An ICT Model to Enhance Teaching and Learning in a Resource Constrained Setting: A Case of Malawi

Richard Pankomera, Darelle Greunen

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Richard Pankomera[1], Darelle Van Greunen[1]
[1]*School of ICT, Nelson Mandela Metropolitan University,*
P.O Box 77000, Port Elizabeth, 6035,
South Africa,
Tel: +27 41 504 2090, Fax: +27 41 504 2213
Email: rpankomera@gmail.com; Email: darelle.vangreunen@nmmu.ac.za

Abstract. Information and Communication Technologies (ICTs) play a pivotal role in enhancing learning and teaching at all levels of education across the globe. Many developed countries appreciate that the use of ICTs has improved the quality of education. Developing countries such as Malawi have also incorporated ICTs in various curricula of programmes at all levels of education. Unfortunately, these resource constrained countries face a number of challenges in gleaning the maximum benefits of ICT in education sector.

This paper discusses the fundamental challenges underlying ICT development in the education system in Malawi. Some recommendations have also been made on how to mitigate the challenges that are encountered in the education sector in Malawi. The paper further advances the notion that the ICT intervention in education can be meaningful and effective if all stakeholders such as government, private sector, policy and decision makers, communities, students, teachers and international agencies are engaged at all levels of the education system. An attempt has also been made to compare different models of implementing ICT in the education system in a resource constrained environment. The paper finally proposes an inclusive model for the ICT intervention in education system in Malawi.

Keywords. Model, Resource constrained, Malawi, Holistic Approach

1. Introduction

Information and Communication Technologies (ICTs) are indispensable tools in enhancing learning and teaching at all levels of education across the globe. Many developed countries appreciate that the use of ICTs has improved the quality of education. Developing countries such as Malawi have also strived to incorporate the usage of ICT tools in various curricula of courses at all levels of education. Unfortunately, these resource constrained countries face a number of challenges in gleaning the maximum benefits of ICT in education sector. This paper therefore endeavours to highlight the emerging challenges of the usage of ICT in the education system of Malawi. It then gives some recommendations to address these challenges. The paper finally proposes a holistic approach to the ICT intervention in education system in Malawi. Section 2 gives the objectives of the study which is followed by section 3 on methodology. Section 4 provides the background of the study. Section 5 outlines the challenges underlying ICT development in education in Malawi. This is followed by section 6 which discusses a holistic model to ICT interventions in education system. Recommendations are succinctly explained in section 7 which is followed by a conclusion of the paper in section 8.

2 Objectives of the study

The aim of conducting the study is to propose a model that will be used by various stakeholders including teachers, policy makers, decision makers and others in implementing ICT in the education sector at all levels in Malawi. The following specific research questions are addressed during the study:

i) What is the status of ICT interventions in the education sector in Malawi?
ii) What are the challenges that are encountered in implementing ICT interventions in the education sector in Malawi?
iii) What model can be used to implement sustainable ICT interventions in Malawi?

3 Methodology

The study embraced the systematic review of different journal articles, peer reviewed conference papers and books with an aim of answering specific research questions. This involved the formulation of research questions; searching of relevant work from multiple sources; describing study characteristics; summarising the evidence and finally interpreting the findings [1]. A number of articles by various researchers were accessed from electronic databases such as Science Direct, Google Scholar, web of science, ERIC and EBSCOhost. Most of the journals that have been analysed are from 2002 to 2016. The study also endeavoured to examine other documents such as Malawi ICT National Policy, Global Information Technology Report, E-learning Africa report and books.

A combination of keywords such as *model, framework, guideline, ICT, computer, education, developing, underdeveloped, poor setting, implementation, challenges, barriers, ICT interventions, resource constrained* and *Malawi* were used to select appropriate articles. This resulted in displaying more than 10,000 articles. Special Boolean operators like *AND, OR* and *NOT* were employed in order to alter the scope of the search. These articles were further filtered by year and title of the publication with their relevance to the implementation of ICT in education and learning in a resource constrained setting such as Malawi.

4 Background

4.1 Context Setting

Malawi follows an 8-4-4 education system which is composed of primary schools, secondary schools and University. This means that primary school, secondary school and university education takes 8 years, 4 years and another 4 years to complete respectively [2]. With a population of approximately 16 million, Malawi has a total of 4,449,000 pupils enrolled in primary and secondary education. 83% of them are enrolled in primary education [3]. It is also interesting to note on average 62% of 15 to 24 year olds do not complete primary education in Malawi. However, the literacy rate is 72% among the youth population; this is higher than the average youth literacy rate in other low income countries [3]. For the purpose of this paper, literacy rate is the ability to read and write with understanding a simple statement related to one's daily life. With regards to ICT literacy, most public primary schools do not offer

computer lessons. It is only in the isolated few private primary schools where pupils can learn the basics about computers. At the secondary school level, very few isolated schools offer computer studies as a subject due to a number of challenges. As for public institutions of higher learning, only Mzuzu University, the University of Malawi and Malawi University of Science and Technology offer degree programmes in either computer science or ICT.

4.2 ICT interventions in education

Many ICT interventions have been put in place in an effort to circumvent the aforementioned challenges. The major goal of these interventions is to improve the quality and quantity of learning and teaching at all levels of the education system since ICT has proven to provide opportunities for teachers and students to collaborate within the schools and the rest of the world [4].

The government of Malawi adopted a National ICT Policy in December 2005 which aimed at developing the ICT industry and at the same time promoting the development and use of ICTs in all sectors including the education sector [5]. It was therefore envisaged that the use of ICT in education sector would assist in improving the management of education systems in Malawi, thereby transforming Malawi into an information and knowledge driven ICT literate nation [5]. This would consequently enable the improvement of ICT literacy levels by both students and teachers. To achieve these objectives, many strategies were developed such as ensuring that primary, secondary schools and colleges have adequate and reliable computers; building facilities to promote ICT training and education in schools and colleges; promoting e-learning, e-teaching and e-distance learning; and developing user-friendly electronic management information systems to improve the quality of management of educational institution [6]. Institutions were therefore formed to facilitate the implementation of the National ICT policies. In collaboration with the Department of E-Government, the responsibility of the Ministry of Education is to promote and facilitate the development and utilization of ICT skills in the education sector. On the other hand, Malawi Regulatory Authority is an ICT regulator that promotes the development of the ICT sector through investment, monitoring, research and training to professionally deliver reliable and affordable communication services throughout Malawi [7].

There are a number of projects that assist to bridge the digital gap in Malawi. For instance, Computer for African Schools (CFAS) is a scheme that was administered by British council in collaboration with SchoolNet Malawi Trust. This enabled the introduction of computer lessons in some of the secondary schools in Malawi in 2003. The scheme provides computers to schools that have the right facilities and security to house the equipment. Erach and Roshan Sadri Foundation (ERSF) is another charity organization which has managed to donate a number of ICT equipment including desktop computers, wireless access points, laser printers and internet access to various schools. The secondary school beneficiaries are Blantyre, Chichiri, Zingwangwa and Chipasula secondary school. For instance, in appreciation of this ICT intervention, the headmistress of Blantyre secondary school said, “The lab has increased the enrolment ratio of students pursuing computer studies. It has also simplified teaching and learning for the teachers and the students" [8]. This is one of the scenarios that assert how ICT can transform the teaching and learning environment in schools. Table 1

summarises some of the projects in education in Malawi. It must be known that most of these projects are donor funded and they are not centrally run by the government.

Table 1. Some ICT Project interventions in education in Malawi

No	Project	Focus	Beneficiaries
1	MAREN	Internet connectivity for the tertiary education and research sectors in Malawi [9].	Institutions of higher learning in Malawi: Mzuzu University and Chancellor college, College of Medicine
2	FAIR Denmark	Bridging the digital divide between developed and developing countries by providing refurbished ICT equipment [10].	Secondary Schools in the northern and central regions which received over 1000 desktop and laptops
3	ITSchoolsAfrica - Computers for Malawian Schools	Creating e-learning centres for students and training of teachers [11].	Secondary Schools such as Blantyre, Chichiri, Chipasula, Zingwangwa.

5 Challenges in ICT in education in Malawi

Malawi is rated as one of the poorest countries in the world owing to a number of factors. For instance, its infrastructure is underdeveloped. There is poor road network infrastructure, poor and few number of school facilities. There are few schools with limited number of classrooms. As a result of this, most pupils learn under the tree. Therefore increasing number of schools remains a priority over the acquisition of computers in introducing computer lessons at all levels of education. The power supply in Malawi remains unreliable. There is intermittent power supply across the country. In some instances, black out may even last for days. World Bank states that 8% of the population in Malawi has access to electricity. In addition to this, 84% of the population lives in the rural areas where there is no electricity [12]. This means that the national electrical energy system is accessible to less than 1% of the rural population [13]. It is an undeniable fact that computers need regular supply of power for them to operate. This poses a number of difficulties even in primary, secondary and let alone university where computers lessons have been introduced.

High cost of telecommunications aggravates the feasibility of introducing computer education at all levels of education too. Malawi still remains a country where the cost of internet access is high [14]. Unfortunately, some computer lessons at all levels of education require access to the internet in order to obtain current and updated study materials. Internet access may be necessary when students and teachers need to communicate in real time over a long distance. As these problems are not enough, cellular network coverage still remains limited. Even though, better cellular network is found in the urban areas, over 80% of the population live in the rural areas. Introducing ICT at all levels of education remains a hassle in Malawi because most pupils cannot afford to acquire even the basic ICT gadgets. The penetration of mobile and fixed phones too is one of the lowest in Malawi as compared with other countries across the African continent. 45% of the households in Malawi use a mobile phone while 1% use fixed phones [15] [7]. It is therefore not surprising that Global Information Technology Report ranked Malawi as among the countries that is below the average Network Read Index (NRI) [16].

The quality of education in Malawi is very low with high student/teacher ratio of 63:1 at primary level. The absence of teaching and learning materials, adoption of pedagogical learning and deployment of untrained teachers especially at primary level contribute to the dwindling quality of education in Malawi [17]. Most teachers in the primary, secondary and even at the university level are computer illiterate due to negative attitude towards technology change. No wonder there is a proliferation of sub-standard ICT syllabi and poor ICT service delivery in the schools. This presents difficulties in offering computer lessons to pupils or students at all levels of education in Malawi. Besides this, most qualified trained ICT teachers opt to go for greener pasture. They either migrate from Malawi to other countries especially within SADC region or they may opt to move to a private sector rendering the public schools still in dire need of ICT competent teachers.

Due to high levels of ICT illiteracy in schools, teachers have problems in appreciating the introduction of ICT in education. To this end, most teachers who are used to traditional ways of teaching may not have enough confidence in embracing the ICT interventions.

As one of the poorest countries in the word, Malawi still depends upon donors for financial support across all sectors. Since ICT is taken as an enabler to the implementations of core services, it is not given enough financial allocation. In fact, approximately 40% of the national budget for Malawi comes from donors.

With the dynamic advancement of internet technology, most researchers can easily collaborate and even easily share research publications. This is not the case where there are high levels of ICT illiteracy. As a result, current best practices of teaching and learning are not incorporated in the curriculum.

In conclusion, Malawi being part of Africa, it shares the some problems with the other countries in the adoption of ICT in education system as stipulated in the E-learning Africa 2015 Report. Generally, common obstacles that prevent greater use of ICTs are: high cost of ICT services, unavailability of ICT equipment, poor electricity or energy, lack of awareness of how best to use ICT in education, lack of government investment or support, lack of private investment, lack of relevant content and lack of confidence in embracing ICT [18].

6 Approaches in implementing ICT in resource constrained setting

There are a number of models that have been used to implement ICT in the education system in resourced constrained settings such as developing countries. Hawkridge stipulated six rationales for adoption of ICT in schools especially in the developing countries [19]. First, the preparative rationale ensures that students use ICT so that they are equipped with skills for their social and vocational functioning. Second, the pedagogical rationale uses ICT as an enabler to improve student learning, understanding and retention. Third, catalytic rationale employs ICT as a catalyst to stimulate educational change. Fourth, the accessibility rationale ensures ubiquitous access to education by every student. It is noteworthy that mobile learning technology seems to be a promising solution in enhancing accessibility in remote and resource constrained setting. Fifth, the motivational rationale entails that ICT motivates students to engage in learning activities. Sixth, the administrative rationale uses ICT to monitor students and manage educational processes and components in institutions

[19]. It is not surprising that most models and approaches in implementing ICT interventions evolve around these rationales.

Table 2: Approaches in implementing ICT intervention in some of the resource constrained environments.

No	Country	Framework/ Approaches	Focus/ Components
1	South Africa	A Pragmatic framework for integrating ICT into education in South Africa [20]	• Mobile instant messaging service • Mobile tutoring platform • Mobile teaching platform • Learning content by content providers • Learning management systems • Various learning activities • Multiple learning models
2	Nigeria	ICT integration in education [21].	• Establishment of computer laboratories in university and some institutions with support from external sources • Computers and blended learning being used in the distance learning programmes of some teacher raining institutions • Radio and television in distance learning • Establishment of ICT laboratories and cyber cafés
3	Tanzania	An approach to ICT based school education in Tanzania [22]	• Introduction of mobile computing laboratory facilities • Computer assisted instruction-learning/web based learning • Computer supported teaching • Institutions of higher education adopting the nearby schools

Mishra and Koehler proposed a generic Technological Pedagogical Content Knowledge (TPACK) framework that facilitates technology integration in the teaching and learning environment. It is envisaged that this framework requires that teachers have technological pedagogical content knowledge to competently embrace ICT in the classroom environment [23] [24]. On the other hand, the Substitution Augmentation Modification Redefinition Model (SAMR) emphasizes different levels of ICT integration; from enhancement to transformation of lessons. At the enhancement level, technology acts as a direct tool to be used firstly with no functional change but secondly with an improvement change. At the transformation level, technology allows for the redesign of significant task and also it allows for the creation of new tasks which were inconceivable before [25]. SAMR model has been used to evaluate the deployment of ICT intervention in the mobile learning environment. On the other hand, Donnor and Kentaro recommends the model of ICT integration in education that focuses on processes and outcomes rather than the supply of hardware and equipment [26]. This is related to Hamel's human development approach that employs the technology to enable people to collaborate, network and learn beyond national borders [27].

Another promising approach in resource constrained environment is mobile learning technology intervention. The benefits of mobile learning are: i) It is flexible to learners as they can use their mobile devices anywhere and at any time with different forms of data such as video, text and audio. ii) Content in mobile platform is concise which contributes to better completion rate by learners iii) Online communities enhance collaborative learning. iv) It enables learners to assimilate concepts at their own pace as it facilitates an increasing personalised learning. Despite all these benefits, implementation of ICT in the education sector in resource constrained environment has not been rosy. Table 2 endeavours to compare some of the different approaches in deploying ICT interventions in the education sector in some of the resource constrained environments.

Much as the ICT has been appreciated in advancing the quality of education at all levels, it is of paramount importance not all ICT solutions that have worked in developed countries can also be successfully implemented in a resource constrained setting such as Malawi. These solutions need to be customised in response to the local knowledge and cultural beliefs. The relevant and appropriate solutions must meet the needs of the developing country such as Malawi. In this context of argument, a simplistic model is proposed that must be followed when implementing ICT interventions in a resource constrained setting such as Malawi. This model has three major phases: planning; implementation; monitoring and evaluation. Figure 1 depicts these phases as explained in the following [26]:

i) Planning

This may involve establishing institutional goals at district, regional and national levels. Stakeholders and necessary resources need to be identified to meet the formulated visions, goals, and objectives. Planning teams need to be formulated for the acquisition, deployment and disposition of the resources. Technological, social, cultural, financial and political requirements that are necessary for the deployment of ICT interventions must succinctly be explored. Staffing and training needs must be considered during the budgeting process during this phase. It is important that all stakeholders such as teachers, parents, policy makers and even students are involved at an early stage as possible.

ii) Implementation

At this phase an action plan must be designed and fully implemented. This may involve the actual acquisition of the necessary resources as well as the planning of their integration in the classroom to meet the institutional goals. Other activities may include the design and implementation of course content; design an approach to classroom assessment; design professional development activities for teachers; and the design of monitoring and evaluation framework.

iii) Monitoring and evaluation

Once the ICT interventions are fully operationalised, the monitoring and evaluation framework assists the management and other stakeholders to determine whether the objectives have been accomplished.

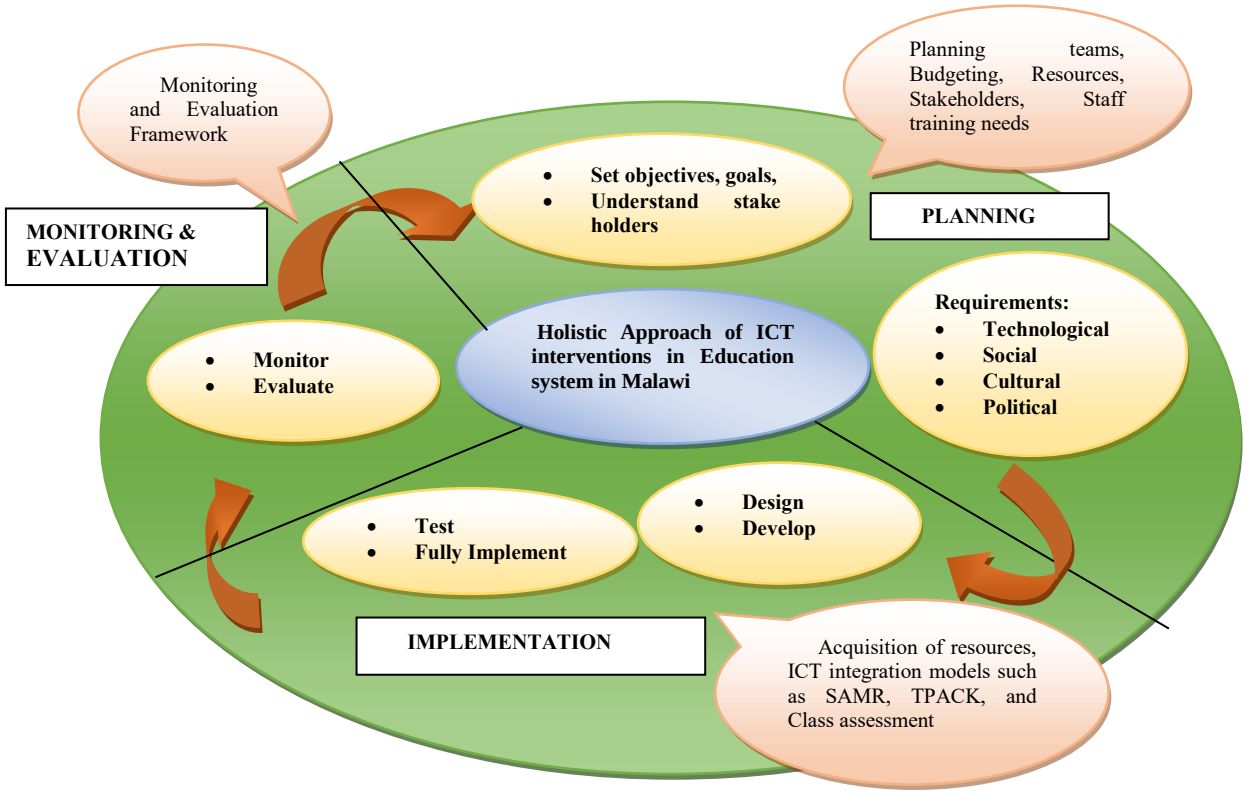

Figure 1: A model to ICT interventions in Education system in Malawi

7 Recommendations

This paper therefore endeavours to provide a number of recommendations. Since mobile technology has an advantage of being accessed ubiquitously, it is a promising technology for resource constrained settings especially where road network infrastructure is bad as it regards to Malawi. With the proliferation of basic mobile phones, an investment of mobile application in education by both the public and private sector stake holders is very much recommended. Strides must be made so that applications that are used in education sector must be developed in a language and cultural context of the learner. This may eventually reduce the learning curve when ICT interventions are introduced. This will also motivate the leaner to accept the new technology. The major problem of internet connectivity in education systems needs to be addressed if ICT is to reap adequate benefits. Private-public partnerships can be set up in order to improve poor ICT infrastructure and limited cellular network coverage. Policies must be formulated in order to assist rural areas to have an access to affordable ICT gadgets and services.

As it has been noted that most teachers and instructors at all levels of education are ICT illiterate, deliberate policies must be put in place to ensure the acquisition and development of ICT skills. This can be done by incorporating ICT in the curriculum at all levels. Through e-learning, e-teaching and e-distance learning, students and teachers must be encouraged to adventure various ways of improving their ICT skills. It is argued that channelling resources towards empowering teachers in ICT skills and professionalism will have a longer-term and sustainable impact on the education of the students [28]. Being one of the poorest countries, Malawi lacks a number of resources including computers and network equipment. It is therefore recommended that collaborative effort must be made among government, international agencies and private sector to ensure the availability of computer hardware and software in primary

schools, secondary schools and colleges. There is a need for ICT policies to be formulated so that they are in tandem with promoting ICT education. This will facilitate the adoption of ICT as a tool for research and e-learning. There must be a political will by the government to promote the implementation and utilization of ICT in education. To circumvent the lack of electric power, solar energy can be used to power mobile devices. Teachers need to be involved in the creation of content of course content for mobile technology learning as early as possible. Finally, monitoring and evaluation mechanisms must be put in place in collaboration with the public and private sector to ensure the sustainability of ICT policies and projects in education. This is why a model is proposed in introducing ICT interventions in the education system in Malawi. This model can be sustainable only if there is fiscal discipline in as far as the political will is concerned.

8 Conclusion

This paper has highlighted the ICT interventions that have been put in place by various stakeholders in order to improve the quality of education at all levels. It has also endeavoured to outline the challenges that are encountered in a resource constrained environment such as Malawi. This paper has highlighted that, even though there are workable ICT solutions in the developed countries, not all of them can successfully be implemented in a resource setting. This is because of disparities in terms of cultural, technological and social differences in this setting. Recommendations have been therefore made to address these challenges in a resource constrained environment. It is also recommended that a model be adopted in planning, implementing monitoring and evaluating of ICT interventions in education at all levels of the education system in Malawi. Emphasis is therefore made that this model can be sustainable only if there are enabling policies such as, fiscal discipline, in as far as the political will is concerned. It is envisaged that the implementation of the model will ensure the availability, accessibility, acceptability and adaptability of ICT in the education sector while enhancing teaching and learning especially in the resource constrained environment.

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