote lab compared to the traditional laboratory (Ma & Nickerson, 2006). Some researchers have warned against preferring the remote lab over the traditional lab (Gadzhanov & Andrew, 2010), arguing that the remote lab cannot be a success in totality; hence some researchers have constantly looked for divergent strategies in the way the teaching of remote labs is conducted.

However, some studies such as (Sonnenwald, Whitton, & Maglaughlin, 2003) (Nickerson, Corter, Esche, & Chassapis, 2007 Ionescu et al., 2013) have shown that remote labs are comparable in effectiveness of learning outcomes to traditional laboratories. In essence, the remote lab is not meant to replace the traditional lab; in this view the remote lab can be more effective if it complements the traditional lab.

### 4.2 Rationale for remote labs

It should be noted that economic constraints are a major driver for the development of remote laboratories. So, a comparison between hands-on and remote labs may not be necessary, due to the fact that the remote lab concept is intended to fill a gap where experimentation would otherwise not be possible. Considering the high cost of equipment, diminishing funding and large student numbers, the intention of this study is to use both platforms to deliver acceptable practical experiences at minimum cost, as supported by Ionescu et al. (2013). Gadzhanov and Nafalski **(**2010: 162) further substantiate the above view by asserting that

remote labs are 'also flexible and not restricted in time and place, and inexpensive in terms of cost per student'.

This paper looks at the issue from the electrical engineering perspective and the interactive remote lab. Most advanced work in the laboratory or workplace today is mediated by computers. For example, the laptop has become an indispensable addition to the toolbox in the power utility industry and other fields. Hence, in the context of an electrical protection experiment, the difference between experimenting through software while sitting at a computer on-site and sitting at a computer remote from the lab and observing the lab via graphical user interfaces (GUI), may just be the psychological sense of physical presence in the lab, as argued by the authors in (Ma & Nickerson, 2006).

The remote-lab concept is already widely used in industries such as robotic control in manufacturing and supervisory control and data acquisition (SCADA) systems in the electric power industry. Hence, the remote lab is part of the real world and simply introduces the students to modern industry practices in preparation for the workplace.

The remote lab has potential for availability to support pre- and post-laboratory work, and the possibility to repeat the lab session where necessary, which is generally not possible with the traditional lab, leading to better cognitive understanding (Ionescu et al., 2013). The students also have the flexibility to form groups and access the lab at suitable times of their choosing within a specified period, and may experiment or explore without the constraints of the traditional lab which helps improve student motivation (Gustavsson et al., 2009). Using group work, students can take charge of their learning and collaborate and solve engineering related problems through teamwork. Problem solving and teamwork are essential graduate attributes mandated by the International Engineering Alliance (2013).

According to (Maiti & Tripathy, 2013) the remote lab makes it possible for the instructor to effectively manage a large group of students with varying abilities and interests, and ensure student engagement and participation in the laboratory work. This is achieved by designing a remote lab strategy that is aligned with the core learning objectives of laboratory work and the experimental content must engage the students actively to achieve the learning outcomes (Corter et al., 2007) (Gravier, Fayolle, Bayard, Ates & Lardon, 2008).

## 5. Theoretical Framework

The study uses the blended learning technique as a theoretical framing. The remote lab concept is used as a conceptual model of blended learning. "Blended learning is the technique where traditional lessons are mixed with virtual, remote, and/or e-learning (or distance) lessons. This kind of scenario offers several advantages that are not commonly available in traditional lessons", (Schaf, Pereira & Henriques, 2008:43). Similarly (Bonk & Graham, 2006) assert that blended learning is a system that combines face-to-face and computer-mediated instruction. In other words, the educator firstly delivers a well-structured introductory theoretical lesson which is then complemented by follow-up materials online (Kirschner, Clark and Sweller, 2006).

Blended learning complemented the remote interactive lab in that after introductory lecture the students are now able to learn in a method customized to their needs whereby they control

the pacing and time. Additionally, in using the blended learning approach there is a chance of increased access at the same time creating an interactive learning community on the *Blackboard* platform. Blended learning gives a new perspective on pedagogy in disciplines like engineering.

## 6. Research design

This study uses a program effects case study approach (Mann, 2006) and this type of case study approach is used to determine the effects of specific programs, whether the programs are failing or succeeding and why (Hayes, Kyer & Weber, 2015). The rationale for selecting the program effects case study is because it correlates with the aims of this research to check on the effects of the interactive lab. The study used an online survey which uses a questionnaire as a data collection technique hence it contains elements of quantitative research. The questionnaires were distributed via *Blackboard*. Practical test results were also used as past results stretching over a period of 6 years from 2012 to 2017 were used to compare the student's achievement pattern in addition to confirming and supporting the findings from distributed questionnaires. The questionnaire was valid in that it enabled students to respond objectively to what the research was investigating, in addition two different groups responded to the same questionnaire and the responses seemed similar in a way. However, a different instrument could have given an in-depth study to the topic underhand whereby students could have given their experiences through narratives or interviews rather than just respond to predetermined questions.

### 6.1 Sampling

The target population for the whole study included all students registered for the Electrical Protection IV module during the first semester over the period (2012-2017). For mark analysis the population included 540 students (2012-2017). For the survey (2016-2017), 166 students were conveniently sampled and only 123 responded. In 2016, 84 students were sample and in 2017, 82 students were sampled. Students were given consent forms and were asked to participate voluntarily. However, of the 84 students (2016), only 58 could voluntarily respond and (2017) 65 responded.

### 6.2 Data collection

An online survey close ended questionnaire was implemented (Cohen et al., 2011) to determine student feedback on the usefulness and effectiveness of the remote lab. A total of 166 questionnaires were distributed and participants responded as a once-off at the end of semesters (2016 and 2017.) The reason for heaving a 2 year gap survey was to enable generalisation on findings and to prevent prejudice of dealing with just one group. Of the questionnaires distributed (123) were returned. Practical test results were also used as part of data collection. The practical test results stretching over a period of 6 years from 2012 to 2017 were used to compare the pattern and statistical achievement. Anonymity was ensured by not requesting any personal student data. Raw data collected was statistically presented.

## 7. Laboratory design and procedure

The architecture of the lab model developed is shown in Figure 1 (Manditereza & Swart, 2015).

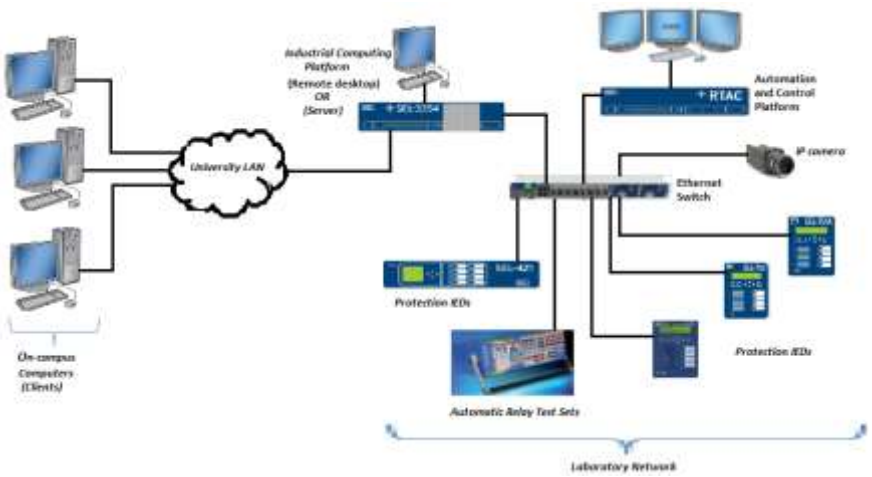


Figure 1: Architecture of the developed remote laboratory

The Ethernet-based network architecture of the laboratory provided the opportunity to expand the boundaries of the lab to include any computer on the university's intranet. This was achieved by simply linking the lab to the already existing university local area network (LAN). The Information and Communication Technology (ICT) infrastructure of the university allows for wired or wireless connection to the lab. This development effectively transformed the lab into a remote lab platform providing all the functionality of the lab, from a remote location. A webcam was added to stream live video footage that enables students to observe the Intelligent Electronic Devises (IEDs) in real-time, making the remote lab platform more realistic.

## 8. Remote interactive lab teaching strategy

The remote lab is intended to supplement short comings in the traditional lab approach where experimentation would otherwise not be possible, because of expensive equipment and large student numbers. Both platforms (hands-on and remote) are used to deliver the practical component of the Electrical Protection IV course in the department.

The laboratory work consists of two practicals that are done hands-on in the traditional lab. Three other practicals are given over the remote platform. The hands-on lab experiments are conducted during scheduled lab sessions, but the remote lab platform can be accessed at any suitable time. For effectiveness, the laboratory exercises are designed to adhere to constructive alignment, where the exercises or tasks are aligned to the expected learning outcomes (Corter, Nickerson, Esche, Chassapis, Im, & Ma, 2007; Gravier, Fayolle, Bayard, Ates, & Lardon, 2008).

Information relevant to the experiments, such as the laboratory guide, is posted on the Blackboard e-learning platform for ease of reference by the students. A discussion forum has also been set up on Blackboard, called eThuto at CUT, for the students to share experiences and to act as a platform for the instructor to provide feedback or instructions on problems or issues that may be impacting the smooth execution of the experiments.

In preparation for the labs on the remote platform, the students are required to complete an online pre-lab on eThuto, based on preparatory information in the laboratory guide. To enhance preparedness, the experiment is introduced during a normal class session where the

experimental tasks and functionality of the test equipment are demonstrated live online with the remote lab.

## 9. Results and discussion

The remote lab platform has now been in use for four semesters (duration of 12 weeks each) over a four-year period (2014-2017), during which improvements were made to the quality and delivery of the exercises and the instruction material. The researchers looked at the lab marks from 2012 to 2017, and noticed an upward trend from 2015. In 2016 and 2017 two different groups taught by the same lecturer were given once-off standardised online questionnaires at the end of each semester.

### 9.1 Questionnaire analysis

At the end of each semester of 2016 and 2017, the students were asked to give their feedback or perceptions on the achievement of learning outcomes of laboratory work based on their experiences of both the hands-on and remote lab platforms. The main aim was to determine if students were benefiting from the remote lab platform through increased accessibility, and to statistically determine students' opinion on the usability of the lab in the context of the expected learning outcomes. A five-point Lickert-scale was used with answers ranging from "Strongly Disagree" to "Strongly Agree". The expected learning outcomes are listed in Table 1 with the corresponding answers of the sample (n = 123) shown in Figures (2-3).

Table 1: Learning outcomes (LO) of laboratory work

| S/No | The student should be able to: |
|---|---|
| LO1 | Interpret experimental results |
| LO2 | Gain laboratory skills in performing experiments |
| LO3 | Enhance understanding of the theory |
| LO4 | Apply knowledge and skills in unfamiliar situations |
| LO5 | Design alternative test procedure |
| LO6 | Give clear verbal description of an experiment |
| LO7 | Solve electrical protection problems |
| LO8 | Motivate teamwork |

The reason for conducting a survey from 2016-2017 was to control issues of prejudice towards the remote lab. As can be seen from Figures (2-3), more than 90% of the students perceived both delivery modes of the laboratory work as effective in enhancing the interpretation of experimental results and understanding of theory. This could be attributed to the careful design of the remote lab pedagogical strategy that is aligned with the core learning objectives of laboratory work, making the remote platform just as effective as the traditional hands-on lab.

However, only 71% of the students found the remote lab effective in gaining laboratory skills compared to 81% for the traditional lab. This is because the students do not actually perform

the connections of the experimental circuits since it is done by the lab instructor. However, the remote platform scores higher with more students favouring the platform for promoting enhanced teamwork, solving electrical protection problems and applying knowledge and skills in unfamiliar situations. This may be attributed to the fact that, using the remote lab, the students have some flexibility and are able to explore as a team without the constraints of the traditional lab.

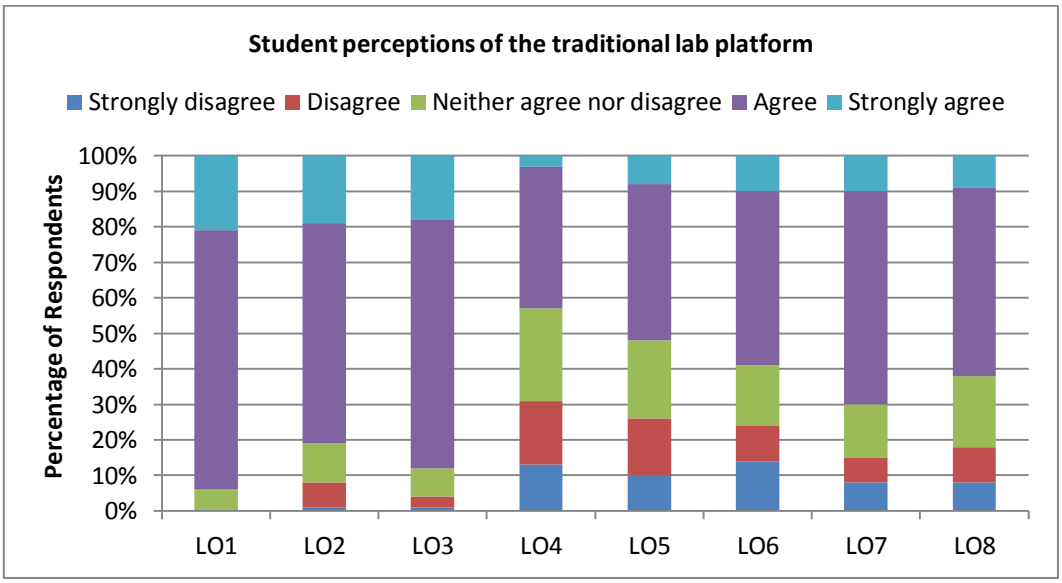


Figure 2: Students' perceptions on the effectiveness of the traditional laboratory

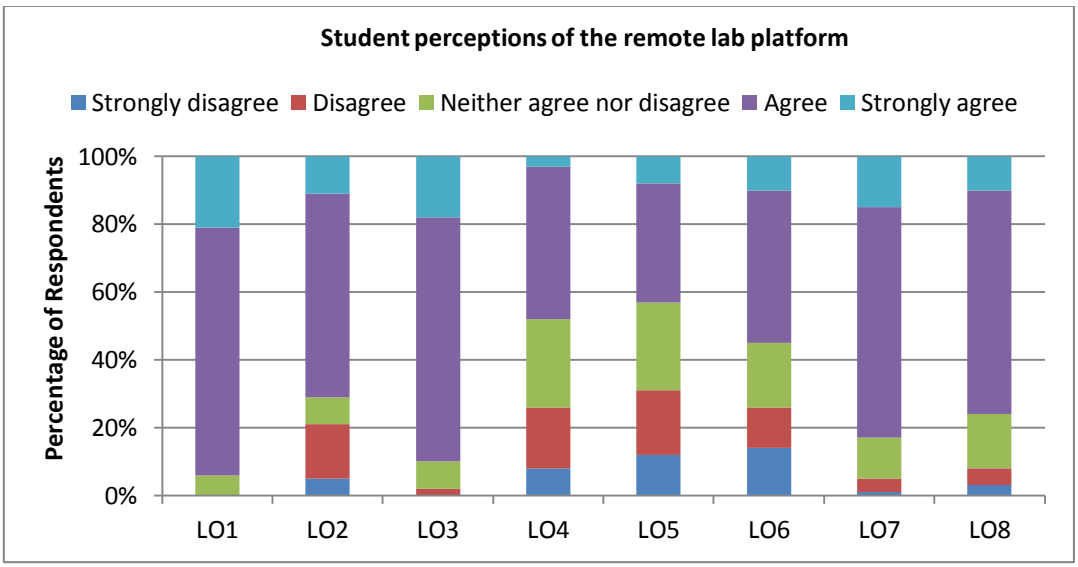


Figure 3: Students' perceptions on the effectiveness of the traditional laboratory

The majority of students expressed great interest in the remote lab and, based on the generated opinions, the remote lab has been accepted as an effective learning tool. However,

the consensus among the students is that both delivery platforms must be used as they are complementary. Using the traditional approach, the students can sit in the lab for hands-on work where they become familiar with most basic instruments and the wiring and connection of circuits. Basic circuit wiring is no longer an objective of the labs later in the semester; these higher-level experiments may then be done on the remote lab platform. The preparatory work of connecting the circuits for the remote lab can be done by the lab instructor without compromising the objectives of these higher-level experiments.

## 9.2 Practical mark analysis

To determine the impact of the remote lab on the content knowledge of the students, the scores from the practical tests over the six-year period (2012-2017) were used. The practical test consists of one question from each of 5 laboratory practicals and is given under examination conditions reducing the likelihood of copying other students' work. The first 2 practicals use the hands-on approach. Practicals 3 to 5 use the remote lab platform as from 2014. The average scores of each question (or practical), expressed as a percentage, are shown in Figure 4 over the period 2012-2017.

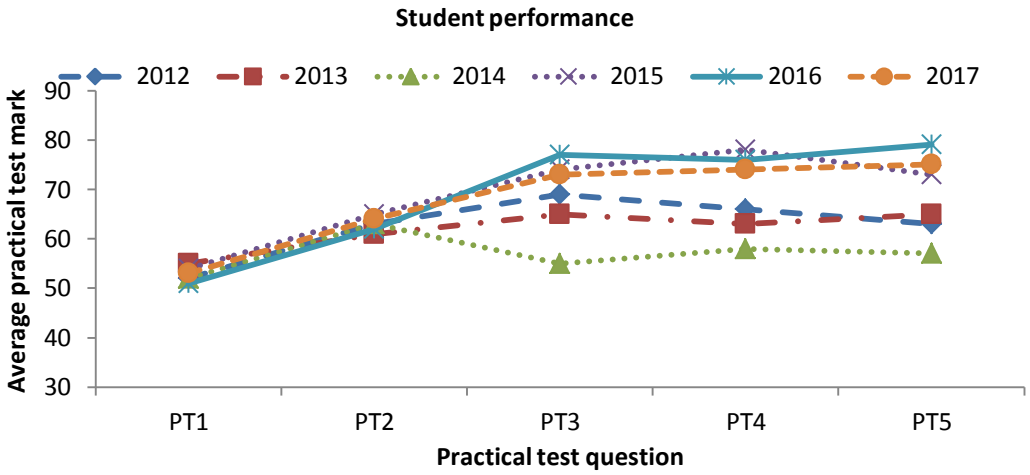


Figure 4: Students' practical test average marks over the period 2012-2017

Analysis of the performance results shows that there was a significant decrease in performance in the first offering of the remote lab platform (2014), but the scores increased in the subsequent years, showing a significant improvement in those practicals that run on the remote platform. This is therefore attributed to an improvement in the design of the remote lab pedagogical strategy which blended the traditional lab approach. Additionally, the remote platform has the added advantage that the students can repeat the lab session where necessary to enhance understanding. In addition to being complementary to traditional lab this is evidenced by a rise in marks as statically presented.

The fact that the students have been taught by the same lecturer from 2012 up to the present moment may validate the improvement in practical test marks. In addition, improvement may also be due to the fact that the remote lab platform seamlessly integrates the theoretical and practical components of the course; when the remote lab is accessed from the classroom, the students are able to compare calculated results and the real results derived through the remote

lab thereby developing an awareness of the limitations of conventional theory and the approximations used in theoretical problem solving. This study cannot entirely say mark improvement may be due to the remote lab. However, our stance sees the remote lab as a higher possibility since learners questionnaires proved students' satisfaction in improved accessibility that also allowed students to engage collectively with their peers, learning from each other.

## 10. Conclusion

This study asserts that the implementation of the remote lab platform was a success because the remote lab allows the students to customize their learning needs since they have control over the pacing of the experiments, the time spent, and the access to the lab. The improved pedagogy and increased access ultimately leads to achievement of an active learning environment which improves learning and performance, at reduced cost to the department.

The results of student perceptions presented in this paper have shown that the remote lab can positively impact on the learning experience of students in large classes, and should be implemented in all fields of study, supported by well-structured sets of learning outcomes and activities necessary to achieve the specified outcomes. The remote lab motivates students to learn by allowing them to observe and experience the underlying concepts from a real-life perspective, essentially bridging the gap between the concepts and their real-life effects. However, student perceptions alone do not necessarily give a measure of the learning that has taken place or whether the educational technology has contributed to enhanced achievement of learning outcomes. The results of the practical test marks show an improvement in actual academic achievement of the students following introduction of the remote lab. However, further research is required to establish the actual contribution of the remote lab and finding ways of ensuring that students' work is authentic.

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# E-TUTOR PROGRAMME: A MODEL FOR STUDENT SUPPORT IN OPEN DISTANCE AND E-LEARNING ENVIRONMENT

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**Abstract**
The increasing Open Distance Learning institutions as well as online courses offered demand more support to students. One of South Africa's prominent Open Distance Learning institution is in the transition state - transforming from traditional to e-Learning. For this reason, the institution has advanced student support and has incorporated the services of online tutors, known as e-tutors to support its students worldwide. We argue in this article that student support in Open Distance and e-Learning environment cannot succeed without the involvement of e-tutors with technological pedagogical content knowledge. Furthermore, we believe e Tutor-student support reinforces the student's sense of confidence, self-esteem and progress in distance learning. Given these arguments, students support in open distance and e-learning institutions remains a challenge. This article reports on the results of a study designed to investigate whether e-tutors are capable to offer adequate support to students in open distance and e-learning environment. Using TPACK frameworks, this article employed a mixed method approach to collect and analyse data. A purposeful convenient sampling strategy assisted in the selection of 24 e-tutors in the field of Mathematics, Science and Technology Education employed to support students in Open and Distance e-Learning environment. The results indicate that the e-tutors are strong in content knowledge but low in both pedagogical and technological knowledge. The article concludes that e-tutors need professional development that will enhance them to select and use relevant online tools to deliver online courses and support students online. We acknowledge that the study used a small sample that could not allow the generalizability of the results to the entire institution population. The article suggests further research in the same field to compare the given results.

**Keywords:** e-tutor programme; e-tutor, student support; open and distance learning, eLearning

## INTRODUCTION

Improvements in the teaching of education courses (mathematics, science, technology) with information technology have defied even the most resolute policy initiatives, curriculum changes and professional development interventions in many countries including South Africa. One of the largest Open Distance Learning universities in South Africa is confronted with challenges on the use of information technology in the contemporary world, especially since it employs the e-tutor system to support their students (Pitsoane, Mahlo & Lethole, 2015). Student support is an essential element of every successful learning institution. One of the famous experts in the field of international open and distance learning (ODL), Alan Tait noted student support. Tait (2003a) writes

> "students want support, student support, especially student guidance and counselling, tutor support, and effective information and administrative systems all provide a range of activity that impacts 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).

Croft (1991) shares the sentiment with Tait and denotes the most support services student wants as to help them realize the instructional objective of the course by minimizing the negative effects of isolation and the lack of regular personal contact.

In light of the above the University of South Africa (UNISA) is concerned about student support and has put in place e-tutor program as a model to support its students. This form of support is possible through the integration of Information and Communication Technologies (ICT's). The model according to Rapp, Gulbahar and Adnan (2016) was developed and adapted to respond to the vital needs for students. Chawinga and Zozie (2016) comment that e-tutoring is used as a form of a specialized division of labour in the delivery and support of students in Open Distance Learning context. It is from this premise that students who are geographically separated by distance and time are meant to benefit from such a model.

For e-tutors to provide such support to open distance and eLearning students, there is a need for them to acquire some specific knowledge and skills. McPherson and Nunes (2014) attest that since e-tutors are the main agents responsible for the delivery of the online courses and the support of the learners, they must be equipped with an appropriate set of skills and attributes in addition to subject matter expertise.This article investigates whether e-tutors have acquired relevant knowledge and skills to offer adequate support to students in open distance and e-learning environment.

## CONCEPTUAL FRAMEWORK

The aim of this article was to investigate whether e-tutors in open distance and e-learning have acquired relevant knowledge and skills that will enhance adequate support to students. The article cannot neglect the worth of conceptualising relevant concepts that ground an understanding of learning in a distance environment. Concepts such as e-tutoring, student support and knowledge, are conceptualised in order to understand their impact in teaching and learning in a distance environment.

### E-tutoring

Literature has identified different and alternative names to describe the e-tutors. These refer to amongst others terms such as leader (Hotte & Pierre, 2002); e-moderator (Salmon, 2000); facilitator (Collinson et al., 2000); motivator, mentor, mediator and production coordinator (English & Yazdani, 1999). Other studies (e.g., Salmon, 2002) focus on online tutoring as provided by an assigned e-moderator. All these terms are used to refer to the same or similar functions of e-tutors to support students learning in open and distance environment. In the context of this study, e-tutoring is defined as teaching, support, management and assessment of students on programmes of study that involve a significant use of online technologies (Carreno, 2009). Thus, e-tutoring only differs with tutoring in terms of the involvement of technology. However, the delivery of e-learning implies much more than a simple technical

exercise in which some material or processes are simply transferred from the offline world to some readymade online realm (Cornford & Pollock, 2002, p.12). In this context, Duke (2002) proposes that e-learning calls for more in terms of pedagogy than simply putting tutors onto the web. Furthermore, it has been established that the adoption of e-learning implies a whole new set of both teaching and learning skills (McPherson and Nunes, 2004). Consequently, tutors and learners may not necessarily be sufficiently prepared to be successful in e-learning environments.

All these definitions of e-tutoring are relevant to this study and provide a guidelines of what e-tutoring is about.

**Student Support**

This section provides a description of student support with reference to scaffolding, online presence and initial student exposure. These are further discussed in the next section.

**Scaffolding** may be perceived differently in the context of open and distance e-learning students. To some students scaffolding might mean the continuous supply of reliable electricity, and to others it might mean the physical access to computers and the adequate internet supply sources. Literature has described scaffolding as any form of instructional support that enables students to complete tasks they would be unable to master without assistance (Feng, et al., 2017). The important feature of scaffolding in student support is that the variation of its intensity should be provided when needed and faded gradually when students achieve their goals and targets. However, the technical problems which seem to be one size fits all for the students who are geographically located and spatially dispersed vary (Anderson, 2008; Denis, 2003). In line with the above, we accept the expressions by Feng, et al (2017) with scepticism and caution since we are of an opinion that the process of scaffolding can only become a success once the person who scaffolds possesses the skills or even is at a level higher than the person whom scaffolding is intended. Our suppositions are in line with UNESCO (2011) that, a significant number of students reside in needy regions about accessible educational opportunities such as the ones mentioned above.

**Online presence** is another type of support mentioned within the model of e-tutoring. Queiros and de Villiers (2013) state that online presence is important during online learning as the facilitator becomes the driver of learning. In order to become a driver of learning, we assume that it is important for an e-tutor to become familiar with online tools to respond with timely feedback and with the knowledge of how to create discussion forums for collaborative activities. It is from this view that the study agrees with literature (Feng, et al., 2017; Queiros & de Villiers; 2013) that the presence and engagement of e-tutors depend upon their familiarity and ability to work with the online tools. Such tools make the delivery of the responsibilities of e-tutoring possible which might take some form of students' stimulation of learning. The examples of tools referred to, might include amongst others, the web sites, blogs and video clips. Without the knowledge of different tools and their manipulation, it becomes a challenge for e-tutors to perform varied forms of stimulations.

**Opening or initial student exposure** is another type of support to online activities for students. A study by Queiros and de Villiers (2013) present an argument that a particularized

attention should be placed on initial exposure for students since some students are technologically challenged and need much greater support. The authors further argue that the initial exposure increases self-efficiency for technology where students will scaffold to self-regulating skills envisaged for online environments. To become an agent of exposure, self - efficiency for technology should be coupled with self- regulating skills for technology. In this regard, it is important that e-tutors possess the same set of skills. For this reason, Rapp, et al., (2016) attested that while the technical infrastructure in the form of internet access, servers with Learning Management System (LMS) often sufficiently exist but the know how about manipulating such tools is often lacking.

The description of the three types of student support in an online setting form the basis of the current study as it focuses mainly on student support in open distance and e-learning environment.

**Technological pedagogical content knowledge**

Within the technological, pedagogical, content knowledge (TPACK) framework, the following domains of pedagogical knowledge (PK); content knowledge (CK); technological knowledge (TK); pedagogical content knowledge (PCK); technological content knowledge (TCK) and technological pedagogical knowledge (TPK) exist. According to Schmidt, Baran, Koehler and Shin (2009) the pedagogical knowledge (PK) refers to the methods and processes of teaching. Content knowledge (CK) on the other side, refers to the knowledge e-tutors must know about the content they teach and how the nature of that content is different from other various content areas. Additionally, Schmidt, et al., (2009) claim that technological knowledge refers to an understanding of how to use various technologies. The three other domains of TCK, TPK and PCK resulted as tributaries from the three mentioned domains. Finally, TPACK resulted as a conglomeration of all the three main domains of PK, CK and TK.

The domains of technological, pedagogical content knowledge are relevant to this papers based on the notion that TPACK is a framework for teacher knowledge of technology integration. It is from this idea that e-tutoring is one form of technology integration as teaching and learning cannot progress without the use of technology.

## RESEARCH METHODOLOGY

This study employed a mixed method approach (Creswell, 2008; Creswell & Plano Clark, 2007; Greene, 2007) to collect and analyse data. A purposive sampling approach was used to identify 24 e-tutors from four of UNISA regional offices (Gauteng, Polokwane, Durban and Umtata). It is worth noting that e-tutoring is a new concept in the said institution, and not all the modules are linked to this programme. This made it impossible for coming up with a large sample. The rationale being that, there is a high students' enrolment in these regions and the researchers believe that sampling these regions will provide deductive and inductive data that will address the research problem. Only e-tutors responsible for the facilitation of mathematics, science, computer integrated education, and technology education were selected.

The data collection instruments were adapted from the Technological Pedagogical Content Knowledge (TPACK) framework as proposed by Mishra and Koehler (2006). A questionnaire was developed by the researchers and administered online to all the selected

(24) e-tutors within the four disciplines. Before the questionnaire was sent to students, the items were shown to colleagues and the lecturers in the mathematics, science and technology education for them to indicate whether the instrument measured what it was intended for. The questionnaire was customized to contain five point Likert Scales with designations of 1 to 5 points of 'definitely disagree' to 'definitely agree. This assisted in collecting the quantitative data.

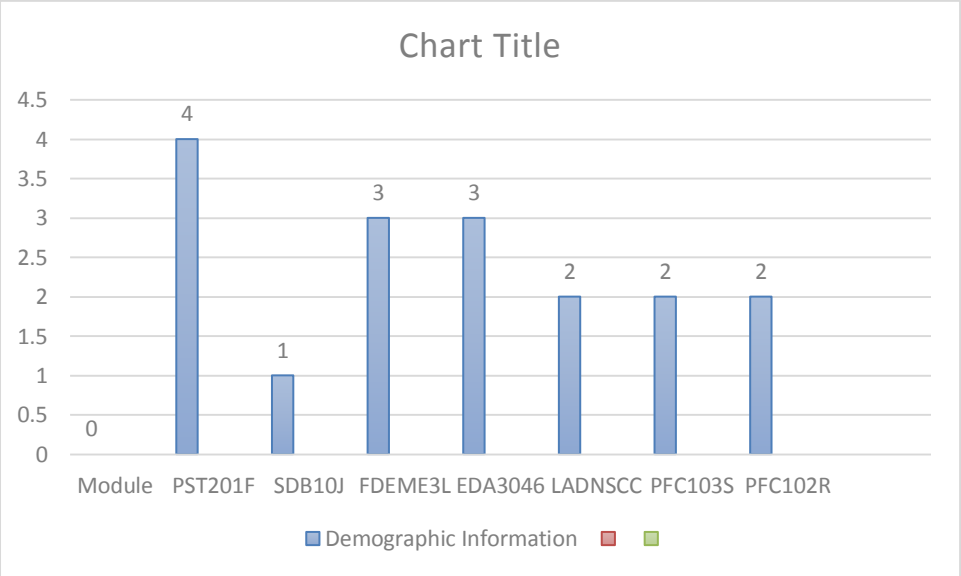
The qualitative data was collected from the semi-structured face-to-face interviews. These interviews were conducted at the UNISA regional offices. Only six e-tutors avail themselves for the interviews. This was based on voluntary participation, and no one was forced to take part in the interviews. Furthermore, qualitative samples are frequently relatively small (McMillan & Schumacher, 2010). The e-tutors were assigned names from ET1 to ET6 respectively. Their responses followed no chronology but their responses were mapped within domains of TPACK.

It has been explained that the study followed a mixed method approach. In light of this, the collected data from the entire instrument was analysed both numerically and thematically. To present the numeric data, the graphs were used whilst the codes and themes were employed in the qualitative data.

## RESULTS

It has been explained in the previous section that the data was analysed numerically, using graphs and tables; as well as qualitatively using the codes and themes. The analysis was informed by the TPACK framework as explained in the literature sections. Table 1.1 summarises the demographic information of participants in relation to the modules facilitated.

**Table 1.1: Demographic Information**



There were five modules (PST201F, SDB10J, FDEME3L, EDA3046, LADNSCC, PFC103S, PFC102R) within the selected specializations. Only 17 respondents provided answers to the demographic information. The question was to indicate their areas of specialisation. The results indicate the highest number (23, 5%) of respondents were from PST201F, followed by FDEME3L and EDA3046 with a percentage of 17,6% respectively.

Next section shows the results on the participants' TK, PK, CK and TPCK as illustrated in Table 1.2.

**Table 1.2: TPCK knowledge of respondents**

| **Technological Knowledge (TK)** | **SD** | **D** | **N** | **A** | **SA** |
|---|---|---|---|---|---|
| I have the technical skills I need to use technology | 70.8 | 0 | 0.27 | 2.0 | 0 |
| I can use technology easily | 79.2 | 0 | 8.3 | *12.5* | 0 |
| I am able to use 2.0 tools | 66.7 | 0 | 0 | 33.3 | 0 |
| I am able to use LMS | 41.7 | 0 | 16.7 | 41.7 | 0 |
| I have sufficient opportunities to work with different technologies | 37.5 | 0 | 12.5 | 50.0 | 0 |
| I know how to organise and maintain virtual classroom | 33.3 | 0 | 8.3 | 58.3 | 0 |

The results indicate that more than 50% of the respondents lack technological knowledge that will enhance student support in open and distance e-learning environment. This is evident where 79.2% of the respondents strongly disagree that they cannot use technology easily. Similarly, 70.8% also do not have the technical skills needed to use technology; and 66.7% cannot use web 2.0 tools.
The results were qualified by the qualitative data whereby participants explained the use of myUnisa tools.

*"I have learned with difficulties how to create interactive learning environment by using websites such as study stack*" (ET4).

"*I create a group site, so normally I will go to the group and initiate a discussion and a topic. Though it was not simple when i started*" (ET2).

"*I always present my presentations using Microsoft PowerPoint. What I would do is create a presentation with PowerPoint then I upload it on my one drive account*" (ET5).

"*There is the one where they create a group side which I always use*" (ET6).

Given the above results, the data also revealed the pedagogical knowledge of the respondents. This information is illustrated in Table 1.3.

**Table 1.3: Pedagogical knowledge of respondents**

| Pedagogical Knowledge | SD | D | N | A | SA |
|---|---|---|---|---|---|
| I can select effective teaching approaches to guide students thinking and learning in my module | 33.3 | 70.8 | 0 | 0.27 | .2 |
| I can teach lessons that combine module content and technology | 29.2 | 0 | 8.3 | *62.5* | *0* |
| I have various ways and strategies of developing my understanding of my module | 45 | 0 | 0 | 54 | 0 |
| I can adapt my teaching style to different students | 50 | 0 | 4.2 | 45 | 0 |
| I can assess student learning in multiple ways | 37.5 | 0 | 12.5 | 50 | 0 |
| I can use a wide range of teaching approaches | 50 | 0 | 12.5 | 37.5 | 0 |
| I am familiar with common student understandings and misconceptions | 0 | 0 | 20.8 | 41.7 | 37.5 |
| I am able to plan group activities in my module | 37.5 | 12.5 | 0 | 50 | 0 |
| I encourage my students to make use of available resources for their own learning | 41.7 | 0 | 16.7 | 41.7 | 0 |
| I know how to guide my students to get along with each other in group work | 29.2 | 4.2 | 33.3 | 33.3 | 0 |
| I teach my student to monitor their own learning | 20.8 | 0 | 20.8 | 58.3 | 0 |
| I guide my students to build on each other's ideas in group work | 16.7 | 0 | 37.5 | 45.8 | 0 |
| I conduct activities that require students to work with each other | 12.5 | 0 | 45.8 | 33.3 | 0 |
| I encourage my students to search for resources independently | 25 | 0 | 20 | 50 | 0 |
| I teach my student to adopt appropriate learning strategies | 62.5 | 0 | 16.7 | 20.8 | 0 |
| I know how to guide my students to learn independently | 41.7 | 0 | 12.5 | 45.8 | 0 |
| I help my students to reflect on their learning strategies | 25 | 4.2 | 25 | 45.8 | 0 |

The majority (62,5%) of respondents strongly disagree that they cannot teach lessons that help students to adopt appropriate strategies. In average (50%) were not able to adapt their teaching styles as well as cater for lessons that vary in teaching styles for all types of their students. This implies that respondents are not in possession of pedagogical knowledge. From the results based on the respondents' pedagogical knowledge, a table 1.4 follows below from the results of the respondents' content knowledge.

**Table1.4: Content knowledge of respondents**

| Content knowledge (CK) | SD | D | N | A | SA |
|---|---|---|---|---|---|
| I can think about the subject matter like an expect in the module | 26.7 | 0 | 18.7 | 52 | 0 |
| I have sufficient knowledge about my module content | 18.2 | 0 | 28.7 | *54.6* | *0* |
| I am able to identify appropriate topics for group activities | 9.8 | 0 | 28.7 | 57.3 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| I stretch my students' thinking by creating challenging tasks for them | 1.44 | 0 | 33.7 | 60.7 | 0 |

The results indicate that the majority (above 50%) of the respondents have acquired the content knowledge. This was demonstrated by the results that 60,7% were able to stretch their students' thinking by using their sufficient knowledge. The respondents (54.6%) also have sufficient knowledge about their module content. Similarly, 52% were able to think like experts about the subject matter. Also the respondents (57.3%) agree that they can identify appropriate topics for group activities. Similarly, the qualitative responses from the face to face interviews indicate levels of confidence from the e-tutors. ET3 indicated that, "*I formulate relevant questions based on their assignments using their prescribed book and I also help them to work on their assignments*".

On the same breath, ET1 explained, "I *will go through the important chapters with them I also do the important list for them to focus on".*

Given the above results, the data also revealed the Technological pedagogical content knowledge of the respondents. This information is illustrated in Table 1.5.

**Table1.5: Technological Pedagogical Content Knowledge**

| **Technological Pedagogical Content Knowledge (TPCK)** | **SD** | **D** | **N** | **A** | **SA** |
|---|---|---|---|---|---|
| I can teach lessons that appropriately combine content, technologies and teaching approaches | 29.2 | 0 | 8.3 | 62.5 | 0 |
| I can select technologies to use in my lesson that enhance what I teach, how I teach and what student learn | 0 | 4.2 | 25 | *66.7* | *4.2* |
| I can use strategies that combine content technologies, and teaching approaches learned in my course work | 4.2 | 0 | 4.2 | 0.8 | 28.8 |
| I can provide leadership to help others to coordinate content, technologies and teaching approaches | 0 | 0 | 16.7 | 66.7 | 16.7 |
| I can use appropriate technologies to represent module content | 0 | 0 | 20.8 | 66.7 | 12.5 |
| my teaching guide caused me to think about the influence of technology to my teaching | 4.2 | 8.3 | 4.2 | 4.2 | 29.2 |
| I can adapt the use of technologies that I learned in different teaching activities | 0 | 4.2 | 4.2 | 58.3 | 33.3 |

The majority of the respondents have strong TPACK which is important for them to deliver their e-tutor mandates. Evidence indicate that the majority (66,7%) benefit from TPACK since they know how they select technologies to use in lessons that enhance what they teach, how they teach and what student learn. Similarly, 62.5% agree that they are able to teach lessons that appropriately combine content, technologies and teaching

approaches. Also, 67,5% can provide leadership to help others to coordinate content, technologies and teaching approaches.

## DISCUSSION

This article set to examine the e-tutors' levels of student support within domains of TPACK in relation to sublevels of TK, CK, PK and also TPACK. Based on the results of the study, an indication is that e-tutors were not able to manipulate technologies for student support (TK). The implication is that the e-tutors were not able to scaffold students for their technological needs and for this reason the results disagrees with Feng et al., (2017). Much as tutors did not develop technological knowledge relevant for student support, their content knowledge was above average. This indicates that e-tutors are strong in content knowledge as compared to their technological knowledge. This was highlighted by literature (McPherson & Nunes, 2014) that e-tutors should be equipped with a set of skills. These skills require not only content knowledge, but also technological knowledge.

The pedagogical knowledge is one aspect distance tutors need focus on. In this study the e-tutors' pedagogical knowledge (PK) had a direct influence on students' learning. In this regard students expected that from the e-tutoring lessons, they could adopt appropriate strategies for online learning. It was disturbing to learn that the majority (62,5%) of respondents could not teach lessons that help students to adopt appropriate strategies. This of course disadvantages the majority of students as they need exposure to increase their self-efficiency. The results are therefore, in line with Queiros & de Villiers, (2013) that initial exposure increases self-efficiency for technology.
The ability for the e-tutors to perform depends on their anytime presence for their students. This was mentioned earlier in literature by Queiros & de Villiers, (2013) that online presence makes an e-tutor the driver of learning.

Finally, respondents showed a strong point of combining technology, content and pedagogy. This was evident wherein they show that they agree that they are able to teach lessons that appropriately combine content, technologies and teaching approaches.

### Conclusion

This article reports on the results of a study designed to investigate whether e-tutors are capable to offer adequate support to students in open distance and e-learning environment. E-tutor model as a form of student support has proven to be a challenge to open distance and e-learning environment. This rises from the notion that e-tutoring require competent e-tutors with a combination of knowledge and skills such as technological, pedagogical and content knowledge. If this could be acquired, then e-tutors will meet the demands of student support as expected by the institution.

The study suggests that e-tutors should be reskilled and equipped with the relevant knowledge and skills that will enhance them to select relevant technologies, combine them with content and pedagogy. This can only be done through the professional development support programs. We acknowledge in the study that e-tutors have been selected subject to

their content knowledge expertise, and without knowledge of technology. It does make it difficult for one to render the services as expected.

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# THE EFFECT OF PROCESS-BASED APPROACH TO TEACHING PROGRAMMING ON STUDENT PERFORMANCE IN A CORE PROGRAMMING COURSE

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## Abstract

This study is a follow up to our previous research on process-based approach to teaching Object Oriented Programming (OOP). The paper presents and analyses the results obtained from an empirical research that was conducted to determine the effect of process-based approach to teaching programming on students' programming achievement and attitude towards programming. The quasi- experimental intact class design was used. A total of 84 programming students who have 'issues' (struggled) with their introductory programming courses (OOP) were selected randomly from our undergraduate classes (i.e. UG 2 and 3) to participate in the research. These students were later divided randomly into two groups. 44 students (n = 44) were randomly selected to formed the experimental group and the remaining 40 students (n = 40) formed the control group. The two groups were pre-tested before the implementation stage. At the end of the study, post-test was given. Teaching and learning process was carried out for four weeks using the process-based approach. Two instruments were used. Programming Process Based Achievement Test (PPBA) and Attitude Questionnaire Items developed by Slavin (1995) was adopted. Data were analyzed using the t-test to determine performance by comparing the mean of the post test for treatment and control group. The results of this study showed that process-based approach improved students' achievement in OOP and attitude towards programming. The researchers concluded that process-based teaching approach enhanced students' problem solving strategies and improved their program development skills than the traditional or conventional teaching approach and recommended that programming tutors should incorporate process-based approach to their teaching of OOP.

**Keywords:** Visual tools, Process based approach, Object Oriented Programming

## Introduction

The teaching of OOP has become a dominant preference at various higher institutions globally (Donchev & Todorova, 2008). In the course curricula of all universities, educating students from the departments of computing, software design, information science and engineering, OOP is always presented (Lawal, 2012). Most universities programming courses have transited from procedural languages such as Pascal to object-oriented languages such as C++ and lately Java, and one of .Net languages such as VB.Net, C# or J#, as evidenced by the popularity of most computer programming texts (Johnson & Moses, 2008). The main reasons for this transition according to Okur (2006) are related to OOP having some conceptual edge like; "Abstraction, Inheritance, Polymorphism and Encapsulation". This transition has in some ways, put extra tensions on both programming tutors and students of the subject.

However, reviews of previous studies concerning the teaching and learning process in OOP have shown that the process is related to many difficulties (Lawal, 2012). There is no single view on their causes among programming tutors. The result of applying various instructional methods with object-early or object-late is inconclusive. Academics are continuously searching for effective ways to teach OOP. Many related studies have shown that students encounter various learning difficulties with this paradigm (e.g. Donchev & Todorova, 2008).

Processed based approach is a dynamic, visualization based approach to teaching in which contents and tasks are presented in a systematic way of learning to program. The reason is to simplify the introduction of basic OOP concepts and principles, and to involve students in active participation in learning, which will be enhanced by creative thinking, and logic mind sets before coding, while decomposing problems and formulating results leading to an efficient and effective coding proficiency (Guo, 2006).

In our previous research, we presented and analysed the results obtained from pre-filled questionnaires to assess and evaluate the effectiveness of a process based approach to teaching OOP for a five consecutive academic sessions for a year two programming module of Coventry University-United Kingdom. Our findings revealed that students that were taught using this approach achieved significant improvement in their programming skills. In this study, we conducted an experimental research to verify these claims revealed by the concerned students. To achieve this research goal, the study was conducted on randomly selected students that struggled in their introductory programming courses in a tertiary institution in Nigeria. The aim was to determine the effect of process-based approach to teaching OOP on students' programming achievement and attitude towards programming. The emphasis was on a core programming course: OOP.

**Purpose of the Study**

The purpose of this study was to determine:

i. Whether there are differences in achievement in programming between the participants in the experimental group and the control group
ii. Whether there are differences in students' attitude towards programming between the experimental group and the control group
iii. The differences between the mean scores of gender exposed to process based approach to learning programming
iv. To find out the interaction effect between the post-test, attitude and the pre-test.

**Research Questions**

The following research questions guided the study

i. What is the mean difference of students' scores exposed to process based approach to learning programming and their counterpart in the control group?
ii. What is the mean score of students' attitude exposed to process based approach to learning programming and those in the control group?
iii. Do male students performed better than the female students when both are exposed to process based approach to learning programming?
iv. What is the interaction effect of the post-test, attitude and the pre-test scores?

**Research Hypotheses**

Four hypotheses guided the conduct of this study

i. There is no significant difference in the mean score of students exposed to process based model and those in the conventional group
ii. There is no significant difference in the mean score of the attitude of students exposed to the treatment and those in the control group
iii. There is no significant difference in the Male and Female students exposed to process based model
iv. There is no significant interaction effect in the scores of students exposed to process based model, attitudes and the pre-test.

**Related Works**

Programming tutors are inventing and experimenting different pedagogy to provide effective learning methods in OOP. Most of these innovations according to Bladek and Deek (2005) have proven to be very effective in helping beginning programmers overcome several of their traditional difficulties. Consequently, such techniques (e.g Lee, et al., 2008) have led to effective and easy-to-use programming environments, software applications, learning tools and resources being developed to address the potential difficulties facing beginning programmers.

Visual tools have proven to be extremely powerful in helping novices to learn abstract computer concepts, such as recursion. However, Naps, et al., (2003) state that "....Visualization technology, no matter how well it is designed, is of little educational value unless it engages learners in an active learning activity". Guo (2006) conducts a survey to verify the effect of using dynamic visual technology materials and the learning aids. Further study by Guo (2006) found that the use of dynamically presented materials in lectures integrated with the learning aids have been effective. A significant improvement was recorded during a post lecture assessment of the study, and some positive comment received from the participants suggest that the approach was very effective.

**Methodology**

The course content on which this approach was based to teach was conducted at the Federal College of Education (Technical) Gusau - Nigeria, an affiliated institution of the Ahmadu Bello University, Zaria Nigeria, for some sampled year two, year three and four students of the department of Computer Science (CS) education. The aim of the treated course contents was to establish students understanding of basic OO concepts, to promote the use of design and programming principles, to give students the knowledge and skills needed to create computer programs that are well designed, well tested and well documented.

The study used a quasi-experimental intact class design. The study population comprises of the year two, year three and four students whose their scores were below 60% in the introductory programming course (COSC 211: OOP I). Random sampling technique was used to select the student that formed the study sample. Forty four (44) students formed the experimental group while forty (40) took part in the control group. The study lasted for four weeks to be accomplished. Student Teams Achievement Divisions (STAD) developed by Slavin (1995) was used as the process based model.

**Instrumentation:** In this study, the Process Based Achievement Test (PPBA) was used to measure the students' mastery of the three administered concepts of OOP: Object/Classes, Encapsulation and Inheritance. The pre and post-test contained 20 objectives questions. The

time allocated is 45 min. Five marks are allocated to each objectives item. All the items were reviewed by three experts from the Computer Science (CS) education department and Measurements & Evaluation for validation. Also the reliability of the instrument was established through the test – re – test method. Coefficient index of 0.67 was obtained which is considered to be good based on the sample size. The researcher adopted the attitude questionnaire items developed by Slavin (1995). The instrument was given to experts from the CS education for validation. Attitude questionnaire contains 25 items. All respondents were guided on how to complete the questionnaire. The questionnaire was administered based on the Likert scale of four points, strongly disagree-1 to strongly agree-4 points.

**Results and Discussion**

Data analysis was performed using statistical package for social science (SPSS) version 20.0, statistical tool employed is the independent t-test. P values less than 0.05 was considered significant. The pre-test result for both the experimental and control groups revealed that the two groups are equivalent at the commencement of this study. This is evident from Table 1.1 where the $M_{exp}$ = 7.38 and the $M_{con}$ = 7.36.

Table 1.1: Pre-test Score of the Experimental and Control Group

| | GROUP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pre-test | EXP | 44 | 7.38 | 1.628 | .243 |
| | CON | 40 | 7.36 | 1.530 | .245 |

The Levene's test for equality of variance and mean for the pretest score was presented in Table 1.2 below. The test for equality of variance revealed that F = 0.300 and Sig = 0.585. The quality of means showed that t = 0.54, df = 82 and p – value = 0.957. Thus no significant differences exist between the two groups at the commencement of the study. Hence, the two groups are equal in their programming knowledge.

Table 1.2: Equality of Variance and Means of the Pretest Score for Both Groups.

| | | Levene's Test for Eqty. of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Diff. | Std. ED | 95% CID Lower | Upper |
| Pre-test | Equal variances assumed | .300 | .585 | .054 | 82 | .957 | .019 | .346 | -.670 | .708 |

The research question 1 was answered from Table 1.3.

Table 1.3 Post-test Scores of Experimental and Control Group of Cooperative Learning

| | GROUP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Post-test | Exp | 44 | 76.45 | 7.206 | 1.086 |
| | Con | 40 | 11.60 | 4.094 | .647 |

$M_{exp}$ = 76.45 and $M_{con}$ = 11.60; $SD_{exp}$ = 7.206 and $SD_{con}$ = 4.094. The mean gain score of 64.85 was reported. This revealed that the experimental group has higher mean score than the control group.

The students' attitude to programming was presented in table 1.4.

Table 1.4: Post-test of Students Attitude of Experimental and Control Group

| | GROUP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Attitude | EXP | 44 | 78.30 | 6.529 | .984 |
| | CON | 40 | 11.60 | 4.094 | .647 |

$M_{exp}$ = 78.30 and $M_{con}$ = 11.60; $SD_{exp}$ = 6.529 and $SD_{con}$ = 4.094 was reported from Table 1.4. The experimental group has a higher mean score compared to the control class with mean difference of 66.70.

The scores for the male and female students exposed to the process based approach model (PBAM) were presented in Table 1.5.

Table 1.5: Post-test of Male and Female Scores of Experimental and Control Group PBAM

| | GROUP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Post-test | Male | 23 | 77.00 | 7.236 | 1.509 |
| | Female | 21 | 75.24 | 9.338 | 2.038 |

$M_{exp}$ = 77.0 and $M_{con}$ = 75.24; $SD_{exp}$ = 7.236 and $SD_{con}$ = 9.338. Mean gain score of 1.76 was reported. The male students' have a high mean score to the female students.

**Hypotheses Testing**

In Table 1.6, t = 50.04, df = 82 and p – value = 0.002 was reported. 95% CDI = 95% Confidence Interval of the Difference

Table 1.6: Test of Post-test Scores of Experimental and Control Group of Process Based App.

| | | Levene's Test for Eqty. of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | T | df | Sig. (2-tailed) | Mean Diff. | Std. Err. Diff. | 95% CID Lower | 95% CID Upper |
| Post-test | Equal Vari. Assumed | 5.434 | .022 | 50.035 | 82 | .002 | 64.855 | 1.296 | 62.276 | 67.433 |

Therefore hypothesis one was rejected because p – value was less than 0.05 and hence, there is a significant difference in the mean scores of students exposed to process based learning approach and those in the conventional group.

The test for significant difference between attitude of students exposed to process based learning model and students in the conventional group was revealed in Table 1.7.

Table 1.7: Test of Post-test Attitude of Experimental and Control Group

| | | Levene's Test for Eqlty. of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | T | df | Sig. (2-tailed) | Mean Diff. | Std. Err. Diff. | 95% CID Lower | 95% CID Upper |
| Attitude | Equal vari. Assumed | 2.134 | .148 | 55.43 | 82 | .003 | 66.695 | 1.203 | 64.302 | 69.089 |

Where t = 55.4, df = 82 and p – value = 0.003. Since the p – value was less than 0.05, the second hypothesis was rejected. This implied that there is a significant difference in the attitude of students in the experiment and control group.

The research result stated in Table 1.8 revealed that t = 0.703, df = 42 and p – value = 0.486.

Table 1.8: Test of Post-test Male and Female Scores of Experimental and Control Group Exposed to Process Based Approach

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Diff. | Std. Err. Diff. | 95% CID Lower | 95% CID Upper |
| Post-test | Equal var. assm | .030 | .863 | .703 | 42 | .486 | 1.762 | 2.506 | -3.296 | 6.820 |

The p – value was greater than 0.05, so the research hypothesis three was retained. Therefore there is no significant difference in the mean scores of male and female students exposed to process based learning approach. This showed that the male and female students; performed equally.

Finally the interaction effect of the posttest scores of the process based learning approach and the attitude scores and the pre-test scores was presented and tested in Table 1.9. The ANCOVA result showed that there was a significant interaction between the post-test scores (dependent variable) and the attitude (p – value = 0.000) whereas no significant interaction exist with the pretest scores (0.487).

Table 1.9: ANCOVA of the Post-test of Students Exposed to Process Based learning Approach and Attitude and Pre-test

**Tests of Between-Subjects Effects**

Dependent Variable: STAD

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 77193.278[a] | 27 | 2859.010 | 11.584 | .000 |
| Intercept | 5785.502 | 1 | 5785.502 | 23.441 | .000 |
| Pre-test | 121.088 | 1 | 121.088 | .491 | .487 |
| Attitude | 77094.196 | 26 | 2965.161 | 12.014 | .000 |
| Error | 13821.293 | 56 | 246.809 | | |
| Total | 265462.000 | 84 | | | |
| Corrected Total | 91014.571 | 83 | | | |

a. R Squared = .848 (Adjusted R Squared = .775)

## Discussion

The results of this study indicated that process based learning approach resulted in higher achievement than the traditional teaching approaches. The reason for the increase in students' achievement perhaps could be caused by the students' involvement in active participation in learning, which is enhanced by creative thinking, and logic mind sets before programming. Process based learning gives more room and opportunities for students to decompose problems and formulating results leading to an efficient and effective programming proficiency. The result aligned with previous studies, as reported by some researchers such as Guo (2006) and Lawal (2012). Traditional teaching methods are teacher based, therefore, less

opportunity is given to students active participation, critical thinking, problem decomposition, logic mind set before programming and creating solution.

The study also revealed that the process based learning approach increased students' attitude towards programming in OOP as evident from the mean scores and statistical difference between the students exposed to the treatment and those in the control group. This is probably because when students learn how to think in objects by visualizing problems in real world realities, problem decomposition is enhanced, this will provide a reliable problem solving strategies, which is the basis of OOP. This may indirectly change their attitudes towards programming, most importantly OOP. The findings also submitted that male and female students performed equally when they are exposed to process based learning. There is no statistical difference between the female and male students achievement in the programming scores. This could be due to the assertion that female students' derive maximum understanding during learning with the process based approach with their opposite sex.

**Conclusion**

The study therefore concluded that process based teaching approach enhanced students understanding and achievement in programming in OOP than the traditional or conventional teaching approaches. Secondly, students' attitude to programming in OOP improved consequentially when exposed to the process based learning approach and finally male and female students achieved equally in the process based learning approach.

**Recommendations**

The study recommends that:

i. Programming tutors should master the programming content to be delivered and plan how to implement process based teaching in the classroom.
ii. Process based teaching approach should be incorporated into the methods of teaching especially STAD model by the curriculum planner
iii. This study only lasted for four weeks. This means that students are exposed to the teaching and learning approach in a very short period. Therefore, further research study should be conducted to last a longer time span so that the results of this study can be validated.

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# CONSTRAINTS TO OPTIMAL ADOPTION OF E-LEARNING RESOURCES BY UNISA STUDENTS: AN OPEN DISTANCE LEARNING CONTEXT

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**Abstract**
E-learning at the University of South Africa (Unisa) has been introduced as one of the strategies of teaching and learning. It is envisaged that it will create an enabling environment for students in an open distance learning context. The e-learning system appears not to be optimally utilised by students. This study investigated the constraints faced by Unisa students in the adoption of e-learning resources so as to suggest the intervention mechanisms to raise awareness and bring improvement in the usage of resources. The study adopted the theory of connectivism. Using the qualitative approach and its procedures, data were collected through focus group interviews and document analysis. The sample consisted of ten students and four regional administrators from one Unisa region. The grounded (thematic) method was used to analyse the data. The findings revealed that e-learning resources are under-utilised by students, that many students face challenges in accessing the internet: they are either not trained in the use of e-technologies or not aware of the e-learning technologies that could be helpful to them, or they lack basic computer skills and seldom use the e-learning system. The study recommends that training in the use of myUnisa as a Learning Management System should be made compulsory for all first-year students.

**Keywords**: constraints, optimal adoption, e-learning, open distance learning, Unisa

## Introduction and background

E-learning is a relatively new teaching and learning technology that is defined differently by different scholars. Balaji, Ali Al-Mahri and Balaji (2016); Sife, Lwonga and Sanga (2007, p.1) state that e-learning is the instructional content or learning experiences enabled by electronic technologies [that] incorporate a wide variety of learning strategies…". These approaches to learning focus on freeing learners from constraints of time and place while offering flexible learning opportunities (Mbatha, Naidoo & Ngwenya, 2010). Although the two definitions capture the essence of e-learning, they are too general and vague as to what these technologies are. As a result, this study adopts Sife et al. (2007) and Du Plessis' (2012) explanation that e-learning refers to the delivery of course content via electronic media such as the internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV, Compact Discs, Digital Versatile Discs, video conferences, mobile technologies, web-based technologies, electronic learning platforms and CD-ROM.

The importance of e-learning is also viewed differently by different authors. According to Boulton (2008), e-learning is important as it provides support to the less able, engages students who do not respond well to traditional classroom learning, provides an opportunity

for accelerated learning for gifted and talented students and develops independent learning skills through a professional learning experience. In other words, e-learning meets different needs of students. Du Plessis (2012) states that e-learning enables access to educational resources from outside the institution on a global and instant basis.

Although literature indicates that e-learning at universities can no longer be disregarded, a study by Mtebe and Raphael (2013, p.9) in Tanzania shows that students are unable to access multi-media-enhanced courses properly via the internet due to bandwidth difficulties and instructors not being available for discussions via forums. Chetty (2012, p.7) shares this view and states that the integration of information and communication technologies (ICTs) with teaching and learning disadvantages students who are already in a disadvantaged position, as these students have limited access to the internet and other technologies. As part of its ICT-enhanced teaching and learning strategy 2011–2015, Unisa (2011c) states that "the optimal and appropriate use of information technology, now more than ever is crucial if Unisa is to deliver on its vision of becoming the African university in the service of humanity - by being Africa's premier distance education provider".

While the university envisages that the new technologies will permit full access to the best learning resources for all staff and students - anywhere, anytime, it appears that the new technologies are not optimally utilised, as evidenced by among others the following observations:

- Students make telephone calls asking for information obtainable on myUnisa.
- They submit hard copies of assignments instead of sending them online.
- They come to university offices for information obtainable on myUnisa.

The aim of this study was to report investigate the constraints experienced by students with the adoption of e-learning resources. The study was therefore guided by the following research questions:

RQ 1: What types of e-learning resources are currently used by students at Unisa?

RQ 2: What challenges do Unisa students experience in the use of e-learning resources?

RQ 3: What strategies can be implemented to improve the use of e-learning resources by Unisa students?

**Theoretical Framework**

This article was informed by George Siemens and Stephen Downes's theory of the digital age, called connectivism. Siemens (2004) contends that "connectivism is being characterised as a reflection of our society that is ever changing, views society as more complex, connected socially, global and mediated by increasing advancement in technology. Similarly, Downes (2009) maintain that connectivism attempts to alter the state of the learner to promote development, personal growth and active engagement. Furthermore, (Downes 2012, p.9) coined connectivism as "the thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks".

The authors of this article view Unisa students as active participants attempting to create meaning by establishing various connections in theory and practice as well as with the lecturers, markers, e-tutors, e-learning technologies and the teaching and learning environment. There is no doubt that connectivism is compatible with the interactive e-learning environment. Connectivism depends on students' readiness to use e-learning techniques, the benefits they gain from using e-learning and the support they receive from their lecturers. This notion resonates with Unisa's contention that open distance learning focuses on removing barriers to access learning, flexibility of learning provision, student centeredness, supporting students and constructing learning programmes with the expectation that students can succeed. (Unisa 2008, p.2)

**Literature Review**

Ajadi, Salawu and Adeoye (2008, p.61) explain Distance Education as a system of education (DE) that is characterised by physical separation between the teacher and the learner in which instruction is delivered to the learner through a variety of media, including print and other ICT resources. The authors, therefore, understand DE where one gains knowledge through communication anywhere in the world, and where education is taught through different tools of technology as opposed to face to face interaction.

The use of educational technologies in DE has the potential to address most of the challenges that distance learners encounter in their learning, which sometimes are so pressing to the extent that some learners opt to withdraw from their studies and others delay to graduate. Nyandara (2012) states that Open and distance learning (ODL) is becoming significant all around the world in contemporary educational development, including Tanzania and China, as an alternative way to meet the huge unmet demand for educational at all levels and especially for higher education. Wong (2008) emphasises that ODL enables working adults to learn new technological skills.

In Africa, Unisa is a leader in this process as an ODL institution that has adopted the use of e-learning strategies for teaching and learning. This positive move is one way to enhance equity and quality, to share instruction technology resources, and to meet the rising demands for tertiary education. At Unisa, ODL is about learning from a distance and connecting via e-learning resources, with no face-to-face contact with lecturers. This implies that there has been a shift from being an ODL institution to being an open distance e-learning (ODeL) institution. According to Ngubane-Mokiwa and Letseka (2015), the move from ODL to ODeL presumes the existence of an established culture of using and relying on modern electronic technologies. Unisa has also put in place a number of 'e-solutions', the benefits of online study, the various search engines and compulsory online modules or signature modules for each college (Unisa, 2011). These strategies are intended to enable new students to acclimatise to the ODeL environment.

E-learning offers benefits to ODeL students. JoomlaMLS Elearning Blog (2017) identified such benefits as follows:

- It does help save costs - Colleges don't have to provide students with space for learning and with some additional materials for their education.

- It makes education more available - For some students coming to another country to study something is impossible, especially if they want only to study a certain course instead of receiving a degree.
- It makes the whole learning process more entertaining - Students learn online, you are able to communicate with people in chats and forums.

With all the benefits highlighted above, one may ask: What are the constraints in the use of e-learning resources in teaching and learning? A number of scholars have looked into the challenges encountered by students in adopting e-learning technologies. For example, Du Plessis (2012) notes that some students are in deep rural areas and do not have access to computers or the internet, and that most students have not received any guidance on e-learning. Boulton (2008), adds that as the use of e-learning from home increases, the issue of who maintains the hardware needs to be addressed. For students with poor computer skills, technical problems may prove a barrier. Again, there may be cost implications of maintenance for students who come from financially disadvantaged backgrounds. Ajadi et al. (2008, p.68) state that, the National Open University of Nigeria (NOUN) experienced the following challenges in the use of e-learning technologies: inequality of technology access by students, technophobia, internet connectivity cost, lack of students' independent learning and inconsistency in the supply of electricity.

**Research Design and Methodology**

The qualitative research design was adopted for this study. This method allows the researcher to investigate behaviour as it occurs naturally, in non-contrived situations, thus there is no manipulation of conditions or experiences (McMillan & Schumacher 2010). Cohen, Manion & Morrison (2011) posit that such an approach is sought as a means of addressing critical problems and improving practice. In this study it was envisioned that the design could help in exploring the challenges encountered by Unisa students in the adoption of e-learning resources used to enhance teaching and learning.

The sample comprised of ten purposively selected students and four regional administrators from one region of Unisa. The researchers selected these students because they were well informed about the researchers' area of interest and therefore were deemed best to provide information needed to address the aim of the study. The administrators were working in the ICT and student support sections and therefore relevant to provide the required data. The researchers utilised the interviews as main data collection instruments and documents analysis as supplementary data collection instruments. Focus group interviews were conducted with the students and individual interviews were conducted with administrators.

Prior to collecting data, ethical clearance was sought from the university and permission was granted by the University Research Ethics Committee. The ethical requirements of confidentiality, anonymity and consent were adhered to.

The grounded (thematic) method was used to analyse data. Creswell and Plano Clark (2007) emphasise that all data collected by electronic or digital means (such as audio or video recordings) must be transcribed. The tapes were transcribed verbatim. The researchers first listened to the tapes several times before transcribing them. This allowed for the emergence

of specific units of meaning and themes. After reading the data (transcripts) several times in order to understand and make sense of them, coding commenced. After coding the transcribed data, the themes relevant to the study were bundled and categorised. The categories were further grouped into themes, which served as research findings of the study.

In order to enhance the validity and reliability of this study, the study triangulated by using two data collection instruments and three researchers.

## Findings and discussions

The findings are discussed under the following headings: types of e-learning resources that are currently used by students, challenges experienced by Unisa students in the use of e-learning resources and strategies for improvement.

### *Types of E-Learning Resources currently used by Students Unisa*

Literature studies show that e-learning technologies include a variety of learning strategies or tools. According to Sife et al. (2007), e-learning technologies encompass television, compact discs (CDs) and digital versatile discs (DVDs), videos conferencing, mobile e-learning (called M-learning), the World Wide Web and e-learning platforms. As said previously, the University of South Africa as an ODL institution uses different technologies in teaching and learning. Chetty (2012, p.7) indicates that students at Unisa supplement the use of myUnisa with other unconventional tools such as blogs, wikis and social networks.

In addition, when students were asked about the types of e-learning technologies they use at Unisa, the majority responded as follows:

*"We use myUnisa, followed by discussion forums, WhatsApp and YouTube, in that order."*

This finding corroborates with findings of other studies conducted at institutions of higher learning regarding the use of e-learning technologies. Chawinga (2014) in the study conducted about the use of Web.20 at Msuzu University (Malawi), discovered that most of the students (from 45.8%-69%) were using e-learning technologies such as Wikipedia, WhatsApp and YouTube. In a related study on the use of WhatsApp among research scholars of Karnatak University in Dharwad, Kenchakkanavar and Hadagali (2015) discovered that 69.06% of students used WhatsApp as an e-learning technology. In view of these findings, the researchers argue that the Unisa students are at par with students from other institutions of higher learning regarding the use of e-learning technologies.

### *Challenges experienced by Unisa Students in the use of E-learning Resources*

#### *Inadequate Infrastructure and Connectivity.*

Most of the respondents pointed out that inadequate infrastructure and connectivity are some of the major challenges hindering the implementation of e-learning at Unisa. In certain areas, there is no connectivity at all; while in others it is poor. The most affected students are from

rural villages or areas far from the main campus. This results in students not getting information on time.

The following are comments made by participants during interviews:

*"Most students are from the surrounding villages with minimal network."*

*"Unisa Radio is only accessible for students who are around the main campus and not at the regions. Therefore, students cannot access information any time when they are off campus."*

*"Data bundles only cater for towns and cities, especially Telkom."*

*"There is lack of resources such as computers and we are many. You have to queue for one student to finish. Also, as you are waiting, a lecturer will come and say I want to use this computer laboratory.*"

These findings seem to be consistent with findings from other literature sources. A study conducted by Wamae (2011) reveals that in Kenya bad connectivity is one of the factors hindering the successful implementation of e-learning. A similar study conducted by Tarus, Gichoya and Muumbo (2015), revealed that internet quality was a hindrance, as the campus network was slow and unstable. The findings of this study are, however, inconsistent with the study conducted by Mtebe and Raphael (2013) in Tanzania, where the majority of respondents had access to reliable internet connections and to computers.

Despite these differing views on the digital divide, the common agreement is that it is required of graduates of today to be computer literate in order to access the different technologies. It is evident from the above discussions that connectivity plays a major role in the use of e-learning strategies by students. Unisa must address this aspect if the e-learning approach is to be successful, particularly in the rural areas served by its regional offices.

***Ineffective E-Tutoring System.***

E-tutoring is the delivery of teaching and learning online via the internet. It consists of tutors who are qualified and are specialists in their subjects. The system was introduced at Unisa mainly to support online communication with students online.

Commenting on this system, most students are of the view that the e-tutoring system is ineffective in the implementation of e-learning at the University of South Africa. Below are excerpts from the respondents' interview responses:

*"We are aware of the e-tutoring system. However, e-tutors take time to respond to students."*

*"I am aware of the e-tutoring system. We are informed by SMS at the beginning of the year about who will be your tutor."*

*"The majority of us are not aware of the e-tutoring system. Students also lack clarity on the role of e-tutors."*

This challenge was unexpected. Contrary to the findings of this study that e-tutors take time to respond to students, Pitsoane, Mahlo and Lethole (2015), found that students do not

respond to electronic communiques of lecturers, they check posts very often, but the majority do not respond to them. This makes e-tutoring ineffective. One could in this instance argue that because students were found to be "shy, reserved and not confident enough to appear on-line, they were not confident enough to respond to e-tutors' communiques (see subsection 2.3 below). Lack of confidence to appear online might also be ascribed to a lack of computer skills.

***Lack of Computer Skills.***

The study revealed that students lack basic computer skills to deal with e-learning technologies. Even if computer modules are offered, there are still students who lack computer skills.

The respondents commented as follows:

*"There is lack of computer literacy, especially for the signature modules."*

*"Some students come from rural schools and others have completed their matric 10 years ago and were never exposed to computers."*

*"Some students do not know how to use myUnisa. The university sends assignment through myUnisa. You have not checked and you get a letter that says the submission of assignments is already due."*

An administrator who was also present during the interviews added:

*"The level of understanding of computers differs according to students. Some appear to have some background. Others find it difficult to register online even if instructions are there. They appear to be afraid even to read instructions. They just raise their hands for assistance."*

The findings of this study are consistent with those by Ajadi et al. (2008) at NOUN. The students admitted that they lacked a computer education background and as a result were afraid to operate one. They went to the extent of hiring experts to help them complete online registration and admission forms.

***Shortage of Staff Assistants.***

It was also revealed that there is lack of staff assistants. This challenge was expressed mostly by students. They indicated that the university has many students and an inadequate number of staff to help the students in matters pertaining to Unisa technologies. The allocated staff appears to have other duties to perform, as they would sometimes leave students unattended.

This finding was expressed by the students as follows:

*"The computer laboratory in our region is understaffed, e.g. one computer assistant operates three computers. Therefore, assistance becomes limited since there are many students seeking technical support.*"

"*Sometimes we [students] are forced to leave the computer laboratory without completing our work as the computer assistant would like to carry out other duties in the laboratory."*

An assistant who was available during the interviews also added:
*"There are not enough staff members to assist the students. We sometimes rely on casual workers."*

The issue of lack of technical support to students seems to be a general problem hindering the implementation of e-learning. Sife et al. (2007), in their study of factors hindering effective implementation of e-learning point out that in most cases technical support is not available in the implementation of e-learning. The users of technologies, both trainers and students, need trouble-shooting skills to overcome technical challenges. The study conducted by Ajadi et al. (2008) revealed that there were few staff at NOUN for maintenance of the system and technical support.

On the contrary, the study by Mtebe and Raphael (2013) reports that their respondents were positive about the support provided prior and during course delivery.

***Lack of Commitment from both Lecturers and Students.***

The students pointed out that lecturers appear not to be committed to the implementation of e-learning technologies in teaching and learning. This is evidenced by their (lecturers) not responding to students' e-mails.

The following is a response from some of the respondents:

*"Some lecturers do not respond to students' e-mails or they take time to respond. They ignore our e-mails until we write examination. There are those lecturers who respond quickly, like Dr ... [name omitted]."*

The issue of commitment is usually associated with lack of awareness and attitude. A positive attitude is important for the effective implementation of e-learning. A positive attitude by lecturers could be developed by awareness programmes and short training (Sife et al. 2007). Also associated with lack of commitment is lack of training of staff. The study conducted by Tarus et al. (2015) in Kenya revealed that inadequate training hinders the effective implementation of e-learning. Some of the staff members were trained before the ICT environmental setting. Even those who have basic computers skills might not be able to effectively implement e-learning.

Mtebe and Raphael (2013) revealed in their study on students' experiences and challenges relating to blended learning at the University of Tanzania that the unavailability of instructors/lecturers was among the challenges faced. The majority of students interviewed indicated that instructors were not available in most of the live chats and only a few students indicated that lecturers participated in discussion forums.

***Strategies for Improvement of the Use of E-Learning Resources by Unisa Students***

When asked about possible strategies to improve the use of e-learning by students, respondents appeared to believe strategies should come from both parties: the student and the institution. The following are some of the responses:

*"Students should have a change of mind-set. They should know that the university is going 'E' – and it will not change. They should just get used to online teaching and learning."*

*"First-year students must attend computer training workshops. Students come from various backgrounds. Some do not have backgrounds of computers. Like, I was studying with … University [name omitted] where we were not exposed to computers for studies. Now you find a student asking about registration dates while the answers are available on myUnisa."*

*"Students should group themselves and help one another through the peer-to-peer method. Those who know should help those who do not know so that we do not always rely on the institution for help."*

Although the University is putting an effort to improve online systems, it is clear from the above analysis that students still have constraints in the use of e-learning resources.

## Conclusion

This study examined the constraints on optimal adoption of e-learning by Unisa students in an open distance learning (ODL) context in order to suggest strategies to address such constraints. E-learning was presented as strategically important for removing restrictions and boundaries associated with the traditional face-to-face method. In addition, it was shown that e-learning does not restrict learners' attendance by location and time, making it compatible with Unisa's mandate to provide open distance learning, whereby students can study anywhere, anytime. In line with changes in technology, Unisa has put in place a number of e-solutions to ensure that students access e-learning resources. However, despite efforts by Unisa to fast-track the use of e-learning technologies among students, this vision has been hindered by a number of constraints. Interpreted in the light of connectivism, the findings suggest that poor connectivity is one of the factors impeding the successful implementation of e-learning. This is compounded by some lecturers not being conversant with e-learning technologies, making it difficult for them to assist students, and by some students being located in deep rural areas not having access to computers and the internet. These factors pose a serious challenge to the optimum use of e-learning technologies.

## Recommendations

In view of the foregoing, this study recommends that compulsory training of tutors and lecturers, on basic computer skills and MyUnisa, be carried out (regularly, if possible) regardless of their computer education background. This study further recommends that training for first-year students be made compulsory as a prerequisite for commencement of studies. Regular workshops should follow as on-going support. Peer-to-peer assistance or student networking should be encouraged so that students who are conversant with the system can assist those who are struggling. Another recommendation is to provide trouble-shooting options on myUnisa to help students with technical problems encountered in the absence of technicians. It is clear from the discussions above that strategies for improving the use of e-learning resources must be a joint responsibility for both students and the university.

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# EFFECTS OF BLENDED AND COMPUTER-ASSISTED LEARNING ECOLOGIES ON STUDENTS' CIVIC SKILLS IN URBAN LEARNING ECOLOGIES

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**Abstract**
There is a great popular demand for the participation of young people in public life in the information age. Researchers are concerned about the dwindling participation of young people in public life despite the communication opportunities presented by computer and other ancillary devices in the 21st century. To realize the objective of building the cohort of active thespian, young people need operations with global skills that are required to navigate the civic world in their vicinities. This study, therefore, determined the effects of computer-aided and blended learning ecologies on students' civic skills in urban learning ecologies.
The study adopted the pretest-posttest, control group, quasi-experimental design using 3 x 2 x 3 factorial matrix. Seventy-eight students from six intact classes in secondary schools in Nigeria were selected and randomly assigned to experimental and control groups. Five instruments used were: Civic Skills Questionnaire (r=0.76), Cognitive Style Test (r=0.72), Computer-aided and Blended Learning Ecology Guides for experimental groups and Traditional Lecture Method Guide for the control group. Three research questions were answered. Data was subjected to Analysis of Covariance, Estimated Marginal Means, and Scheffe's Pairwise Comparison. There was a significant effect of treatment on students' civic skills ($F_{(2;\ 61)} = 6.81$, $p < 0.05$; $\eta 2 = .18$). The students' exposed to Computer-assisted learning ecology had higher adjusted civic skills mean score (X= 54.17), than the traditional lecture ecology(X=48.69), and the blended learning ecology group (X= 34.04). It was, therefore, recommended that teachers in urban learning ecologies in developing countries should explore the benefits of Computer-aided technologies. It is anticipated that this experiment on computer-assisted teaching strategies will act as a spur to active teaching strategies in Social Studies and Civic Education classes.

**Keywords**: Blended learning ecology, Computer-assisted learning ecology, Students', Civic Skills, Urban learning ecologies.

## Introduction

There have been discussions in developing nations of the world on the readiness of students for participation in the global democratic societies dominated by usage of Computer and other ancillary devices. The introduction of Computer and the subsequent evolution of the Internet, which emanated from the Computer revolution (Amosun, Ige & Choo, 2005; Ige & Hlalele, 2017 ) are mounting pressure on students in schools as they develop their abilities as citizens in a world that continues to change. The realities of the Computer age, urgently place demand on teachers to develop teaching-learning ecologies that will foster students a sane and realistic attitude for others in one's community (Pancer, Pratt, Hunsberger, & Alisat, 2007), confidence in other people (Zakrzewski, 2015), capacity for broader civic participation as a way to exert influence on society (Hart, Donnelly, Youniss, & Atkins, 2007; Colby,

Beaumont, Ehrlich, & Corngold, 2010), and desire to collaborate with other ecosystem users to address problems and preserve positive aspects of community (Metz & Youniss, 2005). In this study, we utilized two modes of computer-assisted learning ecologies to foster in students' skills peculiar to civic participation and democratic governance. The Computer-aided learning ecologies are utilized to enable students to become active participants in the global democratic societies that are currently powered by Information and Communication Technologies.

**Computer-assisted Learning Ecology**

The Computer has transformed the once sleepy world into a global village. Dixon (2009) echoed that the rapidly accelerating globalization and expansion of technology have compressed different cultural values into a super-cultural value. Thus, the need for teaching-learning ecologies that are Computer driven is essential. Computer-Assisted Instruction (CAI) is the use of the machine that propelled the third revolution in education (Computer) and other related technological devices to improve students' students learning outcomes (Kelly, Bartholomew, & Test, 2011). Researchers have utilized CAI in a variety of teaching-learning endeavours namely: struggling basic learners with deformities (Regan, Berkeley, Hughes, & Kirby, 2014), effectiveness (Chen, 2013), involvement in individualized Education Programme (Kelly et al, 2011), and reading (e.g. Torgessen, Wagner, Rashotte, Herron, & Lindamood, 2010). Consequent on the potential advantages documented in by previous researchers, further enquiry is warranted for using Computer-assisted Learning Ecology to develop students' civic skills. In this study, Computer-Assisted Learning connotes the use of Computers by students of different sexes with varying computer literacy abilities to develop their civic skills.

**Blended Learning Ecologies**

Evidences from literature suggested that people might have different conceptions of blended learning depending on their teaching and research experience (Ross & Rosenbloom, 2011; Arbaugh, Desai, Rau & Sridhar, 2009). Roumell and Salajan (2016) stated that the common denominator in the earliest definitions of e-learning is the practical and effective use of current technologies in education, which was used in the current study. This tradition featured in the definition of Salajan (2007) which defined e- learning as a process aimed at the consolidating the teaching-learning process with Information and Communication Technologies in education. Njenga and Fourie (2010) added detail to this definition by defining e-learning as the utilization of electronic technology and content in teaching and learning, with clarifications that these technologies ranged from the information super highway, boob tube, cascading video to connected multimedia and mobile technologies. Vaughn (2007) affirmed that blended learning ecologies challenged previous assumptions that the 'chalk and talk' learning method is the most effective method of improving students' learning outcomes. These outcomes are knowledge, skills, and attitudes. Tayebinik and Puteh (2013) highlighted that blended learning ecologies comprise, a combination of instructional modalities, and instructional methods as well as combination of online and face to face instruction, while other scholars believed that the concept 'blended learning ecologies' integrate face to face instruction with computer mediated mode with reduced classroom attendance (Loannou, Vasiliou and Zaphiris, 2016; Li & Yang, 2016; Wu & Patel, 2016). Despite the divergence of opinions among scholars as to what constitute blended learning, it could be noted in the different definitions that combination of computer and other information and Communication Technological devices with traditional classroom teaching

are essential. In this study, blended learning ecologies are the combination of power point presentations facilitated using laptop computers with conventional lecture method. The students with varying computer literacy levels sat in a group of five with balanced number of male and female in each group. The combination of computers with the conventional lecture method is ideal for the schools selected for this study because they had no access to the internet.

**Gender, Cognitive ability and Learning Ecologies**

Hlalele (2013, 2014, 2015) describe schools and their communities (Cloud, 2005) as learning ecologies. Hlalele (2013, 2014, 2015)'s definition presupposes the existence of a complex web of interactions within, between and across learning contexts. Evidences from literature showed that the expression 'Learning Ecology' featured in the works of Levitt and March (1988). Barron (2004) cited that these scholars described how organizations are collections of sub-units with the term 'learning ecology'. Levitt and March (1988) opined that learning ecologies consisted of different kinds of interactions among learners, with these learners linked through the dispersal of each other's experiences and breakthroughs, especially the protection and sharing of confidential information. With the evolution of internet, otherwise called the fourth revolution in education (Ige, 2012), the term 'Learning Ecology' became an allegory. Brown (2002) applied 'Learning Ecology' to paint how distributed resources on the internet became a new genre of environment for learning. We feel the conception of this scholar might not unconnected with the diverse possibilities for participation in the global democratic societies that the fourth revolution in education afforded students. It is premised on the assertion of Brown (2002) that Barron (2004) defined 'Learning Ecology' as the accessed set of milieus, which is made up of configured exercises, and other related stockpiles, found in virtual elbow rooms that provide openings for learning. These definitions to the scholar considered physical contexts where students are resident as crucial sources of learning with recognition of distributed resources. This definition attested to Hlalele's (2013, 2014, 2015) research that affirmed scholars and their communities as learning ecologies. With the realities of the twenty- first century, scholars and the 'web communities' (internet) qualify as 'learning ecologies'. These communities could be combination of computer-assisted learning and learners immediate communities or purely computer- aided communities. For the current study, learning ecologies connotes schools and computer-assisted communities' i.e. the computer replacing learners' communities. The computer-assisted communities in this study are like Barron (2004)'s composition of community as 'libraries, Community Technology Centers, summer camps and clubs and contents.

Several factors other than learning ecologies could have impact on an experimental study of this type. One of the factors that often confounded researchers in a quasi-experimental study is gender (Barron, 2004). Glasser and Smith III (2008) stated that the concept is often associated with differences in the learning experiences of masculine and feminine learners with distinctions based on the traditional understanding of the term 'sex'. Consequent on caution by these scholars that 'gender' has substantially capped 'sex' as the favoured terminology for naming disparate aspects facets of masculine and feminine experiences, reasonings, and actions, in this enquiry 'gender' refers to the male and female learners' demonstration of civic skills. Research have shown that the use of computer aided teaching materials had no significant influence on curiosity in science for both male and female students (Cephni, Tas & Kose, 2006; Ige, 2012; Amosun, Ige & Choo, 2015). However, other scholars (Adigun, Onihunwa, Irunokhai, Yusuf, & Olubunmi, 2015; Bamiro, 2015) have

found that there are wide-ranging differentiations in the psychomotor skills attainment of students across gender bars.

Consequent on evidences from previous research, it is worth-while to find out gender influence on learning ecologies as one of confounding variables in this study. Another factor that can moderate students' civic skills in any learning ecology is cognitive style. Cognitive style describe the traits displayed by learners, such as learn styles, teaching strategies, and interaction techniques in the learning space (Ocepek, Bosnic, Seebec, & Rugely, 2013; Li & Yang, 2016). While scholars have challenged the available body of facts on learning styles (Kirschner, & Van Merrienborer, 2013; Li & Yang, 2016), learning styles have been discovered to affect virtual participation of students (Huang, Li & Huang, 2012) and students' academic achievement (Gappi, 2013; Allert, 2004). Following spare empirical research on the moderating influence of cognitive styles on learning ecologies and arguments that limited studies can test the validity of learning styles applied to education using an experimental methodology, this study explored the likely effects of cognitive style on students' civic skills in learning ecologies, and seeks answers to these questions:
I. What would be the effect of Computer-assisted and blended learning ecologies on students' civic skills?
II. Which of the learning ecologies would have the highest effect on students' civic skills?
III. Will there be any interaction effect of treatment (Computer-assisted and blended learning ecologies), gender and cognitive styles on students' civic skills?

## Methodology

### Research Design

The study adopted a pretest-posttest control group quasi-experimental design. The design is represented schematically below:

$O_1$ $X_1$ $O_4$ _____ Experimental Group I
$O_2$ $X_2$ $O_5$ _____ Experimental Group II
$O_3$ $X_3$ $O_6$ _____ Control group

Where $O_1$, $O_2$, and $O_3$ are pre-test measures of experimental groups 1, 2, and control group respectively. $O_4$, $O_5$, $O_6$ represents the post-test measures of experimental groups 1, 2, and control group respectively.
$X_1$– Computer-assisted Learning Ecology
$X_2$ – Blended Learning Ecology
$X_3$ – Conventional Lecture Method

**Table 1: A Representation of the 3x3x2 Factorial Matrix**

| Treatment | Gender | Cognitive Style | | |
|---|---|---|---|---|
| | | Lowly Analytical | Moderately Analytical | Highly Analytical |
| Computer-assisted Learning Ecology | Male | | | |
| | Female | | | |
| Blended Learning Ecology | Male | | | |
| | Female | | | |
| Traditional Lecture Method | Male | | | |
| | Female | | | |

The study, therefore, adopted a 3x3x2 factorial matrix which consisted of instructional ecologies at three levels of treatment (two experimental groups and one control group) moderator variables of academic ability at three levels (lowly analytical, moderately analytical, and highly analytical) and gender at two levels (male and female). The data collected was subjected to Analysis of Covariance (ANCOVA) with the pretest scores input as covariates. The Estimated Marginal Mean aspect ANCOVA enabled the researchers to calculate the magnitude of performance across the groups. Analysis of Covariance was utilized to sift the data collected in this study because it holds a higher power and separate the initial disparities in the pretest scores. Analysis of Covariance is also applicable in this study because it has a higher power to reduce the error variance and determine the true effect of the independent variable (Computer-aided teaching strategies).

**Selection of Subjects**

The participants of the study were initially 92 Junior Secondary Students in Ondo State, Nigeria; but only 78 Junior Secondary school students. Six intact junior secondary school II classes were selected in each of the six secondary schools (Amosun, Ige, and Choo, 2015). The Junior Secondary School II Students were used for the study because, civic education is offered by students at the Junior level of schooling. The students were selected for the study because they gave their consent to participate in the study. Consequent on this, the students were ready and available to participate in the study.

**Research Instruments**

These research instruments were used for the study:

1. Computer-assisted Learning Ecology Guide (CaLEG)
2. Blended Learning Ecology Guide (BLEG)
3. Traditional Lecture Method Guide (TLMG)
4. Civic Skills Questionnaire (CSQ)
5. Cognitive Style Test (CST)

The contents of these research instruments were common for all the treatment groups.

**Selected concepts for the study**

Five concepts that were found to be central to the development of effective citizenship (Ige 2013; Amosun, Ige and Choo 2015), namely citizenship, social issues and problems, negative behaviours, values and communication (Amosun, Ige, and Choo, 2015), were selected. Research has shown that these concepts are central to the development of effective citizenship (Ige 2013; Amosun, Ige and Choo 2015).

**Computer-assisted Learning Ecology Guide (CaLEG)**

The CaLEG was put together by the researchers to research assistants in experimental group 1 to ensure compliance with set objectives for the study. The CaLEG was put together on each of the selected topic: values, citizenship, ICT, problems of ICT, negative behaviours and social issues and problems for the study. The instrument was validated by doctorate degree holders with extensive knowledge in the field of civic education in a university in Nigeria. The lecturers review was built into CaLEG to enhance content appropriateness for the target students, and curriculum objectives.

**Blended Learning Ecology Guide (BLEG)**

The BLEG was put together as a guide for researcher assistants in experimental group 2. This was done to ensure non-distortion of the research procedure. The BLEG, a combination of face to face and computer-assisted teaching modes was put together on the selected concepts for the study. Three concepts namely, citizenship, problems of ICT and values were animated and put into slides on Microsoft Powerpoint, while the remaining concepts namely ICT, social issues and problems were taught face to face. The instruments were given to doctorate degree holders with vast knowledge in the field of civic education in a University to determine the appropriateness of the instrument for the target respondents. The comments of the lecturers were used to amend the instruments.

**The Traditional Lecture Method Guide (TLMG)**

The TLMG was drafted by the researchers to guide research assistants in the control group to ensure compliance with set objectives for the study. The TLMG was drafted on each of the concepts selected for the study. The Traditional Lecture Method Guide consists of five steps, namely:

- The research assistant initiates the concept
- The research assistant ventilates facts or ideas on the concepts in steps
- The research assistant gives notes on the concept
- The research assistant catechizes questions
- The research assistant provides assignment to students

**Cognitive Style Test**

The Academic Ability Test (AAT) taken from Ige (2001) was renamed 'Cognitive Style Test (CST)' and used to measure the students' cognitive style to perceive and process a given set of information. The test was a modified form of the Sigels cognitive style test. It comprised twenty cards of pictorial representations. The first picture on each card is coded 'A', the second 'B', and the third 'C' for easy identification. The students are expected to identify the two of the three pictures that have common characteristics, choose any two pictures from the three in each group that they feel are complementary, and give reasons for such a choice. The test was first administered on sixty students and re-administered after a two-week interval on the same group of students. The correlation coefficient of the two sets of responses was computed using Pearson Product Moment Correlation, the stability coefficients of r= 0.60 to 0.72 was obtained.

Civic Skills Questionnaire

The Leadership skills, social justice and diversity attitudes sub-scales of Civic Attitudes and Skills Questionnaire developed by Moely, Mercer, Ilustre, Miron, and McFarland (2002) was used to rate the civic skills of the students. The Civic Skills Questionnaire comprised two sections. Section A evoked reactions on the age, sex, and school of the students. Section B of the instruments has three sub-scales namely leadership skills, social justice skills, and diversity skills. The leadership skill sub scale has statements like: 'I have the ability to lead a group of people', 'I would rather have somebody else take the lead in formulating a solution', and 'I feel that I can make a difference in the world'. In this study, an estimated α co-efficient value of 0.77 was got using split-half method. Examples of statements in the social justice skills sub scale are: 'I don't understand why some people are poor when there are boundless opportunities available to them', 'In order for problems to be solved, we need to change public policy', and 'We need to institute reforms within the current system to change

our communities'. The estimated reliability co efficient of the sub scale using split-half method is 0.86. The diversity skills sub scale contains statements like: 'Cultural diversity within a group makes the group more interesting and effective', 'It is hard for a group to function effectively when the people involved come from very diverse backgrounds', and 'I prefer the company of people who are very similar to me in background and expressions'. In this research, the calculated α co-efficient value was 0.87 employing split-half method for this sub scale. The items in the research instrument were structured on a six-point Likert format varying from strongly disagree (1) to strongly agree (6). The total Cronbach's co-efficients of the three sub scales was 0.76, this was done by adding the responses of the students in each of the three sub scales in Section B. The scores on the first two sub scales were then regressed in contrary to the third sub scales (Aremu, 2005).

**Experimental Group One: Computer-assisted Learning Ecology**

The steps are as follows:

Step 1: The research assistants distributes the students into mixed gender groups according to their academic abilities i.e representation of students with low, moderate and high abilities

Step 2: Each group is allocated a laptop with the topic contents of topic to learn on the screen, and as well a group leader.

Step 3: The research assistant introduces the topic

Step4: The research assistant presents the contents of the lesson to the students, while the group leader moves the animated Microsoft Powerpoint slides

Step 5: The research assistant allows a student in each of the mixed gender groups to ask questions on the lesson presented.

Step 6: The research assistant answers the students' questions.

Step 7: The research assistant asks each of the mixed gender groups to do the group discussion.

Step 8: After group discussion, the group leader presents the group's answers.

Step 9: The research assistant notes the main points in each of the group leader's presentation and summarize the lesson.

Step 10: The research assistant asks each mixed gender group leader to close the animated Microsoft PowerPoint slides and shut down the laptop computers.

**Experimental Group Two: Blended Learning Ecology**

The Blended Learning Ecology Guide is the combination of Computer-assisted Ecology Guide and Conventional Lecture Method used alternately on weekly basis; these are:

- The research assistant initiates the concept
- The research assistant ventilates facts or ideas on the concepts in steps
- The research assistant gives notes on the concept
- The research assistant catechizes questions
- The research assistant provides assignment to students

and

Step 1: The research assistant distributes the students into mixed gender groups according to their academic abilities i.e representation of students with low, moderate and high abilities

Step 2: Each group is allocated a laptop with the topic contents of topic to learn on the screen, and as well a group leader.

Step 3: The research assistant introduces the topic

Step4: The research assistant presents the contents of the lesson to the students , while the group leader moves the animated Microsoft Powerpoint slides
Step 5: The research assistant allows a student in each of the mixed gender groups to ask questions on the lesson presented.
Step 6: The research assistant answers the students' questions.
Step 7: The research assistant asks each of the mixed gender groups to do the group discussion.
Step 8: After group discussion, the group leader presents the group's answers.
Step 9: The research assistant notes the main points in each of the group leader's presentation and summarize the lesson.
Step 10: The research assistant asks each mixed gender group leader to close the animated Microsoft PowerPoint slides and shut down the laptop computers.
Control Group: **The Traditional Lecture Method Ecology**

- The TLMG was drafted by the researchers to guide research assistants in the control group to ensure compliance with set objectives for the study. The TLMG was drafted on each of the concepts selected for the study. The Traditional Lecture Method Guide consist of five steps, namely:

- The research assistant initiates the concept
- The research assistant ventilates facts or ideas on the concepts in steps
- The research assistant gives notes on the concept
- The research assistant catechizes questions
- The research assistant provides assignment to students

The treatment proceeded for ten weeks in the selected learning ecologies. The Posttest was given to the students in the experimental and control groups. The research assistants utilized for this study are qualified teachers by the standards of the Teachers Registration Council of Nigeria.

**Results**

From table 2, the main effect of treatment (Computer-assisted and Blended Learning ecologies) on students' civic skills is significant ($F_{\{2, 61\}} = 6.81$; $p > 0.05$; $\eta^2 = .18$). The magnitude of performance in each of the groups of treatment is hereby presented on table 2. This variation indicates that there is a significant difference in the civic skills of students exposed to Computer-assisted and Blended learning ecologies, as well as conventional lecture method.

Table 3 shows that with a grand mean of 47.08, students exposed to Computer-assisted Learning Ecology (Exp. Group I) had the highest civic skills mean score (54.17) followed by students exposed to traditional lecture method (48.69) and those exposed to Blended Learning Ecology (34.04). The result showed that Computer-assisted Learning Ecologies had the greatest impact on students' civic skills. It could be noted from the results that the independent variables, gender, and cognitive style accounted for 52.4% $(.623)^2$ of the total variation in students' civic skills. The results on Table 3 imply that there is a significant difference in the civic skills of participants in the treatment groups (Computer-assisted and Blended Learning Ecologies) and those in the control group (Conventional Lecture Method). This means that significant differences existed in the civic skills of Computer-assisted

**Table 2: Output of 3X3X2 Analysis of Covariance on Students' Civic Skills**
**Dependent Variable: Post_Civic_Skills**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 11623.898[a] | 16 | 726.494 | 6.301 | .000 | .623 |
| Intercept | 4665.092 | 1 | 4665.092 | 40.463 | .000 | .399 |
| Pre_Civic_Skills | 2904.381 | 1 | 2904.381 | 25.191 | .000 | .292 |
| Treatment | 1569.270 | 2 | 784.635 | 6.806 | .002 | .182 |
| Gender | 569.641 | 1 | 569.641 | 4.941 | .030 | .075 |
| Cognitive_style | 508.563 | 2 | 254.281 | 2.206 | .119 | .067 |
| Treatment * Gender | 575.928 | 2 | 287.964 | 2.498 | .091 | .076 |
| Treatment* Cognitive_style | 461.947 | 3 | 153.982 | 1.336 | .271 | .062 |
| Gender * Cognitive_style | 61.078 | 2 | 30.539 | .265 | .768 | .009 |
| Tretment*Gender* Cognitive_style | 453.152 | 3 | 151.051 | 1.310 | .279 | .061 |
| Error | 7032.820 | 61 | 115.292 | | | |
| Total | 199908.000 | 78 | | | | |
| Corrected Total | 18656.718 | 77 | | | | |

**a. R Squared = .623 (Adjusted R Squared = .524)**

Learning Ecologies (X= 54.17), Conventional Lecture Method (X= 48.69), and Blended Learning Ecologies (X= 34.04).

To ascertain the sources of the significant difference, Scheffe's post-hoc pair-wise comparison was conducted and presented on table 3. The result on table 4 shows that the source of the detected significant difference was traceable to civic skills mean scores of students in experimental groups I and II, and civic skills mean scores of students in experimental group II and the control.

The two-way interaction on Table 1 shows that showed no significant effect on students' civic skills ($F_{\{3, 61\}} = 1.31$; $p< 0.05$; $\eta^2 = .06$). This implied that students' civic skills did not vary significantly among students with low, moderate, and high cognitive styles, and was not sensitive because of exposure to different learning ecologies.

**Table 3: Estimated Marginal Means on Students' Civic Skills**

| Variable | N | Mean | Std.Error |
|---|---|---|---|
| INTERCEPT | | | |
| Pre-skills Score | 78 | 43.12 | - |
| Post skills Score | 78 | 47.08 | 1.518 |
| TREATMENT | | | |
| Experimental I (Computer-assisted Learning Ecology) | 26 | 54.174 | 3.248 |
| Experimental II (Blended Learning Ecology) | 14 | 34.044 | 3.059 |
| Control (Conventional Lecture Method) | 38 | 48.685 | 2.001 |

**Table 4: Scheffe's Pair-wise Comparisons of Civic Skills among the Treatment Groups**

| **Treatment** | **Mean** | **Exp. I** | **Exp. II** | **Control** |
|---|---|---|---|---|
| **Exp. I** | **54.174** | | * | |
| **Exp. II** | **34.044** | * | | |
| **Control** | **48.685** | * | * | |

*** Implies that there is a significant difference**

## Discussion of results

This study discovered that the treatment significantly influenced students' civic skills, with computer- assisted learning ecology being the most effective. This might not be unconnected with students' regular usage of mobile phones and computers for virtual social activities. The perceived benefits of operating a laptop as against desktop computers that are regularly used by the students may have led to greater involvement by students in the computer – assisted learning ecology. The finding fully supports the study of Wang and Dwyer (2004) that examined the instructional effects of three concept mapping strategies and prior knowledge in facilitating students' achievement in a web – based learning environment. These scholars discovered that concept matching mapping, a variant of computer learning ecologies has the potentials to minimize the discontinuities between learners with low and high experiences. The finding also confirmed the benefits inherent in the authentic learning strategy applied to an online course which required students to collaborate with peers, mentors, and potential employers over the internet (Ma & Lee, 2007; Lombardy, 2007). The result shows that the three-way interaction effect of treatment, gender, and cognitive skills was inconsequential on students' civic skills. This finding implies that the computer – assisted or blended learning ecologies is suitable for a male or female of low, moderate, or high cognitive styles. However, this finding negates the discovery of Okoronka and Wada (2014) that reported significant interaction effect on students learning outcomes when cognitive style was crossed with gender using analogy instructional strategy.

**Implication for Teacher Pedagogy and Limitations**

This study has implications for the teaching – learning process in twenty – first century schools powered directly or discretely by Information and Communications Technology (ICT). Schools are directly powered consequent on the deliberate use of ICT, which brings about intended learning outcomes, and discretely powered because of students' interactions in virtually learning ecologies (i.e. social networking websites) which facilitate learning experiences outside school learning ecologies. This study has shown that the future of learning ecologies rest on the use of ICTs' to promote, civic competence among students. It is recommended that teachers should integrate computers and by extension the internet (a new agent of socialization) as support tools in teaching. Stakeholder in education as well as educational researchers should unyoke schools from the 'civic shocks' of globalization caught by students in virtual learning ecologies, which are beyond the control of the students.

As advantageous and demanding as these recommendations are, the research was carried out in Nigeria, therefore, caution should be exercised in generalizing to other developing countries. Notwithstanding these restraints, this study is philosophically relevant to the field of Teacher Education.

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