

# Emerging Technologies Supported in ICT Education

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**Abstract.** The authors introduce research, which provides a qualitative perspective on academics' use of emerging technologies on the institutional learning management system, to address the challenges of teaching Information and Communication Technology modules in an open and distance e-learning context. The paper proceeds to a literature review on research into how academics use emerging technologies to increase throughput rates, in some cases in open and/or distance e-learning contexts. Arguments presented center on formulating concepts within a theoretical and conceptual framework. The paper mainly discusses findings aimed at providing a qualitative perspective on academics' use of emerging technologies to address the challenges of teaching Information and Communication Technology modules in an open and distance e-learning context. Conclusions are presented, including a summary of the most important findings. The findings make an original contribution regarding emerging trends in, and promote the development of knowledge in fields related to, academics' use of emerging technologies.

**Keywords:** Emerging technologies · Information and Communication Technology · Open and distance e-learning

## 1 Introduction

### 1.1 Purpose and Objectives of the Study

The study reported on in this paper represents a single site study of the School of Computing (SoC), in the College of Science, Engineering and Technology (CSET) at the University of South Africa (UNISA). This institution of tertiary education offers open and distance e-learning, and draws its student population from all over the world. The institutional Learning Management System (LMS) offers a range of technologies aimed at maximizing the collaboration between academics and students.

The authors introduce research with the **aim** of providing a qualitative perspective on academics' use of emerging technologies for effective teaching to address the challenges of Information and Communication Technology (ICT) modules in an open and distance e-learning context. Although Mukasa-Lwanga and Goosen [1] investigated the use of such technologies towards effective and meaningful teaching in an open distance learning Computing context, their paper provided a quantitative perspective.

The cost of lack of throughput is very high, not only for higher education institutions, which offer Open and Distance e-Learning (ODEL), but also for their students. In order to work towards achieving the aim as stated, the **objective**, which will be used as focus for the research reported on in this paper, is to indicate how academics used various emerging technologies for selected School of Computing modules. Qualitative data, relating to how academics are using various emerging technologies for renewing their ICT teaching practices by building on the past to create new energies, and specifically for renewing their students' learning experiences and assessment, will mainly be provided.

## 1.2 Research Questions

The research reported here focuses on the following primary research question: How are academics using emerging technologies for effective teaching to address the challenges of ICT modules in an open and distance e-learning context? The secondary question to assist in delving into the primary research question is: What are academics' perceptions about the use of emerging technologies?

## 1.3 In the Remainder of This Paper

The paper proceeds to a review of the literature on research into how academics use emerging technologies for effective teaching, in order to thus increase throughput rates, in some cases in open and/or distance e-learning contexts. Main arguments presented center on formulating and situating significant concepts within an appropriate theoretical and conceptual framework.

Although some perspectives on quantitative findings are provided, the paper mainly discusses findings aimed at providing a qualitative perspective on academics' use of emerging technologies for effective teaching to address the challenges of ICT modules in an open and distance e-learning context.

Conclusions are presented, including a summary of the most important findings. The authors show how the findings of this research could make a significant and original contribution regarding emerging trends in, and the promotion and development of knowledge in fields related to, academics' use of emerging technologies for effective teaching in an open and distance e-learning context. By analyzing these findings, together with ideas for best practice provided in applicable literature, suggestions can be formulated to improve the instruction of ICT modules presented in an open and distance e-learning context.

## 2 Theoretical and Conceptual Frameworks

Koohang et al. [2] investigated learning objects from the perspective of constructivist theory through to application, and Frankola [3] interrogated why students drop out, while Swanepoel and Mays [4] worked towards a framework to support transformation through quality assurance at the University of South Africa.

## 2.1 Open and Distance E-learning Contexts

According to Van Schoor [5, p. 41], considerable research on student “retention and throughput has been done at residential” institutions of tertiary education. The University of South Africa definition of open distance education details it as “a multi-dimensional concept aimed at bridging” distances between students and their institution of tertiary education, academics, courseware and peers regarding time, geography, economics and communication [5, p. 40]. Open and distance e-learning “focuses on removing barriers to access” e-learning, flexibility of e-learning provision, student centeredness, supporting students and constructing e-learning programs with the expectation that students can succeed. Neuman and Blodgett [6] state that distance education offers the opportunity to increase students’ enrolment and promote diversity. According to these same authors, distance students in remote locations often indicate tremendous satisfaction, to reflect their appreciation for bringing the program to them.

Ng [7] stated that because of the major reasons of personal development, career advancement and socializing considerations, interest is a common purpose among such adult students. A student’s characteristics, however, influence training outcomes, because the individual’s ability and motivation affect performance [8].

The virtual nature of ODeL, however, together with the anonymity of students, present some challenges to the education system. In support of this statement, Block [9] asserts that open and distance students need to learn how to prioritize their lives and educational endeavors. In addition to this, Block [10] stated that distance requires students to consistently regulate their learning process. This is due to the multiple goals, which may be exhibited among open and distance students, and some goals may take precedence over others. Self-regulated learning is controlling one’s own conduct in order to achieve a goal. This is one personality trait that is considered important for students’ progress in an ODeL context. As Tuckman [11] puts it, many students treat the opportunity for self-pacing as an invitation to procrastinate. This is because the absence of an on-site lecturer makes this behavior difficult to control. Students need to make decisions about, and to exercise control over, their learning activities in terms of pace, depth and coverage of content, type of media accessed and time spent on studying [12]. A point noted by Taylor [13] is that for open and distance e-learning, students’ early engagement is more elusive than for on-campus students, and often only commences when an assessment task is due.

## 3 Literature Review

### 3.1 Learning Management Systems

Various studies, such as those by Frankola [3], Swanepoel and Mays [4] and Van Schoor [5], reiterated the importance of student support, specifically at institutions of tertiary education offering open and distance e-learning, to enhance overall student performance. Related literature, which presented opportunities for further investigation, included Davis and Venter [14] - although they looked at performance and success in an open and distance e-learning context, their students were postgraduate ones in a business module - and whereas Chen and Tsai [15] considered students’ attitudes

towards e-learning at Taiwan University, this paper will study academics' views from an African perspective.

Van Schoor [5] pointed out that the assessment of students' academic preparedness for studying in an open and distance e-learning context is one of the numerous factors, which contribute to success. Nel and Ndeya-Ndereya [16] pointed to the lack of face-to-face contact between open and distance e-learning students and their lecturers as one of the foremost reasons why e-learning contexts are often experienced as being impersonal, lonely and lacking social presence.

Because of their physical separation from their open and distance e-learning lecturers, some students could only use email and the discussion forums available on the learning management system to communicate - a student quoted in an article by Davis and Venter [14] really appreciated this. Picciano [17] shares the same view on the importance of interaction for a successful module, but advises that the nature and extent of the interaction have to be considered to equate the learning outcome. This is in line with the constructivist view of learning and the zone of proximal development, suggested by Vygotsky [18], which proposes that a student's cognitive development is highly dependent on social interaction and collaboration with more capable and knowledgeable others.

The development of a learning management system, myUNISA, "has seen the establishment of" e-learning support for all of the modules offered [4, p. 7]. There is, however, a need to develop an understanding that the overall student experience is affected by "a wide range of different stakeholder contributions and" interdependent activities [4, p. 9] as a result of "the cumulative effect of many subsystems that need to work in harmony." Such a context requires active student "engagement with the learning process and multiple opportunities for interaction between" both students and other students, as well as students and their lecturers [4, p. 17].

## 4 Research Methodology

Aspects relating to the data collection instrument, population, sampling technique and sample, validity and reliability of the instrument and data analysis were also discussed in an earlier paper [x].

### 4.1 Research Design

Mixed-method research was used to ensure that the evidence obtained would be enable the researchers to answer the research questions as unambiguously as possible [19]. Such a mixed-method research strategy is useful when only the qualitative or quantitative approach is inadequate to best understand a research problem [20].

When using a qualitative mode of inquiry, most data take the form of words, as opposed to figures, and generally, researchers search through and explore these until they develop a deeper understanding. A case study research design investigates a restricted system (the so-called 'case'), which employs numerous sources of data located in the situation. In the project discussed in this paper, the focus will be on

several entities (modules) [21], with each case represented by a particular module, selected for use as an example of a particular instance.

As an example of a research design that had been implemented in a previous investigation, Liu [22] used a phenomenological study as part of a qualitative, interactive design in order to investigate student interaction experiences in an open and distance e-learning context [23]. The study reported on in this paper also uses aspects of a phenomenological study, which attempt to describe participants' perceptions, perspectives and understandings.

## 4.2 Validity and Reliability

In terms of qualitative data collection, Maree and Van der Westhuizen [23] raised the argument that the intensely personal participation and comprehensive replies from participants capture adequate levels in terms of validity and reliability. The use of a variety of strategies to enhance validity is required in especially qualitative research, since the validity of such designs include the extent to which perceptions and interpretations made had shared meaning between participants and the researchers. Several resources ought to be employed for comparing findings with each other, for ensuring the internal validity of qualitative research [23]. As suggested by McMillan and Schumacher [21], decisions were therefore made on how to ensure that the data collected is valid. Reliability with regard to qualitative studies can be regarded as findings being consistent with data collected [23]. Dimensions towards reliability are therefore also being ensured in the more qualitative parts of the study.

McMillan and Schumacher [21] agreed that validity in quantitative research can also include issues of reliability. The use of multi-method strategies could produce diverse insights regarding topics of interest and augment how credible, transferable, dependable and confirmable such data and resultant findings, as well as the analysis thereof, are [21]. These strategies also allow for the inclusion of quantitative research, enabling McMillan and Schumacher [21] to indicate triangulation as being critical for the facilitation of interpretive validity. Such validity relates to data, interpretations and/or the conclusions arrived at by using a particular research method in a specific context for a certain reason [23].

## 4.3 Data Analysis

In agreement with suggestions by McMillan and Schumacher [21], the less experienced researcher (the second author) had especially qualitative data analyzed independently by another more experienced researcher (the first author), who had not been involved in obtaining the data. Findings could be analyzed to obtain a representation of the applicable participants and their contexts. Data analysis was done by coding, organizing and combining related information into themes and categories [24]. Two themes were identified, that is, how each classified event was used for ODeL and how it was used to increase pass rates.

## 5 Discussion of Findings

Aspects relating to numbers and rankings for the gross survival rates of selected modules across various years, including 2010, the averages for each of these modules, as well as for Learning Management System (LMS) use, were discussed in an earlier paper [x]. Table 1 shows that correlations between various of these aspects are all negative.

**Table 1.** Correlations for 2010 and averages compared to use of emerging technologies.

Elements being compared	Correlations for numbers	Correlations for rankings
2010 vs. LMS use (excluding no LMS use)	-0.308	-0.409
Average vs. LMS use (excluding no LMS use)	-0.371	-0.341

Please note that whereas Goosen and Mukasa-Lwanga [25] reported details relating to a sub-set of seven academics, this paper shows these for the full complement of thirteen. Just less than two-thirds (8; 62%) of the academics, who ended up participating in the interviews, were female, while the largest bracket of them are relatively young (see Table 2).

**Table 2.** Ages of participants.

Elements	Numbers	Percentages
36–40 years	6	46%
41–45 years	1	8%
46–50 years	3	23%
Older than 50 years	3	23%

Eight of the interviewees each had a Master’s degree as highest academic qualification, together with two Bachelor degrees and three Honors degrees. Four of the interviewees also had a Higher Education Diploma as formal educational qualification, while none of the others had any such educational qualifications.

Almost half each of participants had between five and ten, and between eleven and twenty years’ experience of teaching in an open and distance (e-learning) context, while only a single participant had more than thirty years (see Table 3). The majority of them also had more than 5 years’ experience of using the institutional learning management system (see Table 4).

It is important to note that the number of responses for the modules in Table 5 exceeds the number of academics interviewed, as most of them were interviewed in relation to more than one module that they had been involved with. The majority of the

**Table 3.** Experience of teaching in an open and distance e-learning context.

Elements	Numbers	Percentages
5–10 years	6	46%
11–20 years	6	46%
More than 30 years	1	8%

**Table 4.** Years' experience of using the institutional learning management system.

Elements	Numbers	Percentages
5 years	4	30%
More than 5 years	9	70%

**Table 5.** Average number of students on module.

Elements	Numbers	Percentages
100–250	6	30%
251–500	5	25%
501–750	3	15%
751–1000	2	10%
More than 1000	4	20%

applicable modules that were discussed with the academics during their interviews had an average of between 100 and 250 students usually taking these modules per semester/year. The fact that four of the modules discussed during the interviews have an average of more than a thousand registered students each, however, casts a whole new light on what these academics have to say ...

Table 6 shows that only one of these academics had three years' experience of teaching a particular module, two more on them had four years' experience, while the majority (ten) of the academics had more than that in terms of all of the other applicable modules.

**Table 6.** Years' experience of teaching a particular module.

Elements	Numbers	Percentages
3 years	1	8%
4 years	2	15%
More than 4 years	10	77%

As an example of what was discussed in the interviews, the primary academic of three modules chose to be interviewed on only one of these, because her use of technology was the same for the three modules. Based on the concept of ODeL, academic D would augment the module content using additional resources. She would

use announcements to inform students of any new happenings on the module. She referred to announcements as a means of bridging the communication gap between the academic and students. Students would also be made aware of where to access or buy the prescribed books. On these modules, academic D envisaged the use of discussion forums as an important means of promoting interaction among students.

## 6 Conclusion

The following conclusion section will review the main points of the paper, including a summary of the most important findings, elaborate on the importance of the work and suggest applications and extensions.

One way to explain the correlations found in Table 1, with regard to 2010 and averages compared to use of learning management system technologies, would be that for modules with relative high rates, less effort would be expected with regard to learning management system technologies, and the other way around. This explanation specifically held with regard to two of the modules that one of the academics were interviewed on: while these modules have rankings in terms of both 2010 and averages placing them firmly in the lowest third, these same modules both have rankings regarding myUNISA use in the top 10.

There are barriers/challenges to using emerging technologies in ODeL. So and Bush [26] talk about physical separation, which refers to the space between a student and academic, or between student and student. Although, as stated by academic D, the use of technology by academics and students bridges this gap, there is lack of social interaction [27], as well as feelings of isolation on the part of students, as pointed out by Andersson [28], and more effort is expected from ODeL students than students at residential universities [29].

The academics' responses during the interviews confirmed the effectiveness of using emerging technologies on the pass rates of modules, consequently leading to enhanced throughput rate. Wang et al. [30] **recommend** such initiatives, which help to improve pass rates.

These findings suggest that more dedication is still required from the students to control their learning, and through proper time management, they could contribute immensely to improving their performance. This finding also supports earlier research by Koohang et al. [2] and Schunk and Zimmerman [31].

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