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Technology innovation diffusion at the University of Botswana: A comparative literature survey

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ABSTRACT

The purpose of this study was to identify factors that influence adoption and diffusion of information and communication technology in developing countries through a thorough review of past and current literature, focusing on the case of University of Botswana. Despite the value in adoption and diffusion of technology innovation in the developing world, universities are faced with problems, and studies show that generally, accessible and available technology implementation is not successful. Rogers (2003) concepts of social systems, compatibility of technology, early adopters and factors, are complex. This includes organizational characteristics focusing on policies, faculty support through professional development and training, time, beliefs, and workload. The article concluded that (a) the social system (university administration) develops policies, which accounts for little when the technology plan is not concrete for implementation, (b) technology is not compatible with faculty traditional teaching practices, and (c) university administration does not consider understanding the faculty (early adopters) in context. The study suggests that developing countries need to understand the faculty as early adopters from a bottom-up approach instead of top-down, and should not base success on outcomes, but rather, strategies based on the context.

Keywords: *diffusion and adoption of innovation technology; ICT; social system; compatibility of technology; early adopters, developing countries, University of Botswana*

INTRODUCTION AND BACKGROUND

This article reviews the past and current related literature on adoption and diffusion of technology innovation in developing countries, particularly University of Botswana. Although University of Botswana introduced e-learning in 2001, current literature shows that accessibility and use of available technology is still low (Dintoe, 2018). Similarly, at the Botswana University of Agriculture and Natural Resources, Moakofhi, Leteane, Phiri, Pholele and Sebalatlheng (2017) found challenges that impede the introduction of e-learning at their university, namely lack of management support, inadequate IT support, poor infrastructure, and lack of e-learning policy (p.15). The purpose of this study is to understand the factors that influence use of accessible and available technology by faculty in higher education based on Rogers (2003) Diffusion of Innovation (DoI) theory. Although, information and communication technology (ICT) is introduced and implemented in universities for teaching and learning, little use of accessible and available technology is adopted and diffused by the faculty in developing countries (Chirwa, 2018; Karunaratne, Peiris, & Hansson 2018), particularly University of Botswana as compared to Western world universities. Rogers' three theoretical concepts were used to develop an understanding of

the factors that influence the adoption and diffusion of technology innovation in higher education, namely social systems, compatibility of technology, and early adopters.

Several studies have used general diffusion theories of technology innovation building on Rogers' theory in adopting and diffusing an innovation technology in higher education systems from a macro and/or a micro level (Carr Jr., 1999; Less, 2003). In this regard, Rogers' theory (2003) has been widely used to understand why the adoption and diffusion of innovation varies across different social systems. According to Rogers (1995), diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5), where the 'innovation' can be anything that is seen as new, from the perspective of the adopters. This is the most commonly quoted theory in the field of diffusion of innovation and is based on four main elements of diffusion: innovation, communication channels, time, and the social system. This theory has informed many studies, theories, and models in the field of diffusion (Burkman, 1987; Davis, 1986; Hall & Hord, 2014; Surry & Farquhar, 1997; Surry, 1997). Of the many relevant studies, Rogers' theory has been used to understand why some individuals adopt technology innovation and others do not. In this regard, Rogers (1962) argues that adoption and diffusion of technology follows a normal distribution by all. This means that there is bias towards the need to diffuse technology without considering the consequences of the adoption of the technology. In addition, when an innovation fails, the early adopters are often blamed rather than other factors in the diffusion process, such as the social system within which they operate and characteristics of the technology they use. Rogers (1962) argues that this constitutes individual blame bias because there is a "tendency of diffusion research to side with change agents who promote innovations than with the audience of potential adopters" (p. 103). Rogers claimed that individual adopters as members of the social system do not equally adopt the diffusion of an innovation. The change agents are interested in the rapid adoption and diffusion for immediate results without considering the consequences within the social system. The three main keywords or concepts of Rogers (2003) - social system, compatibility of technology, and early adopters – inform the factors that influence adoption and the diffusion process in this study.

Briefly, it is from this background that generally the university administration does not operate in isolation in the implementation of technology use. The literature from developing countries have shown that it depends on the context; technology is not always normally adopted and diffused for use by adopters (faculty), while others reject because of different socioeconomic backgrounds (Dintoe, 2018, Jacobsen, 1998). The other point is that a university implements technology, through faculty with the expectation to work collaboratively for a common goal. Studies have noted that the system: organization with structures (Rogers 2003) and the characteristics of technology, impacts on the rate of adoption (Samarawickrema & Stacey, 2007). This occurrence has led to the level of adoption and diffusion of ICT being significantly low in developing countries higher education systems like University of Botswana, compared to more developed countries.

It is common for faculty to be blamed for failure of adoption and diffusion of technology use, yet the faculty operates in a social system that has processes and procedures to follow. Samarawickrema and Stacey (2007) found that Rogers (2003) does not include all factors that influence the use of technology in teaching and learning. Kanwal and Rehman (2017) argue that in developing nations:

> *"… the development, implementation, and usage of e-learning systems depend on contextual, social, and cultural aspects, which differ from one country to another" (p.10969)*

These researchers noted that system characteristics are factors influencing adopter behaviours in e-learning. In addition, King and Boyatt (2014) concluded that institutional infrastructure; staff attitudes and skills are influential factors for adoption of e-learning. Arkarful and Abaidoo (2015) from a Ghana context noted motivation and time management skills as influential factors. Based

on this, the article specifically reviews literature more thoroughly on the factors that influence faculty adoption and diffusion of technology in the higher education systems of developing countries. At the University of Botswana, the literature indicates limited use of technology implementation by faculty to support pedagogy (Dintoe, 2018).

The paper first reviews the University of Botswana literature in comparison to, other developing countries and finally presents discussions, conclusions and recommendations for further work in this area.

Problem Statement

Although ICT has been proposed and implemented in higher education for teaching and learning, the problem of ICT adoption and diffusion in pedagogies is ongoing. The published literature shows that factors influencing use of ICT in pedagogies have been reviewed in different contexts in both developing and developed world universities. Most of the studies have ignored the complexity of factors that influence adoption and diffusion of ICT in pedagogies in general; the majority of the researchers had selected one specific element for their study of adoption and diffusion. However, studies have argued that rigorous research is necessary in developing countries to depict issues on ICT adoption and diffusion. To address this gap, this study reviews literature more thoroughly on University of Botswana in comparison to other developing countries based on Rogers (2003) three concepts namely social systems, compatibility of technology and early adopters as determinants that might affect adoption and diffusion of technology.

Purpose of Study

The main purpose of the study was to identify the factors that influence the adoption and diffusion of technology innovation by faculty in higher education in developing countries.

Methodology

The paper reviews literature on adoption and diffusion of technology innovation identifying factors that influence faculty's acceptance in higher education. The paper starts by identifying the factors based on Rogers' three concepts that is social systems, compatibility of technology and early adopters followed by empirical literature survey targeting studies from developing countries with reference to University of Botswana. The purpose of the literature survey was to show various analysis and research from the field and results already published. The research method employed in this paper emerged from the literature review and sources from the last decade including journals, conferences, books, and websites (Bagarukayo & Kalema, 2015) which were used to situate the current study within the body of relevant literature and provide context for the readers. It is on this basis that the literature survey focused on the studies that have used diffusion of innovation theory (Rogers, 2003).

Rogers Theory - Diffusion of Innovation

In review, Rogers' three key components of the theory influenced this study: the concept of social systems, the idea of compatibility of technology, and the categorization of early adopters as described in subsequent sections below. Rogers (2003) claims that innovation is diffused through a population in a social system based on key attributes such as compatibility by early adopters. He focused on the social system from a macro level, that is, the organization, as well as the individual adopters – the micro level. Rogers' views based on these three concepts resonate with the researchers of instructional technology models, which were developed through his (1962, 1995, 2003) Diffusion of Innovation (DoI) theory. The instructional technology models with micro and

macro theories are briefly discussed below, synthesizing their particular concepts to Rogers' three conceptual frameworks specifically to guide this study.

The Technology Adoption Model by Davies (1986), and further developed by Vankadesh in 2000, has three variables for the purpose of this paper Perceived usefulness is related to the individual's beliefs, values, needs, and attitudes, similar to Rogers' (1962) innovation technology's compatibility concept. In addition, the Concern Base Adoption Model (Hall & Hord, 2006, 2014) is similar as far as it focuses on school changes in the education system from a macro level but zeros in on concerns of individual adopters and their level of behavior in using innovation technologies as change agents from a micro level perspective. However, Rogers viewed the change agents as social systems (as an organization) from a macro level while acknowledging the fact that individual adopters from a micro level bring change based on the changes by the organization. Rogers' theory can be used from a macro, social systems as a larger scale, or micro level, focusing on individual adopters as people. In relation to this study therefore, the concept of 'People' from Surry (2002), Surry, Ensminger, and Jones (2003) Resources, Infrastructure, 'People', Policies, Learning, Evaluation, and Support model is similar to the views of Davies (1989), Hall and Hord (2014). They claim that individual adopters from a micro level perspective also influence the adoption and diffusion of innovation technologies in the system from a macro level, which further resonates with Rogers' three concepts that guides the present study.

The emphasis of this study is on 'People' as change agents on how the micro (People), from an instrumentalist view (adopter-based) approach towards the organization (university), is influenced or affected by the macro larger scale of a systemic change, which is the organization (university), into adoption and diffusion of technology referred to as a determinist (developer-based) approach. On this basis therefore, of all the above theories: determinist (developer-based), instrumentalist (adopter-based), instructional technology models (Technology Adoption Model, Concern Based Adoption Model, and Resources, Infrastructure, 'People', Policies, Learning, Evaluation, and Support model) have common views, which resonate with Rogers' (2003) three conceptual frameworks. This study focuses on how the 'People' as early adopters from a micro systems instrumentalist adopter-based bottom-up approach can bring the evolution or change in to the social system, a larger scale of top-down determinist developer-based systemic change approach. On this basis, Rogers's theory is discussed below in the context of higher education using his three conceptual frameworks focusing on 'People' as individual adopters from a micro level perspective, acting as change agents based on social systems mandates through which they operate as early adopters using compatible technology for teaching and learning.

LITERATURE REVIEW

The purpose of this section is to review specific literature on developing country contexts with specific reference to the University of Botswana. The focus is on understanding factors that influence faculty adoption and diffusion of innovation technology at the University of Botswana in comparison to other studies in developing countries.

Technology Innovation Diffusion at the University of Botswana

Overview

According to Mutula (2002), e-Learning technology was introduced in 1999 and implemented at the University of Botswana in 2001 to enhance and facilitate teaching and learning for effective modes of learning, similar to other African countries. The University of Botswana implemented eLearning: ICTs to promote web-based learning. Uys (2003) noted that "the focus on eLearning at University of Botswana was therefore a blended approach in which various modes; methods and media were

integrated and organised for appropriate learning" (p. 5). When eLearning was introduced at the University of Botswana, it was predominantly a blended learning approach and lecturers were trained to provide them with skills and knowledge in eLearning (Mutula, 2002).

There are limited studies conducted in Botswana using Rogers' theory; notable examples are Masalela (2006, 2009) and Thomas (2008). One of the studies (Totolo, 2007) used the Technology Adoption Model by Davies (1989), which is similar and relevant to Rogers' theory. Masalela, 2006, 2009; Thomas, 2008) reported on successful adoption and diffusion processes as well as challenges such as a lack of clear policies, a lack of technological infrastructure, a lack of accessibility and availability, organizational support, a lack of professional development and training, role changes, large classes, and increased workload. These benefits and challenges identified in the use of technology in education in Botswana are evidenced in the following reviews and are discussed based on Rogers's three concepts.

Social System

The three studies of Masalela (2006, 2009 and 2011) were based on University of Botswana from an administrator perspective in facilitating the adoption and diffusion of technology innovation by faculty for teaching and learning.

Masalela's (2006) case study examined factors that influenced the decision of faculty members to participate in online learning at the University of Botswana. The findings of this study suggested that the adopters were intrinsically motivated to teach online courses while non-adopters noted personal needs and extrinsic motivations for participation. The researcher concluded that a lack of policy, reward structure, release time, and faculty needs could prevent faculty members from teaching online courses at the University of Botswana. The study recommended ongoing training, a comprehensive "one-stop" shop for assisting online students with all the transactions, release time to learn and integrate new technology, rewards for faculty who teach online courses, clear online learning policies, technical and instructional support, and more SMART Boards in f2f classrooms. The University of Botswana's commitment to address the issues of resources and the continued support of faculty and open communication could increase the likelihood of overcoming identified barriers and ensure the faculty's continual participation in online learning.

Masalela's (2009) qualitative study examined factors that influenced faculty members' decisions to use blended learning at the University of Botswana. She used Rogers' (2003) DoI theory to interpret the findings, focusing on attributes of innovation: relative advantage, compatibility, complexity, trialability, and observability. Masalela found that early adopters experienced benefits as a result of using blended learning such as improved pedagogy, engagement in learning, and flexibility. Both adopters and non-adopters experienced some challenges and concerns, including the need for time to learn how to use and integrate technology, a lack of equipment, large classes, a heavy workload, a lack of technical support and training, the lack of a policy for online/blended learning, a lack of incentives, and poor management. She concluded that there is a need for a paradigm shift that needs strategic leadership and good decision-making from the University of Botswana through planned, organized and managed systems for transformational change to promote blended learning.

Masalela's (2011) paper articulated, "the flaws attributed to lack of a comprehensive institutional strategy for eLearning and a framework that is based on shared vision with all the stakeholders at the University of Botswana" (p. 4). Masalela noted that the University of Botswana is undergoing transformative changes in response to internal and external responses in higher education. She used a Masters in Project Management course as a focus for her study in the transition process from f2f delivery to online learning. The university attempted to transition towards online learning to enhance educational experiences by offering the Masters in Project Management course, a

course typically offered f2f. Findings revealed that due to a top-bottom approach, the piloted Masters in Project Management course failed. The lecturers resisted. They were ultimately against the idea of implementing online learning. Their reasoning was that since the course is offered full time, distance education learners should attend this full time course.

In addition, they felt that the University of Botswana administration did not involve them in the initiation of the program to be offered online. The other issues were the lack of a comprehensive institutional strategy based on a shared vision, facilitator attitudes, user preparedness, pedagogical issues, a lack of commitment and ownership, and the design and the implementation, which the eLearning lecturers felt was imposed on them. Masalela suggested that the transition to online learning must be done gradually, and the University of Botswana needed articulated online learning, teaching, and strategic management policies and plans to facilitate implementation. The need was also identified for implementation of comprehensive training initiatives.

Compatibility of Technology

In another study, Totolo (2007) investigated the likelihood of computer technology adoption in Botswana among school principals in secondary schools, assumed as transformational leaders. These leaders were expected to implement the technology innovation in schools as part of the teacher mentoring process. They were the leaders who would transform the school systems by introducing computers for teaching and learning. The Technology Acceptance Model survey and an interview were used to determine the perceptions of the school principals about accepting and using computer technology. The survey was used to predict and explain the principals' acceptance of computers in relation to whether they found them useful, easy to use, and if they intended to adopt and use them. The results showed that time constraints, phobias, a lack of skills or training, and a lack of practice with computers were barriers to adoption in this study. The results of the study confirmed that the research population was not homogenous; there were early adopters, who showed characteristics of transformational leadership as well as late adopters and non-adopters who were still learning how to use computers. Therefore, it was recommended that training on the use of computers should include strategies to alleviate barriers to computer adoption.

Early Adopters

Thomas (2008) conducted research from 2005 to 2007, to provide some insights into the progress of University of Botswana since the integration of instructional technology in teaching and learning. Interviews were conducted with ten lecturers and three key members of the Educational Technology team. The theme of Thomas' study was the growth of technology innovation at the University of Botswana from 2002 to 2008. He focused on managing change towards a blended learning model. Thomas used various diffusion of innovation change theories, models, and strategies to determine the progress achieved since the adoption of eLearning technology at the University of Botswana. He found that although eLearning was implemented, only a few lecturers adopted and diffused it, similar to Rogers' (2003) findings, with innovators at 2.5% and early adopters at 13.5%. Thomas (2008) recommended that change management required a team approach: top-down, bottom-up, and inside out for its success. In addition, he noted that the use of innovative technology supported teaching approaches, but regular formative evaluation, time to be allocated for research and the use of technology should be considered to facilitate the diffusion and adoption process of technology innovation in the university.

Thomas's (2008) views were similar to Masalela (2006) and Totolo (2007). He suggested using strategies such as further training and time to be allocated to use the technology, to increase the adoption and diffusion process of eLearning at the University of Botswana. He emphasized that early adopters should be used as mentors in the system, and similar to the findings of later research

(Masalela, 2011), made recommendations that management should use the Leadership, Academic, and Student Ownership and Readiness model for

> *"… technological transformation in tertiary education to guide the implementation and selection of appropriate strategies"* (Uys, 2001, in Uys (2003), Using a Map for Technological Transformation … Para. 3).

According to Masalela (2011), the LASO model, integrates top-bottom and bottom-up initiatives for its success, involving everyone in the system working as a team. Thomas (2008) also suggested that there should be a clear reward structure and infrastructure. In this regard, he noted that the issue of intellectual property should be clearly addressed and lecturers should own their materials.

The above studies present common views on the issue of the adoption and diffusion process, and are similar to the challenges identified related to technology use for education in Botswana, in line with Rogers's three concepts. They indicated there was lack of training, lack of time to learn and integrate technology in teaching and learning, lack of technology infrastructure, lack of leadership support (from the administration), technical support, accessibility and availability of technology in the system, as well as policy issues on technology and online learning (Masalela, 2006, 2009, 2011; Thomas, 2008; Totolo, 2007). These studies also demonstrated the need for strategies to be developed for the system to enable an effective and efficient diffusion process such as better organization, planning, teamwork, and clear communication channels within the system.

Many universities inclusive of those in the United Kingdom, North America, and Australia compared to Africa are offering f2f courses in blended distance education formats and some are fully online. This shows that many universities are in the transition and transformation process, with courses being taught through both modes of delivery. Universities from all contexts generally adopt and diffuse technology innovation for teaching and learning to facilitate the accessibility and availability of their courses and programs locally, nationally, and globally. The faculty in these universities displayed differences in adopting technologies; there were those who were more innovative than others based on their experiences as early adopters and those who were late adopters who resisted adopting technologies due to their needs, values, experiences, and beliefs.

Common factors have been identified from the research that affects the adoption and diffusion process of technology in universities both from the context of developed (United Kingdom, North America, Australia), and developing world universities and Botswana in particular. Some of these factors are technology infrastructure, accessibility, availability, professional development and training, role change, workload, large classes, technology policies, and support (organizational, leadership, technology, and individual) (Agbonlahor, 2006; Chirwa, 2018; Masalela, 2009, 2011; Mtebe & Raisamo, 2014; Twinimujuni, 2011). On the other hand, compared to developed world universities; literature shows that in developing countries particularly University of Botswana context, the social system, that is, university administrators generally lacks ICT policies and if found accounts for little due to lack of funds. In addition, similarly faculty are provided with support through professional development and training but tend to fear using technology. Finally, faculty's self-efficacy is low as compared to those in developed world universities and they are not risk takers.

Technology Innovation Diffusion at other Higher Education Institutions in other Developing Countries

In spite of the technology introduced in universities by administrators as change agents for teaching and learning from a top level approach, faculty at bottom level, have different experiences in teaching and in the use of technology, which impacts the adoption and diffusion process of technology innovation in universities. The purpose of this section is to review previous and current

literature and discuss studies that have used Rogers (2003) Diffusion of Innovation (DoI) theory in higher education (universities) relevant to this paper focusing on developing world context. The focus of discussion is based on the three concepts namely social system, compatibility of technology, and early adopters, with emphasis on the University of Botswana in understanding the factors that influence the adoption of technology innovation.

These reviews are based on the three concepts of Rogers (2003) in an attempt at responding to the problematic area noted in 1962 by Rogers that adoption of technology follows a normal distribution. Rogers meant that ultimately all in the system adopt the technology. However, from the developing world universities perspective, the literature notes that technology does not always follow a normal distribution but it is based on the context and environment: social system, compatibility of technology and early adopters in which it is adopted, diffused and used. Failure of innovation in the system is not presented as the fault of the adopters but it is based on factors in the diffusion process within the social system, compatibility of technology, and on the fact that adopters do not equally adopt and use technology through the innovation process (Dintoe, 2018; Jacobsen, 1998).

Social Systems

The social system is a system within which organizations and early adopters adopt, diffuse, and use the technology (Less, 2003; Samarawickrema & Stacey, 2007). Social systems have complex structures set within a boundary in which innovation diffusion takes place. The purpose of the present section is therefore, to discuss studies that have used Rogers theory (2003) in detail identifying factors relevant to this study that have shaped social systems, thereby influencing the adoption and diffusion of technology innovation by early adopters. In addition, studies found that blame is not on the adopters (Jacobsen (1998), but depends on the context, hence the factors in the social system influencing the process of adoption and diffusion is not always a linear process because adopters are different (Dintoe, 2018; Jacobsen, 1998).

Several factors relating to social systems such as structures, mandates, professional development and training, planning, organization, management, and communication networks influence the adoption and diffusion of technology in universities (Hadullo, Oboko, & Omwenga 2018; Martin, Prosser, Trigwell, Ramsden, & Benjamin, 2013; Li, Yamaguchi, Takada, 2018; Surry, Ensminger, & Jones, 2007). The themes that emerge from these studies include organizational characteristics, professional development, technical support, infrastructure and accessibility, leadership support in technology, change agents, decision-making, and communication channels.

Studies focusing on organizational characteristics that influence the adoption of technologies in higher education identified factors that describe organizational characteristics such as policies, leadership, support, strategic planning, standards, and change agents as barriers to early adopters adopting an innovation (Less, 2003; McLean, 2005; Surry, Ensminger & Haab, 2005; Surry, Ensminger, & Jones, 2003). The focus is on the most commonly cited characteristics of an organization, namely, policies, and professional development and training.

Characteristics of an Organization

Policies

Samarawickrema and Stacey (2007) observed that institutions often shape the actions of innovation adopters. They identified institutional policies as having an impact on how technology is adopted. The organizational structures are used by administrators representing the system to guide and change early adopters' behavior towards the adoption and diffusion of technology for social change. For example, in the study conducted by Samarawickrema and Stacey the

participants commented that there were no clear policies to guide them, and this led to tensions and conflicts. Further,

> *"…participants could not identify university - or faculty-level policies that addressed key concerns such as career paths, work guidelines, and workloads, which impacted on their responses related to technology adoption by the teaching academics*." (p. 329).

Similarly, Surry, Ensminger, and Jones (2003) presented a paper where the results from questionnaires on their Resources, Infrastructure, People, Policies, Learning, Evaluation, and Support (RIPPLES) model were sent to college deans. The authors argued that higher education policies were developed before technology was implemented in the workplace and as a result, the policies served to prevent or inhibit the adoption and diffusion processes. In addition, the failure to include early adopters in the initial stages of policy development and a lack of clear policy statements and standards likewise resulted in academics resisting technology adoption (Birch & Burnett, 2009; Laronde, 2010). According to Keesee and Shepard (2011), organizational policies and procedures should be reviewed in order to better facilitate technology experimentation. They noted that faculty felt that the system should allow them to try out and test the technology innovation such as e-learning to facilitate a more effective adoption process.

The organizational policies for technology guide the social factors such as individual and organizational factors to achieve a common goal in the diffusion process (Agbonlahor, 2006). The technology policies in the social system, such as in universities, are meant to facilitate and guide the implementation of technology innovation in a system by individual adopters to meet the objectives. Therefore, similar to the United Kingdom, North American, and Australian researchers, as opposed to Africa, universities adopt and diffuse ICT policies. These ICT policies are developed based on national ICT policies to guide the individual adopters of technology in the system for teaching and learning. The early adopters in the universities make decisions as stipulated in social systems policies, which guides them through the social change. Early adopters' modes of teaching, behaviors, beliefs, needs, values, and experiences are influenced by the policies within the social system in which they operate. Kajuna (2009) argues that organizations like universities, when developing policies on technology innovations, should involve adopters in the initial stages of its development to make them aware of the university's ICT policies, which should be clearly communicated to them as members of the social system.

Professional Development

Studies have observed that professional development promotes and facilitates the adoption and diffusion of technology innovation (De Gagne & Walters, 2009; Macy, 2007; Samarawickrema & Stacey, 2007). Samarawickrema and Stacey found that participants required different levels of training because they were at different levels of technology adoption in their online courses. The study concluded that training and professional development stimulated faculty interest and their willingness to experiment, boosted their confidence, and led to promoting adoption. Berliner (1992) cited in Jacobsen (1998), argued that:

> *"… those in leadership positions on campus, administration, deans, department heads, should perhaps focus support and training efforts on developing competent performers rather than striving to create a whole cadre of experts across campus"* (p. 195).

The following section focuses on training and support for early adopters -. two themes deduced from the literature.

Although the research took place in the K-12 context, according to Buabeng-Andoh (2012) whether they deal with beginner or experienced technology users, ICT related training programs develop teachers' competencies in computer use and positively influence teachers' attitudes towards computers (Bauer & Kenton, 2005; Hew & Bush, 2007; Keengwe & Onchwari, 2008). It was also observed that not all academic teachers have positive feelings about teaching online and continuous online training, support, and development helped alleviate these feelings. Therefore, it was necessary for the university to understand the differences in individual early adopter needs, beliefs, values, time, accessibility, experiences, and emotions such as fear, lack of confidence, resistance, and/or frustrations before teaching online courses to align them with the professional development and training programs. Research also shows that academic teachers preferred to learn from others in addition to the workshops provided (Martin, Prosser, Trigwell, Ramsden, & Benjamin, 2013). Studies have made recommendations for systems (organizations) to provide proper training programs to support learning on how to use technology in teaching and learning (Keesee & Shepard, 2011). Studies have identified support factors that influenced early adopters and the diffusion process in a system such as organizational, technical, and personal support (Cheung & Huang, 2005).

The organization supports early adopters from a technical and personal level (Cheung & Huang, 2005; Keesee & Shepard, 2011; Shea, Pickett, & Li, 2005). Organizations usually initiate the adoption and diffusion of an innovation in the system through mass media communication channels. They use mass media as an efficient means to inform the audience of potential adopters about the existence of an innovation, creating awareness-knowledge. Mass media channels include mediums such as radio, TV, and newspapers, enabling a source or a few individuals to reach an audience of many adopters within the same system and others outside the system about the innovation, even at the university. They expect early adopters, who often act as role models, to diffuse the innovation within the boundaries of the system's structure and socially to change the behavior of their peers. It is, therefore, important for the organization to provide clear boundaries, system structures, administrative support, and clear mass media communication channels to early adopters at the initial stages when an innovation is introduced.

It is important for an organization to provide technical support to early adopters when the need arises. Early adopters need to be assisted to access the technology, use the technology effectively, and be given support when the technology breaks down (Keesee & Shepard, 2011; Samarawickrema & Stacey, 2007). Keesee and Shepard (2011) recommended that, *"organizations provide systematic technical support for the maintenance of the Course Management System (CMS)"* (Recommendations for Action, para. 45) on time, because if repairs and maintenance are not completed within specific periods, the rate of the diffusion process slows down.

Early adopters need time to be able to learn to use and practice the technology in teaching and learning. Samarawickrema and Stacey (2007) noted that web-based teaching significantly shapes early adopters' learning time, that is, how much allowance the early adopters, in this case faculty, have to adopt and diffuse technology innovation in the system for teaching and learning. Birch and Burnett (2009) found that:

> *"… individual inhibitors to the development of e-learning formats included lack of time, increased academic workloads and perceived failure by the institution to provide time relief"* (p. 124).

The early adopters in an organization need to be personally supported in their work to be able to adopt and diffuse technology innovations in the system. The adopters individually need time to learn the new technologies, how to use them in teaching and learning, how to incorporate their teaching and technology experiences in the system, and to learn from their peers (Jacobsen, 1998;

Samarawickrema & Stacey, 2007). Individual adopters were more comfortable interacting via interpersonal communication channels with those at the same level in the social system (Martin, Prosser, et al., 2013; Reid 2007). It is; therefore, important to understand the role of an organization as a policymaker that influences the adoption process.

Most organizations such as universities provide support to adopters of technology such as technical support, professional development and training, rewards, time management, and leadership for the successful adoption and diffusion of the technology innovation in the system (Mayoka & Kyeyune, 2012; Twinomujuni, 2011). In universities in the United Kingdom, United States of America, Canada, and Australia, researchers reported that faculty are supported and made aware of technologies and the technology adopters are professionally developed and trained, given access to workshops, encouraged to research and present papers at conferences, and to become familiar with implementation of the technology in other contexts.

The successful adoption, diffusion, and integration of technology innovation in the system by individual adopters is determined by appropriate and strategically organized professional development and technology training programs. The professional development offered to faculty enhance their technology competencies, self-efficacy, confidence, and influences their attitudes toward the use of technology in teaching and learning (Krishnakumar & Kumar, 2011). A similar study, in the context of a Nigerian university, concluded that higher education institutions should encourage old and young faculty to be computer literate by organizing conferences, seminars, and workshops to develop good attitudes toward the use of ICT for teaching and learning (Onasanya, Shehu, Oduwaiye, & Shehu, 2010).

Farrell and Isaacs (2007), as cited in Twinomujuni (2011), reported that,

> "… *Although all of the faculty members of the Makerere University were trained and supported by the Faculty of Computing and Information Technology in e-learning technologies, only few teachers had the skills to make pedagogical use of ICTs. The reason "could be due to inadequate ICT training skills, lack of time and negative attitude by teachers towards ICT implementation"* (p. 19).

Twinomununi (2011) recommended in his study that:

> *"… To overcome the problem of poor and lack of skills in ICT, institutions of higher learning could be encouraged to employ a variety of teacher training methods, ranging from face-to-face workshops to online self-study programs depending on training objectives and environments" (p. 91).*

Simelane, Blignaut, and Ryneveld (2007) acknowledged the fact that strategies and approaches need to be put in place to facilitate faculty at Tshwane University of Technology in South Africa to integrate educational technology into their teaching and learning practices. They indicate that a professional development program should be strategically designed and supported by management and academic staff to promote the use of technology in the university, including capacity building, design and development, implementation, and research. Mayoka and Kyeyune (2012) conducted a study examining e-learning information systems failures and adoption problems in Ugandan universities based on Rogers and Shoemaker's (1971) Diffusion of Technology Innovation Theory. Makerere University Business School was used as a case study for surveying two e-learning systems. The authors recommended that,

> *"… universities should work towards improving knowledge and skills of students and staff through training in order to increase chances of technology acceptance to users as had been suggested by Rogers and Shoemaker"* (1971, p. 7).

Similar to researchers in the United Kingdom, North American, and Australian universities, when compared to African universities, researchers acknowledge the need to support technology adopters in teaching and learning through training and professional development (Buabeng-Andoh, 2012; Nyirongo, 2009; Obiri-Jehoah, Kwarteng, & Kyere-Djan, 2013).

The main issue observed by most researchers was that although training, workshops, and professional development were provided to faculty, they were not allowed enough time to learn how to use the technologies introduced to them. They were expected to be able to use them as they were introduced and this negatively affected the adoption and diffusion process. The faculty in an African university context differ from academic teachers in United Kingdom, North American, or Australian universities in that although they are supported through professional development or workshops, they often fear and have 'technophobia' about using technology for teaching and learning (Totolo, 2007). This fear and technophobia negatively influence the adoption and diffusion rate of technology innovation as members of the social system in which they operate. It shows that faculty from an African context are not familiar with operating in a technology environment unlike the faculty from the developed world universities.

The literature has revealed themes similar to developed and developing world universities whenever or wherever technology was introduced or used in university systems. These themes include the need for professional development, faculty support, time management, faculty role changes, teaching strategies, planning, implementation reflection, and individual, organizational, and technological factors (Chiasson, Terras, & Smart, 2013; De Gagne & Walters, 2009; Hadullo, Oboko, & Omwenga, 2018; Macy, 2007; Johnson, 2008; Redmond, 2011; Vyas, 2010). In summary, the literature suggests the need for social system structures to be strategically planned in line with the innovation's attributes, namely, compatibility and early adopters' perceptions to facilitate the adoption and diffusion of technology innovation (Birch & Burnett, 2009; Jacobsen, 1998). In addition, the research shows that it is important for organizations to understand individual early adopters' beliefs and perceptions from the technology compatibility perspective in order to positively influence the adoption rate. Otherwise, if adopters' experiences, needs, and values are not compatible with how the early adopters perceive the innovation, it will not be adopted.

Compatibility of Technology

The purpose of this section is to discuss studies that have used Rogers' (2003) DoI theory in the context of compatibility as a specific concept, to understand factors inhibiting the use of technology in universities. According to Akir, Butcher, and Tsao (2003), ideas that are not compatible with the normative standards and values of a given social system are not adopted as rapidly as those that are compatible. In retrospect, compatibility of technology refers to the technology that is relevant to the context (system), needs, beliefs, values, and experiences of individual adopters (Rogers, 2003). The needs of potential adopters may vary by the position they hold within the department.

In the study by Akir, et al., (2003) one of the respondents described her need to advance the knowledge and skill capacity of the graduate teaching-assistants under her charge by noting the following:

> *"… I train future teachers if I can't do that (use ICT) then I don't have a job... they (her students) are going to go and get a job...they're (potential employers) going to ask them, okay what do you know about technology? That's the question and not because they want to test them. They (potential employers) don't know the answer. They want to make sure the person they are going to hire knows the answer because they don't know anything …" (Akir, et al. 2003, p. 5).*

The study findings (Akir et al. 2003) support the view that the degree of compatibility and innovation processes correlate with the level of behavior changes an innovation requires. Once the innovation's potential is observable and shown to be compatible with the needs of adopters, diffusion occurs (p. 5). When the attributes of technology innovation such as compatibility are high, the adoption process is effective (Birch & Burnett, 2009; Keesee & Shepard, 2011; Samarawickrema & Stacey, 2007). The following common factors were identified from the literature and are discussed below; perceived attributes, technology self-efficacy, and workload.

Although there are criticisms of the perceived attributes (relative advantage, compatibility, complexity, observability, and trialability) of technology, the concept of perceived attributes has been broadly used in higher education research to determine individual early adopters' perceptions in the diffusion of innovation technology process (Bennett & Bennett, 2003; Li & Lindner, 2007; Sherry, 1998; Wilson, Sherry, Dobrovolny, Batty, & Ryder, 2002). This concept has also been criticized as limited because of its focus on technology, which excludes environmental and external conditions (Ely, 1990, 1999; Stockdill & Morehouse, 1992; Surry, 1997; Wilson, Sherry, Dobrovolny, Batty, & Ryder, 2000). Many of these studies conclude that early adopters rate attributes of technology very highly. For example, Samarawickrema and Stacey (2007) conducted a study in a large Australian metropolitan university to explore the adoption of Learning Management Systems. The findings revealed that the attributes of technology, especially the relative advantages and compatibility, were very high, and this influenced the participants' rate of adopting and diffusing an innovation in the system.

Research shows that faculty adopt and diffuse technology innovation if it is compatible with their beliefs, values, experiences, needs, knowledge, competencies, skills, organizational support, rewards/incentives, and teaching and learning (Birch & Burnett, 2009; Samarawickrema & Stacey, 2007). For example, a study conducted by Keesee and Shepard (2011) in an American university aimed to determine instructors' perceptions of the five attributes of a Course Management System, in order to predict adopter status. They concluded that faculty in the different adopter categories had different perceptions in adopting and using the Course Management System. The authors noted that,

> *"… Early Adopters are willing to try new technologies and are not averse to an occasional failure. Therefore, Course Management System would seem to be compatible with the early adopters' level of technology expertise and experience because they are more technologically savvy in the first place…" (Discussion, para. 27).*

Although early adopters are experienced in teaching and in the use of some technology, studies have noted that there are those who resist being early adopters because they do not want to change the teaching methods, preferring to use the same traditional modes of f2f to online teaching (Jacobsen, 1998). Laronde (2010) found that professors who were using computers indicated that the Internet was unreliable and too slow to be used in class. Many also commented that they would not be able to move around in a classroom with 40 B.Ed. students using laptops plugged into electrical outlets.

Research has been conducted on academic teachers' self-efficacy, and results have shown that it has an impact on the adoption and diffusion process. Self-efficacy is defined as a belief in one's own abilities to perform an action and/or activity to meet goals (Jacobsen, 1998). Bandura (2010) defined self-efficacy as personal judgments of one's capabilities to organize and execute courses of action to attain designated goals, and he sought to assess its level, generality, and strength across activities and contexts. Self-efficacy of early adopters, then, is defined in the context of the confidence, competency, and capability to use technology for teaching and learning.

For instance, Jacobsen (1998) concluded that early adopters' computer self-efficacy is generally higher than that of late adopters. Early adopters have high self-confidence, competencies, and the ability to solve challenging problems, and they do so by taking risks. It was reported in studies that early adopters diffuse technology innovations earlier than their peers in the same system because they believe they are capable and have the ability to use technology in teaching due to high self-efficacy (Birch & Burnett, 2009; Jacobsen, 1998; Keesee & Shepard, 2011; Moore & Benbasat, 1991).

Studies have revealed that the workloads of teachers influence their acceptance of technology in classrooms (Samarawickrema & Stacey, 2007). For example, Samarawickrema and Stacey investigated factors related to the use of Learning Management Systems in a large multi-campus urban university in Australia. The consequences of increased workload negatively affected the technology diffusion process. Several studies revealed that the use of technology increases workload when developing learning materials, and when all students can access technology individually and send more than one email to the lecturer (Laronde, 2010; Less, 2003; Shea, et al., 2005; Samarawickrema & Stacey, 2007). Samarawickrema and Stacey noted that the workload of early adopters increased with technology adoption. Early adopters tend to use many of the features in Learning Management Systems, for example, and the resulting overload is sometimes difficult for them to manage. Dealing with student posts and responses was also overwhelming.

Samarawickrema & Stacey (2007) noted that early adopters found that more preparation time for developing learning materials and using technology in teaching and learning was also required. Similar results have been noted in studies of K-12 school systems where teachers were overloaded by the amount of time required to learn how to use technology, prepare learning materials, and teach classes while integrating the technology (Neyland, 2011). Heavy workload for early adopters reduces the rate of the technology diffusion process. For the diffusion process to be effective there is a need to plan, organize, and manage the time for each individual early adopter. For example, Birch and Burnett (2009), in their study of academics noted that some early adopters found it easier to update the printed materials, which they were familiar with using, rather than using technology, because it increased their workload.

Agbonlahor (2006) investigated levels of information technology use by Nigerian university lecturers in order to understand the characteristics and factors that motivate the lecturers to use information technology. Agbonlahor used DoI theory (Rogers, 1995), focusing on two of the components - the characteristics of the innovation itself and the characteristics of the social system in which the individual adopter exists. The findings indicated that perceived usefulness and perceived ease of use significantly influenced the use of information technology by lecturers in Nigerian universities. Early adopters, as members of the social system, whether in Africa or systems such as those in the United Kingdom, North America, or Australia, adopt and diffuse technology in the system, provided it is compatible with their experiences, values, needs, beliefs, and is simple, or easy to use in teaching and learning. Studies have noted that the attributes of technology influence the diffusion process in the system when high or low (Agbonlahor, 2006; Chigona & Dagada, 2011; Obiri-Jeboah, Kwarteng, & Keyere-Djan, 2013; Twinomujuni, 2011). The findings of these studies showed that although technology was available and accessible, adopters of technology in universities in Africa find it hard to use technology in teaching and learning. Their experiences were often not compatible with the new technologies, and students did not access the available technology for use based on various reasons such as costs, lack of electricity, and lack of skills and knowledge on how to use specific tools associated with the technology. However, for faculty and students (teaching and learning) in a technology environment in developed world universities their self-efficacy was high.

According to Farrell and Isaac (2007), countries in Africa are different from each other in the application and implementation of ICT policies and infrastructure for education. They noted that

South Africa was able to move its ICT agenda forward, similar to the way in which countries of North Africa that have resources and high bandwidth connectivity to Europe have been able to. Ghana, Mauritius, and Botswana were also identified as countries moving steadily forward and making remarkable progress in ICT. Farrell and Isaac also mentioned another group of African countries, which are consistently facing conflict and economic instability, such as Malawi, Rwanda, Somalia, Senegal, Algeria, and Nigeria. These countries were found to be in need of more assistance with ICT.

According to Farrell and Isaac (2007), universities are expected to lead in the process of integrating ICT in education. However, universities are experiencing a paradigm shift in changing education systems to use technology, whether they deliver a single and/or dual mode: f2f, blended distance education, or online learning. Many universities are facing challenges, for example, regarding the type of students to be admitted. These students are usually scattered throughout both rural and urban areas and need to access university courses and programs wherever they are, irrespective of geographical distance, making it an imperative for the universities to implement technologies into their systems so that these students can access their available programs from any distance.

It was also noted that print-based distance education was a predominant tool in the distance education system in African universities, including Sub-Saharan Africa, with reference to Southern Africa in particular, since this has proved to be an easier method of deployment (Dodds, Nonyongo, & Glennie, 2002; Haughey, Murphy, & Muirhead, 2008; Mpofu, 2005). The main hindrances that have been identified in this regard are a lack of infrastructure, accessibility, a lack of networking, high telephone and Internet costs, limited expertise and skills and a lack of enabling national policies (Adeya, 2001; Farrell, Isaacs, & Trucano, 2007; Isaacs, 2007; Ojuloge & Awoleye, 2012; Schachter, Pence, Zuckernick, & Roberts, 2005).

Technology is being adopted and diffused in education systems to improve accessibility and infrastructure, and implement educational reform. Several studies on the adoption and diffusion of technology innovation in African universities have reported that even if technology infrastructure is in place, accessible, and available, some of the experienced adopters of technology and teaching are not able to use technology in the system (Krishnakumar & Kumar, 2011; Kyakulumbye, Olobo, & Kisenyi, 2013). Research has been conducted on technology diffusion using Rogers' theory in African universities in Sub-Saharan Africa. The findings highlight innovation characteristics similar to social factors such as individual and organizational factors (providing training and easy access to information technology) within any social system are important in the diffusion process because they influence the process.

Early Adopters

Numerous studies have used the early adopter categories espoused by Rogers (2003) in exploring the adoption and diffusion of technology innovation in social systems (universities) (Hixon, Buckenmeyer, Barczyk, Fieldman, & Zamojski, 2012; Keesee & Shepard, 2011). The influences of early adopters' experiences of technology, teaching, and learning in universities were also explored (Less, 2003; Laronde, 2010; Martin, Prosser, Trigwell, Ramsden, & Benjamin, 2013). The following common factors were identified from the literature and are discussed below, namely; characteristics, experiences, and beliefs.

The category of early adopter is commonly used in studies because these are the individuals who directly communicate through interpersonal channels with their peers or late adopters to adopt the technology in the system in which they all operate (Giardna, 2010; Reid, 2009; Sahin, 2006). It emerged from the literature that early adopters are potential leaders (role models), and are often unique in adopting and diffusing technology innovation in the system.

As noted in the previous section, early adopters tend to adopt technology earlier than others in the system. Thus, identifying early adopters and targeting them is an effective approach to innovation diffusion (Bates, Manuel, & Oppenheim, 2007; Birch & Burnett, 2009). Birch and Sankey (2008) argue that early adopters persuade other potential adopters in the diffusion process. According to Hixon, Buckenmeyer, Barczyk, Fieldman, and Zamojski (2012), early adopters are influential in their use of instructional technology and they can change the behavior of other potential adopters. They are generally more open to and have more teaching experience with the use of technology as compared to others in the system. Early adopters are often highly respected locals and potential leaders who can easily change the behavior of their peers through interpersonal communication channels in the system. They often demonstrate to peers how they use technology in teaching and learning. Thus, early adopters, play a critical and unique role in the diffusion process as members of the social system and as part of a change agent process.

Jacobsen (1998) argues that early adopters are unique because they take risks, and are willing to experiment with and use the technology. They are able to solve difficult tasks related to the new technology. Late adopters, in contrast, resist technology adoption. Jacobsen (1998) argued that,

> *"…because of their different levels of computer use and years of experience, each early adopter appeared to have a unique innovation-decision cycle"* (p. 166).

For example, some use the Internet for classroom demonstrations, while others published on the web, or required students to post online. In this case, early adopters are convinced of the benefits of web-delivered instruction and see it as an enhancement to f2f instruction. As a result, Jacobsen claimed that early adopters are different from others in the system in the way that they make decisions about adopting and using technology, hence Rogers referred to them as heterophilous (different from each other) and others are homophilous (similar to one another).

Evidence from other studies confirms that early adopters are different from their peers (Laronde, 2010). Less (2003) concludes that early adopters are often agents of change. According to Reid (2007), early adopters are sometimes experts in the field. Early adopters are often more experienced in technology, teaching, and learning than their peers are in the same system (Jacobsen, 1998).

Early adopters are experienced users of technology in teaching and learning (Jacobsen, 1998). This experience affects their attitudes. For example, studies have observed that early adopters are technologically more experienced and have more positive attitudes towards technology (Jacobsen, 1998; Laronde, 2010; Samarawickrema & Stacey, 2007; Shea, et al., 2005). Research has revealed that teacher's experiences, attitudes, and beliefs towards technology influence the successful integration of innovative technology (Jacobsen, 1998; Samarawickrema & Stacey, 2007). Teachers' attitudes towards technology also influence their acceptance of the usefulness of the technology and its integration into teaching (Jacobsen, 1998; Samarawickrema and Stacey, 2007).

Jacobsen (1998) reported that,

> *"… faculty comments provide evidence that the integration of technology supports a shift from a primarily 'knowledge-transfer' mode of content delivery to a more 'knowledge-construction' type of teacher-student interaction"* (p. 172).

The point made by Jacobsen relates to the experiences of faculty in teaching and the use of technology where faculty acknowledge that their f2f mode of teaching changes. The use of technology changes shifts and/or transforms their role of teaching from teacher-centered, that is,

knowledge transfers, to student-centered, where the knowledge is constructed by learners through teacher-student interaction.

Early adopters believe that the use of technology in teaching and learning makes their work easier, allowing them to interact more easily with learners and build social networking communication channels (Reid, 2007). In addition, Jacobsen (1998) found that some early adopters believed that they could become better teachers by using technology. Beliefs in the value of technology also affect the motivation of early adopters (Jacobsen, 1998, 2000). Early adopters' belief in the value of technology motivates them to further their technological expertise. For example, Jacobsen (2000) conducted a study in a Canadian university to investigate the relationships between excellent teachers and early adopters of technology. She found that early adopters believed that an individual as a technology expert is different from someone with pedagogical skills. Jacobsen observed that this does not mean that technology can improve teaching and learning skills, because some early adopters cannot apply their technological expertise in teaching and learning. On the other hand, the most interesting result of her study was that excellent teachers were eager to integrate technology into their teaching because they were motivated and influenced by innovators.

According to Jacobsen (1998, 2000) early adopters, also have intrinsic belief structures that integrating technology into their teaching is the right thing to do. In sum, some early adopters are convinced that technology cannot improve poor teaching, whereas others believe it can solve their problems. According to Jacobsen (1998):

> *"…early adopters believe in their ability to solve difficult problems if they try hard enough and invest the necessary effort, and are confident about their ability to deal efficiently with unexpected events"* (p. 164).

Yohon and Zimmerman (2006) reported that although opportunities to learn technology through workshops and seminars were available to lecturers, early adopters preferred more informal learning opportunities, such as talking with other faculty members. Similarly, Martin, Prosser, Trigwell, Ramsden, and Benjamin (2013) argued that although training was provided on the use of technology, early adopters preferred interacting with peers in order to learn to use technology. Reid (2007) claims that early adopters preferred using social media when they interacted with their peers in a system.

Early adopters are reported as experienced in technology, teaching, and learning; thus, they are assumed to adopt and diffuse technology innovation at a higher rate compared to other peers as members of the social system in which they all operate (Agbonlahor, 2006). For example, Tshabalala, Ndeya-Ndaya, and van der Merwe (2014), in one of South Africa's universities, revealed that teachers with more years of teaching had strong computer skills, which led to a higher rate of adoption; whereas the teachers with fewer years of teaching experiences or with fewer or no computer skills, exhibited low rates or resistance in adopting the innovation technology.

Krishnakumar & Kumar (2011) noted that teachers with experience in using computers and those who own computers have favorable attitudes towards eLearning. Teachers who own computers at home and have access to computers in the institution are familiar with technology and thus can easily adopt, integrate, and diffuse technology innovation in their teaching and learning experiences. In the context of Africa, at times users or adopters, even when they are aware of the potential benefits, are not ready or are unwilling fully to embrace ICT (Obiri-Jeboah, Kwarteng, & Kyere-Djan, 2013). As mentioned earlier, some adopters of technology innovation in universities are technophobic. They had fear of using technology for teaching and learning, lacked knowledge and skills, and were not aware of technology policies; and university policymakers and administrators initiated and introduced the new technologies without involving them. Some

technology adopters in universities such as faculty tend to use technology in teaching when they have been exposed to it in advance through training or workshops, and had used it before.

In conclusion, the reviews from African universities when compared to the United Kingdom, North America, and Australia showed that there are similarities and differences as far as the adoption and diffusion of technology innovation is concerned. For example, studies demonstrated that policies are informed by national ICT policies and guide the diffusion process, whereas in African universities the ICT policies are generally not communicated and thus have a negative impact on academic teachers' use of technology.

The other point noted from the studies was that the faculty from the African context is often technophobic because of the challenges they face, such as a lack of infrastructure, and not being able to access the available technology due to network, bandwith, and costs. Where the available technology can be accessed for teaching and learning, it is not compatible with their experiences, beliefs, needs, and values and they end up applying their f2f traditional teaching experience. In addition, students do not access the posted learning materials online like students in developed world universities.

The studies reviewed concluded that early adopters' experiences of technology in teaching and learning focused more on f2f with less technology in an Africa university context. The lecturers were more comfortable with using their traditional teaching experiences over web-based learning as compared to United Kingdom, North American, and Australian faculty. It is important to explore in depth the factors influencing faculty adoption and diffusion of technology in a developing country university context with reference to University of Botswana, to fill the gaps found in the previous studies.

Comparison of University of Botswana and Other Developing Countries on Factors Influencing Adoption and Diffusion of Technology by Faculty

In summary, the factors identified in the case of the University of Botswana have been confirmed in the literature in other developing world universities as noted in Table 1 below. It is evident from the data shown in the table that although several studies have been conducted on the ICT component of some universities, the subjects of investigating the social systems, compatibility of technology, and early adopters as factors that influence the adoption, and diffusion of ICT by faculty in higher education institutions have not been adequately addressed.

Table 1: *Summary of the Results on Factors Influencing Adoption and Diffusion of Technology Innovation in Developing Countries - Case of University of Botswana*

Themes (Rogers, 2003, theoretical concepts) as Influencing Factors	Issues	Sources	Issues at University of Botswana	Issues Identified at Other Higher Education Institutions in Developing Countries
Social System	Professional Development, Policies, Support,	University of Botswana and Literature – Developing Countries	Dintoe, 2018; Masalela, 2011; Thomas, 2008; Totolo, 2007; Farrell, Isaac, & Trucano, 2007	Adeyi 2001; Agbonlahor, 2006; Buabeng-Andoh, 2012; Chirwa, 2018; Farrell, Isaac, & Trucano, 2007; Haddullo, Mayoka & Kyeyune, 2012; Isaac, 2001; Mtebe & Raisano, 2014; Muhammed, 2018; Nyirongo, 2009; Neyland, 2011; Obiri-Jehoah, Kwarteng, & Kyere- Djan, 2013; Oboko, & Omwenge, 2018; Kajuna, 2009; Simelane, Blignaut & Ryneveld, 2007; Twinomujuni, 2011.
Compatibility of Technology	Infrastructure, accessibility, networking, Use (adoption and diffusion)	University of Botswana and Developing Countries	Dintoe, 2018; Farrell & Isaac, 2007; Masalela, 2006, 2009, 2011; Thomas, 2008; Totolo, 2007	Adeyi, 2001; Chigane & Dagadu, 2011; Karunamatne, Peiris, & Hansson, 2018; Hadullo, Oboko, & Omwenga, 2018; Mayoka & Kyegwe, 2012; Obiri-Jehboah, Kwarteng & Keyere-Djan 2013; Ojuloge & Awoleye, 2012; Onasayan, Sheu, Oduwaije & Shehu, 2010
Early Adopters	Experienced in Technology, more years teaching – higher rate of adoption, fewer years of teaching – fewer or no computer skills – low rate of adoption or resistance, favorable attitudes towards e-learning, Aware of benefits but not ready or unwilling to embrace ICT, own computers at home.	University of Botswana and Developing Countries	Buabeng-Andoh, 2012; Dintoe, 2018; Farrell & Isaac, 2007; Masalela, 2011; Mutula, 2002; Thomas, 2008; Tshabalala, Ndeya-Ndaya & van der Merwe, 2014.	Buabeng-Andoh, 2012; Kyakulumbye, Olobo & Kisenyi, 2013; Obiri-Jehboah, Kwarteng & Keyere-Djan 2013; Tshabalala, Ndeya-Ndaya & van der Merwe, 2014; Twinomunjuni, 2011.

DISCUSSIONS AND CONCLUSIONS

The literature and theory on the use of technology among early adopters substantiated that eLearning, ICTs, and educational technology are important as they facilitate easier access to university courses and programs. Researchers from a social systems perspective also note that n faculty support through the implementation process of a technology increases the chance of adopting it in their pedagogy (Bates, 2000, 2005a, 2008; Beggs, 2000; Hardaker & Singh, 2011; Lane, & Lyle III, 2011; Whitworth, 2011). In addition, the literature noted that if faculty are not given enough time to practice using the technology they tend to use strategies that are compatible with their traditional teaching experiences. Further, faculty in an African university context tend to fear using technology more so if they have been exposed to a non-technology environment, unlike the faculty from developed world universities. Reviews from the literature revealed the challenges faced by universities and individual adopters using ICT for teaching and learning. In this regard, the status of technology in African universities is generally low due to lack of proper communication on ICT policy structures, lack of infrastructure, and lack of accessibility of available technology for faculty and students.

The other point noted was that African countries are not all the same in the diffusion process. South Africa, North Africa, Mauritius, Ghana, and Botswana were more focused on the implementation of technology in their system as compared to other countries in Africa (Farrell & Isaac, 2007). Although these countries are more developed in terms of technology they still face the issue of a digital divide, where urban areas have better technology infrastructure compared to rural areas. This defeats the aim and objectives of many of the ICT policies initiated by governments in Africa designed to make programmes and courses accessible in all geographical areas; that is, rural and urban areas. Higher education in Africa was found to be dominated by the print-based modes of distance education compared to the United Kingdom, North American, and Australian universities, which have transitioned more fully to online learning. The University of Botswana, which initiated strategies for implementation of online learning in 2001, has experienced limited success. Although, research in Botswana and at the University of Botswana, has shown across the board problems with the implementation of online learning, little in-depth research has been conducted with early adopters themselves to establish what they are doing with technology.

Compatibility of technology is high in developed world universities as compared to the African universities, particularly the University of Botswana. The review from the literature shows that although technology accessibility and infrastructure are available this negatively influences use of technology in developing world universities. The faculty tend to rely on traditional delivery modes because the available technology is not easily accessible to learners in remote rural areas in particular.

Finally, factors affecting faculty were reviewed from an early adopter, bottom-up perspective. Early adopters of technology are different, their socio-economic status is high and they are willing to adopt technology for pedagogies and solving challenging complex issues in technology. The views of Rogers (2003) are relevant and applicable to faculty operating in a technology enabled environment, unlike in a low-level technology context in the African universities discussed in this study. In this regard, researchers concluded that early adopters from developing world universities fear using technology because they felt that the university forced them into using technology without understanding their context and thus they prefer to deliver through traditional teaching modes instead of the learner-centered mode afforded by technology. In this regard, the normal curve concept (Rogers, 2003) does not apply in these developing country contexts, given the situation and status of technology use in higher education in these countries.

The findings of several studies have noted factors influencing ICT use in universities by faculty and students (Buabeng-Andoh, 2012; Hadullo, Oboko, & Omwenga, 2018), which suggest that

institutions should ensure that these factors are positive for the successful adoption of eLearning. Technology implementation inhibiting factors are noted in these studies, which compare developed and developing world universities, and although there are some similarities and differences, the question can be asked: where is the problem - the social system, or technology itself, or early adopters and how can this be solved? Knowing and understanding how the social system, compatibility of technology, and early adopters' influences each other from a bottom-up to top-level approach may help in reducing the factors influencing adoption and diffusion of technology.

Rogers' theory has been used in different contexts; and it continues to be studied in relation to universities across the globe in order to explore the adoption and diffusion of technology innovation in systems. In places such as Europe, North America, Australia, New Zealand, Asia, and Africa, Rogers' ideas have been used to understand the specific concepts of diffusion, including social systems, compatibility of technology, and early adopters. This paper reviewed Rogers' DoI theory (2003) to understand the factors that influence adoption and diffusion of technology innovation in developing countries. A review of the literature identified common factors classified under three concepts based on Rogers's theory, that is, social systems, compatibility of technology, and early adopters. The review suggests that achievement of successful integration of technology requires an effort in three main areas: the social system (university administrators), early adopters (faculty), and compatible technology.

This review of the literature focused on the previous and current situations and barriers to ICT integration in teaching and learning at developing world universities, comparative to developed world universities, with an emphasis on the University of Botswana. The common factors identified within the three concepts are complex and specific to policies, professional development and training; however, beliefs, experiences and values assumed importance. The review suggests that universities in developing countries need to understand the faculty as early adopters from a bottom-up instead of a top-down approach, in order to achieve successful outcomes, and develop strategies based on their country context. Possible gaps in the existing literature have provided directions for future research into ICT use.

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