

# Measuring the Impacts of E-Learning on Students' Achievement in Learning Process: An Experience from Tanzanian Public Universities

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**Abstract**— This paper is located within the 21<sup>st</sup> century global debates about the impact of e-learning as one of the ICT on students' achievements in teaching and learning process in universities. From the perspectives of Tanzania, this paper provides a model for measuring the impact of e-learning on students' achievements in universities. The rationale for the investigation stems from the notion that despite the hundreds impact studies, the impacts of e-learning on student's achievements remain difficult to measure and open too much reasonable debate. This raised contradiction and elusive findings on the conclusion based on the impacts of e-learning systems on student's achievement. A Mixed method research methodology involving survey and interviews was employed in the collection of data for building the model. Multiple regressions technique was used to analyze the hypothesized relationships conceptualized in the research model. The model was built and validated using structural equation modeling and Delphi technique respectively. Measuring e-learning impact on student's achievements, indicators such as student engagement, student cognitive, performance expectancy, student control, student satisfaction, continue using, student motivation, student self-esteem, student confidence on e-learning system have positive significance relationship with students' achievement. The model has the potential to policy makers, universities and other stakeholder to understand the impacts of e-learning after implementation in order to justify the total investment based on that technology. The novelty of this research lies in the extension of the findings in literature with constructs such as frequency use and intention to use e-learning in learning context.

**Keywords-** *E-learning, learning process, impacts of E-learning, Tanzania Universities, Public Universities*

## I. INTRODUCTION

Information and Communication Technologies (ICTs) have influenced the landscape of education sector by changing the way various education activities are being conducted. The creative development of information technology, aided to the access to efficiency of learning processes in universities (Lwoga and Komba, 2015), as a results, there is a leading to improved students' achievements. This associated academic career achievement provides the promise for meaningful

employment of graduates as well as movement towards a knowledge-based economy and rapid national economic growth (Olson et al., 2011). As a result, both governments and higher learning institutions in developed countries have invested in e-learning systems. As such, electronic learning systems (e-learning systems) have become a major phenomenon in recent years (Tossy, 2012) as transforms teacher-centered teaching and learning system into a student-centered one (Truncano, 2005). Further, this transformation enables students to develop their problem-solving abilities; information reasoning and communication skills; improves creativity and other higher order thinking skills (Rosenblit et al., 2005). The e-learning system indeed changes the way in which learning of education activities are conducted (Tossy, 2012; Lwoga and Komba, 2015); offers efficient use of time and ease sharing of educational materials between students and staff (Shivaraji et al., 2013) and improves the quality of teaching and learning (Kahiigi et al., 2008; Jones, 2011).

Despite these notable attributes of utilization of e-learning in learning, its impact on student's achievements remain difficult to measure and open to debate as there are few conclusive statements (Truncano, 2005; Rosenblit and Gros, 2011). Others argue that there is a contradiction on the conclusion on the impacts of e-learning systems on student's achievement (Hilz et al., 2001; Trancore, 2005). It is also argued that data to support the perceived benefits from e-learning technologies are limited and evidence of effective impact is elusive (Eurydice, 2011; Bocconi et al., 2013; Pandolfini, 2016). In developing countries, there is paucity of information about the relationship between e-learning technologies and student's achievement (Rosenblit et al., 2011). There is thus a need to carry out more research, notably to develop useful indicators and methodologies that need to be used in measuring the impact of e-learning in teaching and learning in developing countries including Tanzania in order to guide policy formulation. This is important because developing countries including Tanzania are still at very basic stage of e-learning technology adoption. Tanzania needs to tap into

experiences of universities in developed countries that have long experience of using e-learning so as to formulate innovative corrective measures.

## II. E-LEARNING

Wentling et al. (2000:5) define e-learning as:

*“The acquisition and use of knowledge distributed and facilitated primarily by electronic means. This form of learning currently depends on networks and computers but will likely evolve into systems consisting of a variety of channels (e.g. Wireless, satellite), and technologies (e.g. Cellular phones, etc.) as they are developed and adopted. E-learning can take the form of courses as well as modules and smaller learning objects. E-learning may incorporate synchronous or asynchronous access and may be distributed geographically with varied limits of time.”* (Wentling et al., 2000:5).

From the definition above, E-learning imprisons a wide range of terms (Albert & Mori, 2001) referred to as ‘labels’ which have been used to describe the concept of e-learning. These labels include, but are not limited to Web Based Learning (WBL), Web Based Instruction (WBI), Web Based Training (WBT), Internet Based Training (IBT), Online Resource Based Learning (ORBL), Advanced Distributed Learning (ADL), Tele-Learning (T-L), Computer-Supported Collaborative Learning (CSCL), Mobile Learning (M-learning or ML), Nomadic Learning, Off-Site Learning [Collis, 1996; Khana, 2005; Yieke, 2005; Bates, 2001; Dam, 2004; Goodear et al., 2001; Pegler & Littlejohn, 2007; Dabbagh et al., 2000; Barbara, 2002, 2004; Cramer et al., 2000; Salzbert & Polyson, 1995; Schreiber, et al., 1998; Schank, 2001; Howard, 2003; and Singh, 2003]. The e-learning term is used interchangeably with other related terms such as online learning, virtual learning, and web-based learning (Twaakyondo, 2004).

Tossy (2012) argues that while The use of e-learning has the added value of flexibility (“anywhere, anytime, anyplace”), E-learning facilitates both learner engagement and the engaging of experiences (Uys, 2004; Meyen, 2000; 2002). Meyen (2002) demonstrate how e-learning helps to overcome the traditional barriers to education delivery. These barriers include lack of physical infrastructure, lack of qualified teaching staff, absence of adequate education budgets, and the failure of traditional pedagogy and curricula. East African countries are characterised by these barriers (Ndume et al, 2008). The failure of the government’s efforts in building physical classrooms has created an opportunity for innovative education delivery via e-learning (Yieke, 2005). As Alavi and Leidner (2001) argues that e-learning’s importance will grow right across the educational spectrum from primary to HEIs, the e-learning implementation in Tanzania HEIs is taking place despite the various outlined barriers. The e-learning implementation differs from one HEI to another.

## III. TANZANIA HIGHER EDUCATION STATUS

According to TCU (2010), the education sector in Tanzania has grown drastically for the past fifty (50) years; this has been due to an increase in the number of Higher Education Institutions (HEIs). The students’ enrolment has increased tremendously since independency. As MoEVT (2011) states that the number of students enrolled in HEIs increased drastically. In 1961, Tanzania had 1,737 students enrolled in 4 HEIs, while in 2011 a total of 244,045 students in 358 HEIs (MoEVT, 2011). This emanated from free markets which encourages establishment of both private and public HEIs, backed by various government policies on education sector such as Vision 2025, ICT Policy and Higher Education Master Plan (HEMP), which enhance the establishment of both private and public HEIs (Maliyamkono, 2006:396-445). Despite the fact that the number of HEIs has increased since 1961, the pace of increase of students compared to overall national population growth doesn’t match the enrolment offered by these institutions (Maliyamkono, 2006). This is due to limitation on enrolment capacity, geographical constraints, cost of education, lack of enough infrastructures, lack of qualified personnel and lack of innovative ideas (Chiemelie, 2012). In the light of those challenges, e-learning is sought to be the ultimate solution in which the enrolment does neither depend on the infrastructure nor geographical locations (Noe, 2005). As MoEVT (2011) argues that the HEIs should deploy e-learning for their day to day training activities, in order to minimize training cost and to remain competitive in the market. Furthermore, while MoCT(2003) articulates the need for harnessing ICT opportunities to meet the vision 2025 goals by blending strategic ICT leadership; ICT infrastructure; ICT Industry through Human Capital, MoEVT (2007) stipulates that Tanzania needs national e-learning sensitization by stressing the effort on applications such as distance education, e-learning, m-learning and blended learning.

## IV. E-LEARNING AT HEIS IN TANZANIA

Dr. Gajaraj Dhanarajan (2001:9), President of the Commonwealth of Learning, argued that:

*“One would be foolish to question the importance of the internet and www for education in this new decade; at worst it has the ability to connect communities of learners and teachers and at its best it could very well be the tool that education has been waiting for these past thousands of years; its promise is only limited by the imagination and capacity of the people who can apply and benefit from it”.*

This kind of vision of a future electronically driven and inclusive education has been a driving force for HEIs in Tanzania and has provided the spur to implement e-learning. As is the case with other African countries, the rate of implementation of e-learning platforms in Tanzania is still very

slow despite the potential opportunities provided by open source technology and the conducive environments created by the respective governments. There have been some initiatives on the part of governments to develop ICT policies as a way forward in the implementation of e-learning. In addition there have been different round table conferences and the formation of the Tanzania Commission of Universities (TCU) has fostered a debate on a common education delivery. For example, Tanzania has abolished all taxes related to computers and related equipment and reduced licence fees and royalties payable by the telecommunication operators (Morrison & Khan, 2003 and McPherson & Nunes, 2008). The more established public and private HEIs have managed to implement e-learning platforms in Tanzania. They are implementing these using either open source or customized platforms such as WEBCT, Blackboard, Moodle, Joomla, etc. Other universities in the Tanzania have started the basic process of ICT infrastructure expansion to include local area network implementation, Internet, computer labs and other facilities, as a way forward to the establishment of e-learning (Sife, et al., 2007).

## V. E-LEARNING MARKET AND THE DRIVERS OF CHANGE IN TANZANIA

E-learning is not a new phenomenon in the developed world. However, may be new to some developing countries including Tanzania. Its market is rapidly increasing globally. While Merrill Lynch (2003) argues that the e-learning is the fastest growing sector in the developed countries, Many developing countries (including Tanzania) are striving to implement e-learning in HEIs. Doughty et al. (2001) and Saint (1999) have documented the rise of the virtual university in Africa (including Tanzania). There are many e-learning initiatives in progress in Tanzania, such as Schoolnet, e-learning centres, and African Virtual University (Ndume, et al., 2008; Sife et al., 2007). The increase in the demand for higher education is one of the driving forces for implementing e-learning. Higher population growth, lower education costs, increased access to education, and higher participation rates in higher education changes the way firms organize work and cost-effectiveness and are factors driving the implementing of e-learning in Tanzania (Ndume et al., 2008).

## VI. METHODOLOGY

### A. Conceptual Model and Research Hypothesis Development

The research model for this study was formulated based on the concept of information system (IS) success model adapted from DeLone and McLean (1992). The model consists of three dimensions each consists three constructs as illustrated in Figure 1. This paper therefore uses this conceptual model to underpin the measurement of the impact of e-learning system on student's achievement in Tanzania universities.

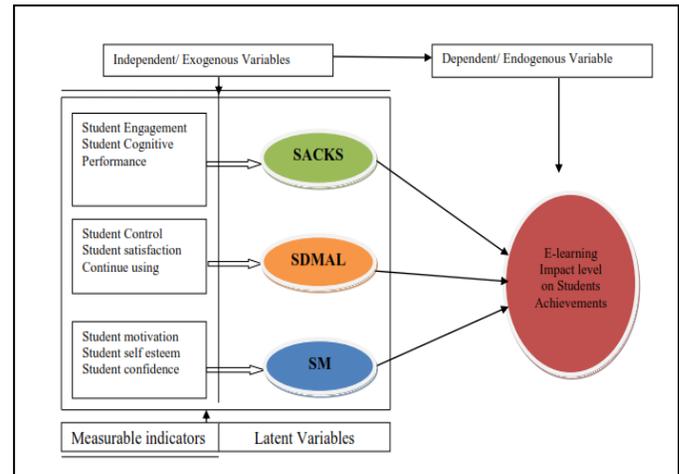


Figure 1: Conceptual Model Adapted from (DeLone and McLean, 1992)

Based on the conceptual model depicted in Figure 1, the following hypotheses were proposed:

Students' acquisition of knowledge and skills (SACKS)

H1. Students' engagement on using the system has a significant positive relationship with their achievements

H2. Students' performance expectancy has a significant positive relationship with students' achievement

H3. Cognitive learning using e-learning system has a significant positive relationship with students' achievement

Students' development maturity as autonomous learner (SDMAL)

H4. Students control on using e-learning system has positive relationship with students' achievement

H5. Students continue using e-learning system has positive relationship with students' achievement

H6. Students' satisfaction on e-learning system has positive relationship with students' achievement

Students Motivation (SM)

H7. Student's motivation on using e-learning system has positive relationship with students' achievement

H8. Students self esteemed on e-learning system has positive relationship with students achievement

H9. Students' confidence on e-learning system has positive relationship with students' achievement

The study used a survey design, involving 4 universities with long ICT experience. These were thus purposively selected amongst 30 universities in Tanzania. Three hundred and fifty

(350) respondents used in this study, thereby 306 respondents equal to 87.5% representing the planned respondent pool. The survey questionnaire consisted of five point Likert scales (Likert, 1932) was employed. The in-depth interview was employed to collect qualitative data from ICT experts during model validation. The data was then analyzed quantitatively and qualitatively respectively to identify different indicators and aspects relating to the measure of the impact of using and not using e-learning systems on students' achievements. The empirical data were analyzed using multiple regressions and structural equation modeling (SEM) using Statistical Package for Social Science (SPSS). The multiple regressions were used in analyzing hypothesized relationships conceptualized in the research model. In order to validate the model, the Delphi Technique was employed (Harold and Murray, 1975) and a new model was developed accordingly (Rowe and Wright, 1999).

## VII. RESULTS AND DISCUSSION

### A. E-Learning Experience and Awareness

The study revealed that 75% of the respondents were exposed to e-learning systems based on whether one had ever used it for learning; attended a course on e-learning (9.5%); heard about it from a colleague of other institutions or seen a colleague using it (2%). It was further evident that 79% of students were aware of the use of e-learning frequently in their day-to-day learning activities, while 65% were found to have intention of using e-learning methods in their academic career. These results match with those of previous studies by Alexander (2008) and Mazman and Usluel (2009) which found that the more a person is involved in Internet or Web activities, the more they are likely to use e-learning. It is therefore more likely that, in developing countries particularly Tanzania, use rate of e-learning methods is likely to increase if university can afford to embrace them in institutional operations.

### B. Indicators of the impact of e-learning

The results of the multiple regressions are shown in Tables 1, 2 and 3.

TABLE 1: SACKS INDICATORS OF STUDENTS' ACHIEVEMENTS

Students Achievement (Measure)	Indicators	$\beta$	t-value	Significance	Tolerance	VIP	$R^2$
SACKS	(Constant)	.412	2.304	.012			.513
	SE	.268	.886	.271	.926	1.079	
	SC	.618	7.854	.000	.641	1.560	
	PE	.596	7.617	.000	.641	1.679	

The results in Table 1 show that indicators such as student's engagement (SE), student cognitive learning using e-learning methods (SC) and the performance expectance (PE) on e-

learning had positive relationship with the student's achievement.

TABLE 2: SDMAL INDICATORS OF STUDENTS' ACHIEVEMENTS

Students Achievement (Measure)	Indicators	$\beta$	t-value	Significance	Tolerance	VIP	R <sup>2</sup>
SDMAL	(Constant)	.412	2.304	.012			.684
	SCO	.191	.092	.244	.807	.931	
	SS	.730	8.181	.000	.641	1.560	
	CU	.592	6.211	.000	.641	1.559	

The results [Table 2] further show that indicators such as students' control on using e-learning (SCO), students' satisfaction (SS) and continued use of e-learning had positive relationship with the students achievement.

TABLE 3: SM INDICATORS OF STUDENTS' ACHIEVEMENTS

Students Achievement (Measure)	Indicators	$\beta$	t-value	Significance	Tolerance	VIP	R <sup>2</sup>
SM	(Constant)	1.106	6.88	.000			.896
	SSE	.323	4.409	.000	.641	1.560	
	MT	.545	7.191	.000	.641	1.679	
	CON	-.069	.881	.257	.903	1.108	

Table 3 indicates that students' self-esteem on using e-learning (SSE) and student motivation (SS) had positive relationship with the students' achievement with the exception of students' confidence on using e-learning.

performance expectance ( $\beta = .596, p < .01$ ); student cognitive learning (SC) ( $\beta = .618, p < .01$ ) control on using e-learning ( $\beta = .191, p < .01$ ); continued use of methods ( $\beta = .592, p < .01$ ); satisfactions ( $\beta = .730, p < .01$ ); motivation ( $\beta = .545, p < .01$ ); self-esteem ( $\beta = .323, p < .01$ ) and confidence on e-learning ( $\beta = -.069, p < .01$ ). Only student confidence on using e-learning in learning context was not supported.

C. A Model for Measuring E-Learning Impact on Student Achievement

The previously hypotheses were tested using SEM. Of the nine relationships, eight were statistically significant (Table 4). These were student's engagement (SS) ( $\beta = .268, p < .01$ );

TABLE 4: SUMMARY OF HYPOTHESES TESTED

	Hypotheses	Accepted/Rejected	$\beta, p < .01$
<b>H1</b>	Students' engagement on using the system has a significant positive relationship with their achievements	Accepted	.268
<b>H2</b>	Students' performance expectancy has a significant positive relationship with students' achievement	Accepted	.596
<b>H3</b>	Cognitive learning using e-learning system has a significant positive relationship with students' achievement	Accepted	.618
<b>H4</b>	H4. Students control on using e-learning system has positive relationship with students' achievement	Accepted	.191
<b>H5</b>	H5. Students continue using e-learning system has positive relationship with students' achievement	Accepted	.592
<b>H6</b>	Students' satisfaction on e-learning system has positive relationship with students' achievement	Accepted	.730
<b>H7</b>	Student's motivation on using e-learning system has positive relationship on students' achievement	Accepted	.545
<b>H8</b>	Students self esteemed on e-learning system has positive relationship students' achievement	Accepted	.323
<b>H7</b>	Students' confidence on e-learning system has positive relationship on students' achievement	Rejected	-.069

With the latent variables presented in the conceptual model, Structural Equation Modeling (SEM) approach (Bollen, 1998; Hoyle and Panter, 1995) was used to determine the cause-effect relationships among the latent variables with their indicators and the e-learning on students' achievement in education. Three regression models were developed and used to determine the value of dependent variables. The regression models were developed for Students' acquisition of knowledge and skills (SACKS); Students' development maturity as an autonomous learner (SDMAL) and Motivation (SM). SACKS indicators were student engagement (SE); cognitive capacity (SC) and Performance expectancy (PE). It was further apparent that SDMAL measurable indicators were student control (SCO); satisfaction (SS); continued use (CU) and the measurable indicators for SM were student motivation (MT); self-esteem (SSE) and confidence (CON).

Based on the findings, the initial regression models were as follows:  
 $SACKS = 0.268SE + 0.596PE + 0.618SC \quad R^2 = 0.513 \dots \dots \dots (1)$

$$SDMAL = 0.191SCO + 0.592CU + 0.730SS \quad R^2 = 0.684 \dots \dots \dots (2)$$

$$SM = 0.545MT + 0.323SSE - 0.069CON \quad R^2 = 0.896 \dots \dots \dots (3)$$

Where:  
 SE = Student Engagement: SC = Student Cognitive: PE = Performance expectancy  
 SCO = Student Control: SS = Student satisfaction: CU = Student Continue Using  
 CON = Confidence: MT = Student Motivation: SSE = Student Self Esteem

The entire model was found to have a significant fit for the study, as all the three regression models had  $R^2 \geq 0.5$  (Hoyle and Panter, 1995). All hypotheses from H1 up to H8 were found to have significant positive relationship with the student's achievement. However, on the hypothesis (H9), the study revealed that students' confidence on e-learning system had a negative relationship with students' achievement. However, this was contrary to the findings of the study conducted by Olson et al., (2011).

Further from the findings above, it is clear that, student engagement, student cognitive capacity, performance were the key indicators of the latent variable which is *students' acquisition of knowledge and skills (SACKS)* for one to realize how e-learning impacts on student teaching and learning achievement. In addition students' control, satisfaction and continued use of e-learning strategies were indicators of the latent variable, which is *Students' development maturity as an autonomous learner (SDMAL)* which is known to have an influence on student's teaching and learning achievements. The findings further show that self esteem and motivation were indicators of the latent variable which is *Students Motivation (SM)* that had positive significance on students' teaching and learning achievement. In exception the study shows that student's confidence on e-learning had a negative impact on student's achievement. These findings agree with those of Olson et al. (2011) and The McGraw Hill report (2011).

#### D. Model Validation

The model was validated using the Delphi Technique based on the assumptions that a group expert judgment is better than an individual judgment (Amiresmaili et al., 2011). Therefore, two different groups composed of panels of ICT experts were formed with the view to discuss and evaluate the model. The experts were technical personnel; lecturers specialized in e-learning and consultants of e-learning. All relevant determinant factors obtained from Section 2 were critically discussed by panelists and compared. The expert judgments arising were then used to test the validity of the model, which was then refined using inputs from the workshop. The model finally established was a function of Students' acquisition of knowledge and skills (SACKS), development maturity as an autonomous learner (SDMAL), Motivation (SM) and Behavioral Intension (BI) as latent variables, each with measurable variables as presented in section 3. This relation is depicted mathematically as follows:

$$\text{Measurement Model} = f(\text{SACKS}, \text{SDMAL}, \text{SM}, \text{BI}) + e$$

This further shows that the model had the potential to improve the measurement of e-learning impact on student's achievement in order for the management at an institutional level to make decision based on the impact. This is envisaged to help to realize the net benefit to justify the total investment.

#### VIII. CONCLUSION AND RECOMMENDATION

This study shows that developed model [Figure 2] has the potential to be used in measuring the impact of e-learning on students' achievements in universities and other institutions. Results obtained through a mixed research method approach revealed that Student Engagement (SE), Cognitive capacity

(SC), Performance expectancy (PE), Control (SCO), Continued use (CU), satisfaction (SS), Confidence (CON), Motivation (MT), Self Esteem (SSE) are important measurable indicators of the model. In particular, intention to use (IU) and the Frequency of using (FU) e-learning are measurable variable from behavioral intension (BI) which are of particular importance in evaluating its impact on students' achievement. These are novel additions indicators to measure e-learning technology utilization impacts using the developed model. These results call for more research that focuses on evaluating the impact of e-learning systems on students' achievement in teaching and learning using the developed model in this study. The developed model as a result of this paper is important as it help policy makers, university managements and other stakeholder to measure the impact of e-learning in order to understand the status of e-learning for justifying the total investment in learning context.

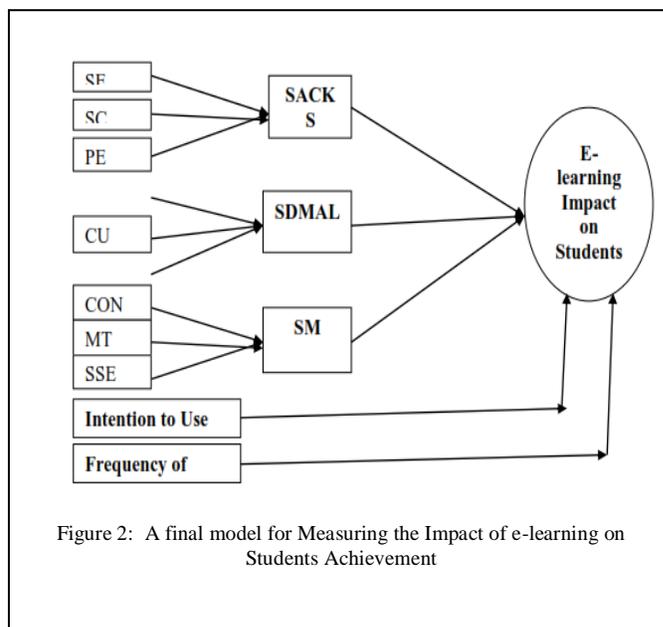


Figure 2: A final model for Measuring the Impact of e-learning on Students Achievement

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## AUTHOR PROFILE

**Dr. Titus Tossy** is a lecturer of information systems at Mzumbe University, Faculty of Science and Technology in the department of Computing Studies. Dr. Tossy has 13 years of teaching experiences in higher learning institutions in Africa and UK.



Dr. Tossy's main research interest is in understanding the uses of ICT for national Development as well as how people, span organizational, professional, and cultural and other boundaries in the process of building and using new technology. He uses qualitative and quantitative methods and a range of social and organizational theories in his work including classic grounded methodology. He currently studies Data sciences and its impact on national development, and impact of e-learning in education in Africa. In 2007, he received a SPIDDER grant to establish national e-learning at the open university of Tanzania. In 2009-2010, He received the University of Cape Town award to study the main concern of e-learning providers working in east Africa. In 2012, he was a founding director of Tanzania Business School. Before joining Polytechnic of Namibia, Prof. Tossy worked as the founder of various postgraduate studies and research initiatives in various universities, such as MBA in Information Technology Management, MSc in IT security, MSc in computer applications and MSc in Software Engineering. He also developed strong research, and training collaborations with various universities. Dr. Tossy received his Bsc (Hons) in Computer Science and Statistics from university of Dar es salaam and MBA in Information Technology Management from Coventry University. He received her Doctor of Philosophy in Information Systems from University of Cape Town.



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