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Leverage Points for Effective E-learning Implementation in Developing Country Contexts Using a Systems Thinking Approach

[1]Evelyn Kigozi Kahiigi, [2]Agnes Rwashana Semwanga
[1]Department of Information Technology, [2]Department of Information Systems
School of Computing and Informatics Technology, Makerere University
Kampala, Uganda

Abstract: - The effective integration of e-learning into the education system in developing countries is slow. This can be attributed to isolated aspects of e-learning implementation. As a result, the actualization of benefits derived from implementing e-learning is very limited and in some cases lacking. This article presents a holistic approach to identifying key leveraging point for sustainable implementing e-learning in developing country contexts. Extensive literature review and focus group discussions are used to identify interrelationships between different factors that affect e-learning implementation in developing country contexts. Three interrelated categories of factors emerged:1) Technology/infrastructure readiness 2) Institutional readiness and 3) Pedagogical change. The systems thinking approach is used to probe the factors in order to holistically identify the dynamics associated with the demand and supply of e-learning implementation. Twelve (12) leverage points that could substantially improve e-learning implementation in developing country contexts are derived and discussed.

Keywords:- *E-Learning; Developing Country Context; Technology/Infrastructure Readiness; Institutional Readiness; Pedagogical Change; Systems Thinking.*

I. INTRODUCTION

Developments in the educational sector have seen the emergent of e-learning over the past decade (Esichaikul et al., 2017). E-learning is viewed as a critical component through which universities have innovatively supported the delivery of knowledge and the creation of learning communities (Pham and Huynh, 2017). Despite the numerous e-learning initiatives with a growth rate of 15.2% in Africa (Hadullo et al., 2018); e-learning is still not effectively adopted for its optimal benefits to be realized (Usagawa, 2018). Challenges in e-learning implementation are mostly realized in developing country contexts that are used to didactic teaching and learning and the lack of fundamental components such as computers, electricity, and skills (Tarus et al., 2015). The complexity of e-learning integration in the education process in various contexts (Müller, 2015) and focusing on isolated aspects of e-learning implementation can be attributed to failed e-learning implementation.

In this regard, there is a need to identify new approaches of examining and understanding e-learning as well as determine key factors that can enhance its application in teaching and learning (Sangrà et al., 2012). However, Rossiter (2007) affirms that e-learning should be viewed as an innovation that ought to be contextualized in order to develop frameworks will support its implementations. This is specifically emphasized in developing country contexts where there limited or no understanding of e-learning adoption and use (Paiva et al., 2015).

The primary goal of this study focuses on holistically identifying interrelationships between different factors that affect e-learning implementation in developing country contexts. To close this gap extensive literature review was carried out on various e-learning implementation initiatives in developing countries. A systems thinking approach was then employed to identify key leverage points that could possibly enhance e-learning implementation.

A. Analysis of E-learning Implementation in Developing Country Contexts

The inherent debate within the developing country context on whether the implementation of ICT initiatives such as e-learning should supersede the provision of basic needs has taken center stage. Although basic needs such as the provision of clean water, food, and shelter need to continue to form national priorities, technology innovations (Ashraf et al., 2008) have been found to contribute positively to the education of individuals who lack these basic living resources. In a sense, e-learning ought to be viewed as a basic aspect of fundamental improvement in facilitating improved education and capacity building in order to empower students who desire to compete in the new knowledge economy (Sehrt, 2005).

E-learning has the ability to expand access to and improve the pertinence and nature of instruction. Indeed, Berhanu (2010) reports that advancing e-learning provides an opportunity for developing countries to advance to the global knowledge economy. Worth noting is that higher education institutions in developing countries, still adhere to the conventional education methods. This can be attributed to the absence of supporting ICT infrastructure, resources, and skills and the fact that e-learning adoption and use has not yet fully penetrated the existing education institutions (Gamal and Aziz, 2011).

E-learning developments have been threatened by the lack of efficient support mechanisms, the required ICT infrastructure and failure to acknowledge the paradigm shift (Berhanu, 2010). Attempts to enhance and reform the education sector through the integration of e-learning in developing country contexts have been negatively affected by unreliable and inadequate ICT infrastructure and resources. Most areas in this context lack a reliable supply of electricity and the nearest Internet points of presence are not readily accessible. Individuals have to travel long distances to access Internet services. Anecdotal evidence in developing country contexts points to the adoption of wireless technologies as a possible avenue for leapfrogging (Nyakudya, 2012), even though there are still issues that relate to affordability.

In addition, the imbalance created by access to computers between the rural and urban communities has greatly impacted the advancement of e-learning in developing country context. The poor populace, who have an authentic requisite for education improvement, are as yet denied of such opportunities. As it were, the adoption and use of e-learning in developing countries has not done what's needed to extend the education access in the rural communities, who can not readily have access to traditional schools/ universities and teachers (Tarus et al., 2015).

It should be underscored that, for e-learning to thrive in the developing countries, there is a need to have supporting ICT infrastructure and sufficient Internet connectivity (Aziz et al., 2017). The recurrent high bandwidth cost and slow connection restrict usage, thus limiting the amount of content downloaded and accessed by students and teachers (Hollow, 2009). Efforts to reduce the bandwidth cost to almost a third of the current market price in Africa are being achieved through creating synergies among partners' research and education networks such as the UbuntuNet Alliance and the Research and Education Network of Uganda (RENU) in Uganda. The bandwidth obtained from such subsidies is still not affordable, adequate or sustainable to support administration, education and research environments, including e-learning.

Another aspect that has negatively impacted the advancement of e-learning in developing countries is the lack of ICT skilled teachers. The inherent challenge is that teachers struggle to understand the incorporation of ICT in the education process and are still apprehensive about its adoption because of the perception that technology is going to replace them (Sharma et al., 2011). This perception could be eliminated if teachers were made to understand and appreciate their changing role through training and mindset change so as to create a “buy-in” of the innovation. As a precursor of e-learning, development, teachers need to be completely prepared and acquainted with the ICT environment in order to fully utilize it.

Garrison and Anderson (2007) point out the importance of a deeper understanding of how people learn and how new tools support and access the learning gains. This alludes to the importance of involving students in the implementation, as their perceptions are crucial to success. From a developing country perspective research on students’ perception in regards to e-learning is limited and thus should be emphasized as they are critical in implementing the e-learning projects since they are the main beneficiaries.

The lack of management support is another aspect that has adversely impacted on e-learning developments. Successful and sustainable e-learning implementation strongly depends on management conceptualizing the entire e-learning ecosystem (Kahiigi et al., 2008, Ndume et al. 2008) in order to prioritise and support e-learning.

Furthermore, most e-learning initiatives in developing countries have been tailored from current approaches and methods. However, different contexts differ in needs, resources and aspirations. It is therefore imperative to develop content and tools that are context specific in order to implore cultural cues (Vesisenaho, 2007; Wicander, 2011) and promote effective and sustainable adoption and use of e-learning.

The changing pedagogical paradigm that shifts from teacher focused to learner focused learning has impacted on e-learning progressions in developing country contexts. The learner focused learning approach encompasses deepening the learners understanding of the learning content in order for them to construct and intellectually share knowledge as well as develop cognitive thinking skills (Light, 2009). The change in this pedagogical approach requires effort, since the current education norm is mainly based on a teacher focused methodology.

Reflecting on the obscurity of e-learning and the benefits and risks it presents, there is a need to move beyond disintegrated approaches to studying and understanding e-learning implementation processes in developing country contexts. In this paper, the Systems Thinking approach is used to holistically examine the complexity and interrelationships of factors associated with e-learning implementation in a developing country context.

B. Review of Methods used to examine e-learning implementation

Although e-learning is cited as a popular mode of delivering education materials, the adoption of e-learning in developing countries is still low (Bhuasiri et al., 2012). In this section, a review of some of the methods used to analyze the e-learning implementation is presented.

Sun et al., (2008) built a model to study user satisfaction with e-learning. The model had six dimensions specifically; learners, instructors, courses, technology, design, and the environment. The model guides institutions on the best way to improve their e-learning implementation by highlighting critical factors that affect learners’ perceived satisfaction. Such factors include; instructor attitude towards e-learning, computer anxiety, course

quality and flexibility, perceived ease of use and diversity in assessments.

Park (2009) utilized the structural equation modeling technique with the LISREL program to substantiate the process of adoption and use of e-learning by university students in Korea. Park (2009) employed the Technology Acceptance Model and found out that variables which included system accessibility, subjective norm, attitude, perceived ease of use, behavioral intention to use e-learning and e-learning self-efficacy were significant in developing and actualizing the implementation of e-learning.

Bhuasiri et al., (2012) utilized the Delphi method and Analytic Hierarchy Process (AHP) methodology to determine critical success factors that impact e-learning systems in developing countries. The research showed 20 success factors within 6 dimensions for e-learning adoption in developing countries. Among the constructs that were identified as key in successful e-learning implementation were: technology awareness, changing learners' behavior, motivation and curriculum design.

In research to establish the critical success factors in e-learning adoption in South Korea, Lee et al., (2009) proposes a model that is based on the amalgamation of three concepts, the flow theory, service quality, and Technology Acceptance Model. Lee et al., (2009) identified two belief variables, which were perceived usefulness and ease of use. They further identified intention to use e-learning as a dependent variable and instructor characteristics, teaching materials, design of learning contents, and playfulness as independent variables.

In yet another research, Ozkan and Koseler (2009) use the hexagonal e-learning assessment model (HELAM) to evaluate the learners' satisfaction with the learning management system within educational organizations. The research showed that 6 dimensions namely; system quality, service quality, learner perspective, content quality, instructor attitude, and supportive issues significantly impacted on the learners' satisfaction.

Palmer and Holt (2009) used surveys and multivariate linear regression to understand the factors that determine student satisfaction with online learning environments. The research presented the following factors that influence student satisfaction; confidence while communicating and learning online, a clear understanding of what is required to excel and perform in an online community.

The methods reviewed above implore linear methods of examining isolated factors associated with successful e-learning implementation. In this paper, a Systems thinking approach, method was adopted to scrutinizes the interrelationships among the constructs, the feedback loops and time delays that affect the behavior of the entire system. This is done by examining the holistic view as well as placing emphasis on the complex dynamics of a real-world system. The model derived using systems thinking simulates the effect of proposed actions on the problem and the system as a whole.

II. METHODOLOGY

The goal of the study was to gain a deeper understanding of the key leveraging points that support effective e-learning implementation in a developing country context. To achieve this goal, a methodical review of articles related to e-learning in developing countries between 2010 and 2018 was used. The articles were selected from Google Scholar, ScienceDirect, Taylor and Francis, Springer, Emerald Publishers, and IEEE databases. The search terms specifically used were e-learning in developing countries, factors affecting e-learning in developing countries, and the benefits and challenges of e-learning in developing countries. An avalanche effect was used to select and review articles generated by the search engines; references in a given article led to other articles. Saturation was used as the stop criterion when new articles did not yield new factors (Andersson and Grönlund, 2009). Content analysis was used to analyzed and synthesized the data. The study adopted an interpretive approach to identify factors associated with e-learning implementation. This was followed by the generation of variables and the relationship between the factors and variables that are associated with e-learning implementation. A qualitative systems thinking model using Vensim modeling software was developed to show the cause and effect relationships, the polarities, feedbacks, and delays. A focus group discussion meeting with two representatives from each stakeholder category was done to validate the constructs of the model and the relationships. This resulted in the final causal loop diagrams and generation of the leverage points.

A. Systems Thinking

Systems thinking is defined as a problem-oriented modeling approach used to better understand industrial problems (Forrester, 1958). Systems thinking modeling simultaneously depicts the diverse complex means through which factors (inputs) interact to generate feedback loops leading to patterns of unintended results of policy change or counterintuitive system behavior (outputs) (Sterman, 2000). In this regard, Systems Thinking enhances the understanding and working with complexity through gaining insights of the whole by examining the linkages, interactions, feedbacks, and processes between the elements as opposed to dealing with isolated aspects of the problem. This article adopts a Systems thinking approach to interrogate the intricate complexities of e-learning implementation.

B. Application of system thinking in e-learning

Implementation of e-learning is complex, involving various components arising from an amalgamation of e-learning challenges and the education system in which they are interacting and evolving. This level of complexity requires increasingly all encompassing methodologies that recognizes the multifaceted nature of utilizing e-learning in developing countries where actions need to be taken, monitored, and managed. (Xiao et al., 2012) point out that

making system interventions result in a ripple effect that has a great impact on other parts of the system. These are some of the reasons that contend for using a Systems thinking approach which considers an all encompassing perspective of the problem while taking into account the intricate complexity. The systems thinking methodology employs a vast range of conceptual, methodological and analytical tools used for engaging the key stakeholders in conceptualizing the dynamics involved. This helps in determining the factors that can be leveraged upon for improved e-learning policies and interventions.

Contexts: Bangladesh, Tonga Vanuatu, Solomon Islands, Kiribati, Tuvalu, Tanzania, Uganda, Nigeria, Kenya, Pakistan, Indonesia, Laos, Thailand, Philippines, Saudi Arabia, Lebanon, Jordan, Malaysia		
Category	**Factors**	**References**
Institutional Readiness (IR)	IR1. Formation and operationalization of policies IR2. Finance IR3. Recruitment and training of technical support staff IR4. Training lecturers and students IR5. Change management IR6. Management support IR7. Work ethic IR6. Generic IT knowledge IR7. Training plan IR8. Language skills IR9. Practical experience IR10. Cost of Hardware and software IR11. Funding sources IR12. Competing Salaries in the Market IR13. Recognition and remuneration	Tedre *et al.* (2010) Oye *et al.* (2011) Kanwal and Rehman (2017) Boggs and Van Baalen-Wood (2018) Al-Hunaiyyan *et al.* (2018) Fleming *et al.* (2017) Mosa *et al.* (2016). Joo-Nagata *et al.* (2017) Alhabeeb and Rowley (2018)
Technology/Infrastructure Readiness (TR)	TR1. Bandwidth TR2. Computer access TR3. Internet access TR4. Electricity supply TR5. E-learning environment TR6. Technical support TR7. Durability and reliability of ICT Equipment (System robustness) TR8. Security TR9. Internet penetration	Ventayen *et al.* (2018) Nawaz *et al.* (2011) Farid, Ahmad, and Alam, (2015) Kanwal and Rehman (2017) Mutisya and Makokha (2016). Adyanta *et al.* (2018) Weber and Hamlaoui (2018) Mnyanyi, Bakari, and Mbwette (2010) Khan, Hasan, and Clement (2012)
Pedagogical Change (PC)	PC1. Lecturer presence PC2. Lecturer competence PC3. Student-student interaction PC4. Group work PC5. ICT literacy PC6. Class size PC7. Parental participation PC8. Attitude towards e-learning PC9. Workload PC10. Class size PC11. Language (competence in English) PC12. Course quality PC13. Cost of content PC14. Perceived usefulness PC15. Attitude towards students PC16. Teaching load PC17. Students' self-motivation	Hogan and Kedrayate, (2010) Bhasani *et al.*, (2012) Mahmud, 2010 Albugami and Ahmed, (2016) Quadrin *et al.*, (2017). Terbini *et al.*, (2017) Hammouri and Abu-Shanab (2018) Al-Rahmi *et al.*, (2018) Boateng *et al.*, (2016) Kim and Park (2018)

Table 1:- Factors Affecting E-Learning Implementation in Developing Country Contexts

III. RESULTS

A. *Factors Affecting E-learning Implementation in Developing Country Contexts*

Over the past few years, several efforts have been undertaken to integrate e-learning into their teaching and learning processes in developing country contexts. Through literature, various factors were identified as having an impact on e-learning advancement in a developing country context. Table 1 indicates results derived from a thematic analysis. Three interrelated categories emerged: 1) Technology/infrastructure readiness 2) Institutional readiness and 3) Pedagogical change. Technology/infrastructure readiness relates to the availability of supporting technology/infrastructure resources that will facilitate the development and use of the e-learning environment. Institutional readiness refers to an enabling organizational environment that supports the development and sustainability of e-learning, Pedagogical change involves rethinking the conventional model of education. This can be through changing lecturers/teachers as the providers of knowledge and students as recipients to the interactive or collaborative model of knowledge construction.

B. *Systems Thinking Modeling*

After analyzing the data and creating a thematic analysis, the findings were further used to derive categories of factors that are associated with learners (demand factors) and factors that are associated with the provision of e-learning services (supply factors). Qualitative models also known as causal loop diagrams (CLDs) were used as part of the system thinking concept. Causal loop diagrams are diagrams used to visualize the relationships between variables and how they affect one another (Le and Law, 2009). CLDs are descriptive models that facilitate the

understanding of the systems' interrelated parts as well as the cause-effect linkages for the problem. CLDs help us in conceptualizing and depicting the feedback mechanisms that are created within complex systems. The complex systems are composed of variables, their relationships, dynamics and delays. CLDs reflect the interrelations between the variables and influences. An influence has direction shown by an arrow and polarity which shows the direction of influence (cause and effect). A positive (+) sign shows that an increase in one variable results in an increase in the other while a negative (-) sign reflects the inverse relationship between the variables. CLDs were developed to depict all variables and their potential relations and causes associated with effective e-learning implementation. The study presented in this paper derived two feedback loops (reinforcing and balancing) that were expressed in the CLDs.

C. Demand for E-learning Services

The causal loop diagram Fig.1 presents the dynamics associated with the demand for e-learning. The model focuses on the variables that play a key role in enhancing the demand for e-learning. The demand for e-learning can be described using 2 loops; a reinforcing loop R1 and balancing loop B1.

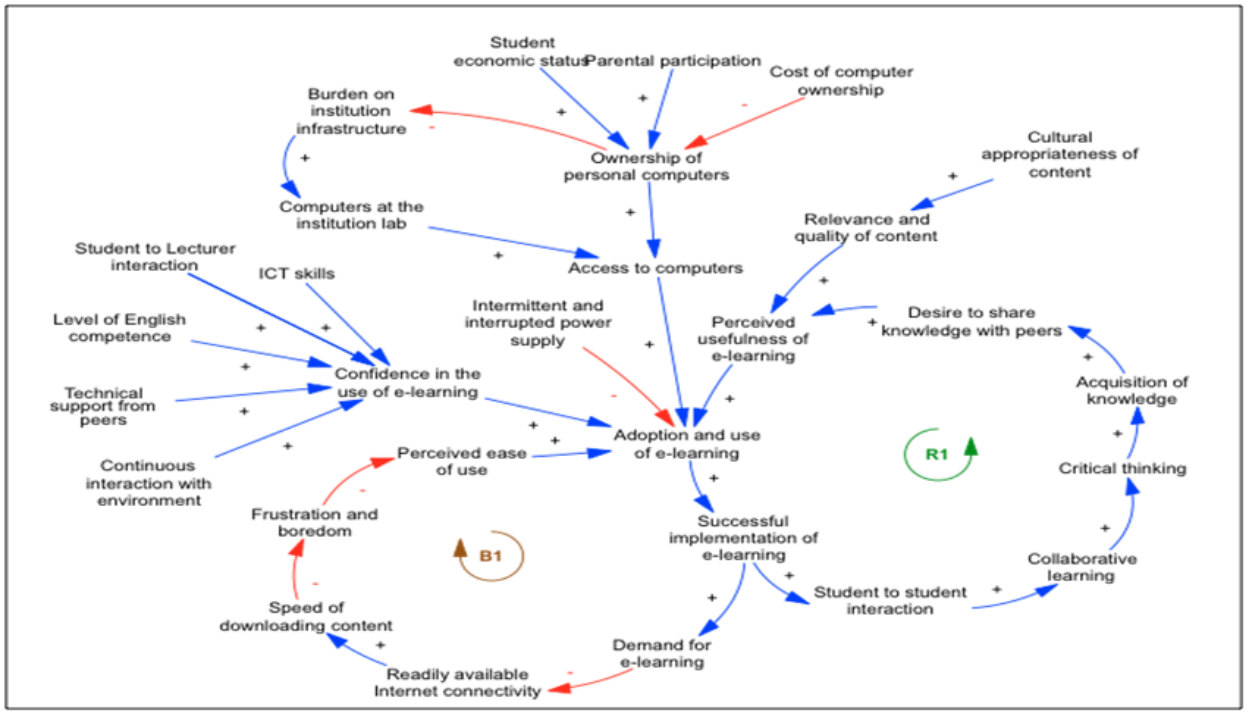

Fig. 1:- Causal Loop diagram depicting the demand side of e-learning services

- Loop R1 is a virtuous reinforcing loop that produces the desired effect of enhancing the adoption and use of e-learning. An increase in the adoption and use of e-learning boosts the successful implementation of e-learning which increases the student to student interaction resulting in an increase in collaborating learning. An increase in the collaborating learning results in critical thinking which enhances the acquisition of knowledge stimulating the students' desire to share knowledge with their peers. The desire to share knowledge coupled with the relevance and quality of the content resulting from designing content that takes care of cultural issues result in perceived usefulness of e-learning and this eventually leads to the adoption and use of e-learning after a delay.
- Loop B1 is a balancing loop whose goal of increasing the adoption and use of e-learning is slowed down due to inadequate resources in this case, the bandwidth. As the demand for e-learning increases, the Internet connectivity is slowed down due to a large number of users resulting in a reduced speed of downloading content. This results in frustration and boredom which lowers the perceived ease of use thus reducing the adoption and use of e-learning.

Other factors affecting the demand include confidence in the use of e-learning which is enhanced with increased students' ICT skills and level of English competence, student to lecturer interaction, support from peers and continuous interaction with the e-learning environment. Increased access to computers through the use of computers at the institution and ownership of personal computers enhances the adoption and use of e-learning. The ownership of personal computers can be increased through the purchase and support of parents with high socioeconomic status. On the other hand, this can only be made possible when the cost is affordable.

D. Supply of E-learning Services

The causal loop diagram Fig. 2, presents the dynamics associated with the supply of e-learning services. The model focuses on the variables that play a key role in enhancing the supply of e-learning services. The supply

side of e-learning can be described by using 3 reinforcing loops R2, R3 and R4.

- Loop R2 is a virtuous reinforcing loop that produces the desired effect of successful implementation of e-learning. An increase in staff performance and online course delivery promotes institution readiness, however staff performance and online course delivery is further enhanced by several factors which include; staff motivation (promotion and recognition), availability of technical support in course preparation, initiatives for compensation for preparation of online course, confidence in the security of e-learning and improved staff retention initiatives which include matching competing salaries in the industry, ICT skills development and training.

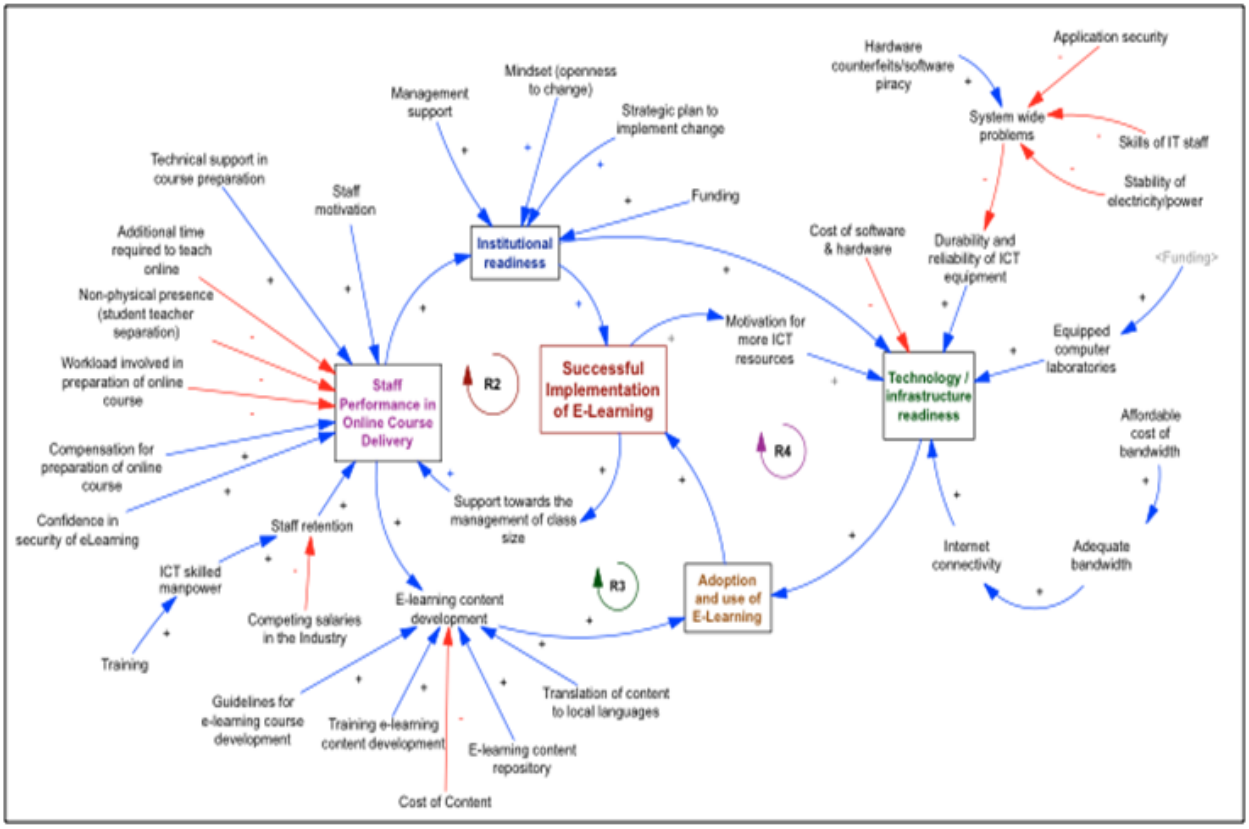

Fig. 2:- Causal Loop diagram depicting the supply side of e-learning services

On the other hand, staff performance and online course delivery are negatively impacted by the additional time required to teach and engaged in an online environment, non-physical presence (student-teacher separation) and the workload involved in the preparation of the online course. Institutional readiness supports the successful implementation of e-learning and is enhanced by the availability of funds for setting up the e-learning environment, management support, strategic planning to implement change and a positive mindset (openness to change). From a developing country perspective, successful e-learning implementation provides support towards the management of class sizes which in turn enhances staff performance in online course delivery.

- Loop R3 is a virtuous cycle that highlights the importance of e-learning content development. In order to deliver an online course, there is a need to develop online content which is dependent on factors such as e-learning course development guidelines, training e-learning course developers, implementation of an e-learning content repository, localization of course content. The cost of content acquisition negatively impacts on e-learning content development if there is limited funding. The increase in e-learning content development enhances the adoption and use of e-learning which supports the successful implementation of e-learning leading to increased support in the management of class sizes and staff performance and online course delivery.

- Loop R4 illustrates that technology/infrastructure readiness supports the adoption and use of e-learning. Successful implementation e-learning motivates and provides justification for the need of more ICT resources thus leading to technology/infrastructure readiness. Worth noting is that technology/infrastructure readiness is highly dependent on Internet connectivity, cost of software and hardware, computer laboratories, durability and reliability of ICT equipment. Internet connectivity depends on adequate bandwidth which is dependent on the affordable cost of bandwidth. The increase in the funding available to support the procurement of software and hardware equipment promotes the availability of equipped computer laboratories. The level of application security, skills of

IT staff, the stability of electricity/power and hardware counterfeit/software piracy result in reduced system-wide problems which in turn lower the durability and reliability of ICT equipment.

E. Identification of Leverage Points

In order for e-learning to be effectively implemented, there is a need to have collective accountability and responsibility of the various stakeholders. Table 2 below presents the key stakeholders in e-learning implementation with their respective aspirations and interests.

The varying stakeholder aspirations and interests demonstrate the complexity involved in achieving a common understanding of the various stakeholders' viewpoints and identifying areas of potential leverage. Developing a model that represents diverse stakeholders (involved in e-learning implementation) viewpoints increases the validity of the model and builds consensus from multiple viewpoints. This enables ownership of the model among the stakeholders as a result supporting sustainable e-learning implementation, adoption, and use. Table 2, provides a list of stakeholders' aspirations and interests in implementing e-learning. Two representatives from each stakeholder category were involved in focus group discussions whose objective was to validate the constructs of the model and the relationships. The engagement resulted in the final causal loop diagrams and generation of the leverage points

Stakeholders	Aspirations and Interests
Students/Learners	Getting empowered to use e-learning in day to day learning environments
Teachers/Instructors	Optimum and effective use of ICTs to improve the teaching and learning process. Establish educational networks for sharing educational resources
Managers of institutions	Impart teachers and students with the necessary ICT skills in order to enable them to use ICTs in the teaching and learning process. Sustainability and value addition of the e-learning program.
Education and government policymakers	Review curricula at all education levels in order to pedagogically integrate ICTs in the teaching and learning process
ICT regulators	Improve the level of investment in educational ICT equipment, software as well as broadband connectivity in education institutions
Community Leaders	Community outreach efforts to increase levels of education in the community.
Donors	Supporting program implementers to increase e-learning implementation

Table 2:- Stakeholders Involved in E-Learning Implementation

Leverages influence the system composition by causing variations that create a substantial change in the entire system. The analysis of the CLDs (Figure 1 and Figure 2) showed the following factors as high leverage points which can significantly improve the successful implementation of e-learning in developing country contexts. The leverage points are as follows:

1) Support from Management: Successful e-learning implementation is highly dependent on management support. Management needs to prioritize and make budget allocations in relation to resources required for e-learning implementation (ICT skills training, ICT Infrastructure development, etc.)
2) Training: There is a need to continually train lecturers in online content development and use in order for them to effectively adopt and use e-learning in the teaching and learning process. Students and lecturers need to have basic ICT skills to work effectively in e-learning environments.
3) Rewards and recognitions: In order to enhance staff performance and motivation to adopt and use e-learning there is a need to institute mechanisms that support rewards and recognition for staff who have effectively adopted and used e-learning in the teaching and learning process.
4) Collaborative e-learning: There is a need to establish mechanisms such as providing instruction that enhance student to student interaction through the learning management system which will compel them to engage in collaborative learning which will eventually help them to appreciate the usefulness of e-learning which leads to adoption and use. Collaborative e-learning is a learning method that employs ICT to support students working interactively in order accomplish their learning goals. This can be achieved through group assignments and presentations, online discussions forums facilitated by lecturers.
5) Engagement and Awareness: Early adopters need to engage and share success stories with their peers to encourage them to use e-learning in their teaching and learning activities. Resistance or late adoption of e-learning can also be attributed to lecturers' fear of losing control of their classes and worry about job security, but it should be noted that resistance to change can be leveraged by creating awareness among students and lecturers.
6) ICT literacy and technical support: Students and lecturers need to have basic ICT skills to work

effectively in e-learning environments. Given the limited number of computers used by numerous students with varying ICT skills, there are bound to be failures; frequent power fluctuations also affect computers and there is a need for skilled technical staff to support the available ICT infrastructure. Bhuasiri et al., (2012) affirm that quality infrastructure and systems are some of the important elements required to ensure the proper functioning of e-learning environments.

7) Increased Computer Access: One of the prerequisites of e-learning implementation is the availability of computers. Limited access to computers demystifies the notion that e-learning creates flexibility if students in developing country contexts cannot access learning anytime and anywhere because they have to share the few computers available to them. With the widespread of mobile penetration, mobile-enabled applications can be design to support mobile learning.
8) Local content repository: Mahmud (2010) points out that because of bandwidth and connectivity limitations downloading content is slow and creates frustration among students. Local content repositories that can be accessed via the internal network can provide a possible solution to the challenges created by inadequate connectivity.
9) Alternative sources of energy: The frequent electricity outages have negatively affected e-learning implementation. Although backup generators are available in some units, the generators cannot support the load and the recurrent fuel cost of running the generators is high. Implementing and using alternative sources of energy such as solar energy to supplement the expensive and intermittent electricity power should not be taken for granted in volatile environments if e-learning is to be implemented and sustained.
10) Pedagogical change: The need is to provide students with learning activities that will facilitate a process of inquiry through which they can create and share knowledge. This calls for a change in the pedagogical approach which involves the re-contextualization of knowledge dissemination and learning situations to support student learning.
11) Lecturer presence: is another important factor that is crucial in supporting students while they engage in an e-learning environment. Lecturers' presence is viewed as a coupling element among students while they engage in communities of inquiry to construct and share knowledge during the learning process. Lecturer presence can fundamentally promote the effective use of e-learning among student.
12) Lecturer competence: relates to the possession of pedagogical skills to conceptualize, prepare and design course content that will support students learning with or without technology. There is need to training lecturers in the pedagogical use of ICT to support students while they engage in e-learning environments. Worth noting is that students rely on the lecturers' skills and proficiency to effectively engage in using e-learning to support their learning activities.

IV. DISCUSSION AND CONCLUSION

The drive to adopt and use e-learning in developing countries has been fostered by the need for students to leapfrog into the competitive economic market and the rapid transformation in various business sectors that require a skilled workforce with quality education. Recent developments in the education sector have realized a widespread recognition for the need to position e-learning in a broader context of the emerging knowledge economy since it enhances learning. However, e-learning in developing country contexts is still struggling to achieve the desired benefits (Usagawa, 2018). Consequently, this article focuses on holistically identifying interrelationships between different factors that affect e-learning implementation in developing country contexts.

This study suggests that systems thinking can be adapted to holistically analyze the interrelationship of factors that impact on e-learning implementation in developing country contexts. Content analysis from a number of articles was carried out to derive different factors that have impacted on e-learning implementation in developing country contexts. The factors were divided into three main categories: 1) Institutional readiness, 2) Technology/infrastructure readiness and 3) Pedagogical change.

The results illustrated by the causal loop diagrams indicated that there are several factors that have positively and negatively impacted on e-learning implementation in developing country contexts. Factors with positive impact include: Student to lecturer interaction, Technical support from peers, Continuous interaction with the e-learning environment, Relevance and quality of content, access to computers, Technical support from peers among others. Factors that had a negative impact on e-learning implementation include: Intermittent and interrupted power supply, speed of downloading content, frustration and boredom, additional time to teach online, non-physical presence, the workload involved in preparing online courses, lack of ICT Skills, lack of computers, limited bandwidth.

While the study presented in this article identifies several factors that have an impact on e-learning implementation in developing country contexts. It also suggests that no two developing countries that are alike. Several factors impacting on e-learning implementation overlapped across contexts, while other factors are unique for a given context. It should be further noted that addressing these factors depends on the needs and priorities in a given context. Consequently, it should be emphasized that e-learning should be implemented to take into consideration the needs of a given context (Nawaz et al., 2011) to facilitate its development and sustainability.

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