Towards an instructional design model for learning environments with limited ICT resources in higher education

Frederick Kwaku Sarfo[1]* and Jan Elen[2]

[1]Department of Educational Leadership, University of Education, Kumasi Campus, Winneba, P.O. 1277, Kumasi Ashanti, Ghana.
[2]Center for Instructional Psychology and Technology, Katholieke Universiteit Leuven Vasaliustraat 2, 3000 Leuven, Belgium.

ABSTRACT

This paper provides grounds for creating an integrated instructional design model that can be used to guide the design of quality classroom instruction in higher education also in countries with limited resources. To achieve its purpose the paper investigates various projects on integration of ICT in education in developing countries and identifies that limited ICT resources and financial constraints are major difficulties they face. The paper further elucidates, based on the findings from the literature that limited ICT resources are considered as a major barrier to successful integration of ICT in teaching and learning. In line with the literature on instructional design and technology, the paper argues that it is the effective use of the real principles of instruction rather than ICT that makes learning effective. Based on this proposition and the deficits of the current instructional design models, the paper presents theoretical and practical justifications for testing the generalizability of the basic instructional design models in the context of higher education classrooms with limited, moderate, and adequate ICT resources.

Keywords: Instructional design model, learning environment, developing countries, Africa, limited ICT resources, ICT integration, access, higher education.

*Corresponding author. E-mail: sarfofredk2001@yahoo.com.

INTRODUCTION

Many countries all over the world are struggling with how to improve their higher educational systems. This is because quality higher education is considered as a critical factor to the development of individuals' potentials and/or democratic development; gross domestic product (GDP); infrastructure development; and ability for a country to participate fully in the global economy. The integration of ICT in education, to some great extent, has become one of the issues in improving the quality of educational systems. Already twenty years ago, Harvey (1993) postulated that the effectiveness of the use of computers in education may be the important factor in determining which countries will succeed in the future. Kozma (2014) affirms Harvey's proposition by saying that a common rationale for investing in educational ICT is the

role it can play in preparing a future workforce and supporting economic development (Kozma, 2014). Kozma emphasizes that with ICT: 1) industrialized countries can reform their education systems to advance an information economy and knowledge society and 2) developing countries can support education and economic development at a lower operational cost and greater time and space advantage with ITC. In this paper, ICT or IT refers to digital technologies. Examples are computer, internet, bandwidth, wireless networks and related software.

According to Pelgrum and Law (2003), the issue of computers in education started to become popular, mostly in the developed countries, in educational policy-making in the early 1980s when relatively cheap

microcomputers became available for the consumer market. Since then many computer determinists entertain the expectation that the introduction of computers itself in education would bring about quality teaching and learning (Elen et al., 1999). For instance, Papert (1980) proposed that technology would change the educational landscape forever and in ways that would engender a dramatic increase in the performance of learners. The availability of internet and wireless networks, which has promoted the use of online and hybrid learning, has brought more hope for computer determinists in education. It has been predicted by Johnson et al. (2013) that new emerging technologies such as massively open online courses (MOOCs), tablet computing, wearable technologies, learning analytics, and 3D printing will have potential impact on teaching, learning and research in higher educational institutions in the next five years. Are the predictions true? This is subject to complex debate. It is important to note that the focus of the present article is not on the role of ICT in virtual classrooms and distance courses to supplement higher education. The proliferation of ICT and more especially the spectacular uses of ICT in the 21st century have created and still are generating more and more expectations that ICT is the engine for achieving the modern aims of higher education. The conception that ICT can play a key role in augmenting teaching and learning has also been expressed in Ghana (President's Committee on Review of Education Reform, 2002) and many developing countries. In Africa, the sentiment for the introduction of computer technology in all schools and other governmental and non-governmental organizations originated from the statement made by Professor F. H. Allotey of the Kwame Nkrumah University of Science and Technology when speaking in Tanzania to top decision-makers in Africa: "We paid the price for not taking part in the industrial revolution of the late eighteenth century because we didn't have the opportunity to see what was taking place in Europe. Now we see that information technology has become an indispensable tool. We can no longer sit down and watch passively" (Sagahyroom, 1995:164). But it is not only the leaders in developing countries who emphasize the importance of ICT in education and other economic and social activities. A United Nations (2005) report reveals the potentials of ICT to expand access to quality education and to boost literacy in developing countries. At the first African Ministerial Forum in Tunis, Fenchun Miao, an educational specialist at UNESCO said "ICT was the key to ensure better learning for all", he said "his organization 'UNESCO' has already been successful in this goal in Asia, we can do the same thing in Africa" (New vision, 12th Dec., 2013). These statements have incited many governments, policy-makers, businessmen, and educationalists in developing countries. It has further made them confident that the integration of ICT in various levels of education and other sectors of the economy will enable them succeed as

developed countries. Avgerou (1990) noted that the idea that IT can help developing countries is intriguing to many, because of the benefits that have apparently been realized in the West. Avgerou (1990) however indicated that the literature sometimes contains a naïve taken-for-granted assumption that the success of the West is attributable to ICT, and therefore bringing the benefits of this development to poorer countries is simply a matter of delivering IT.

Wagner and Kozma (2003) indicate that the promise of ICT to enhance education is a tremendously challenging area of development work today, in both poor and healthy nations. Similarly, Jhurree (2005) argues that education reform is occurring throughout the world and one of its tenets is the introduction and integration of ICT in the education system. Jhurree (2005) asserts that the successful integration of ICT into the classroom warrants careful planning and depends largely on how well policy makers understand and appreciate the dynamics of such integration.

Empirical data gleaned from the literature (Land and Hannafin, 2000; Sicilia, 2005; Korte and Hüsing, 2006) indicate that lack of access to ICT tools serves as a critical barrier to the use of ICT to achieve quality education, more specially quality teaching and learning. There is abundant evidence in the literature (Sarfo and Ansong-Gyimah, in press; Jhurree, 2005; Akbaba-Altum, 2006) that limited access of ICT resources is a major issue in developing countries. It is argued, in this paper, that even if ICT is considered as the engine for quality instruction, the fact that developing countries face the problem of limited ICT resources and financial constraints, they are at disadvantage. This is a serious threat or danger to educational reforms in developing countries or countries with limited ICT resources and it needs urgent attention from policy makers, educational change leaders, educational practitioners, and instructional technologists all over the world.

However, a careful review of the literature (Sarfo and Elen, 2007, 2008; Clark, 2001) on learning and instructional technology reveals that in the context of constraints in hard technology, soft technology together with innovative instructional strategies based on effective principles of instruction can achieve learning results as effective as instructional strategies integrated in hard technology. The intention of this paper is to argue that whilst the overreliance on ICT as a teaching tool (to facilitate teaching and learning) in the classrooms of higher education in developing countries could retard the process of achieving quality education, a possible redirection of the focus of ICT to the effective design of instruction could show a better way. More specifically in this paper, it is argued and proposed that identifying an integrated instructional design model based on effective principles of instruction can promote quality instruction in the classrooms of higher education in developing countries irrespective of their ICT resources. The paper

aims at contributing to the relevance of instructional design in higher education in both countries with adequate/moderate ICT resources and countries with limited ICT resources.

The article begins by describing the various ICT and educational reform projects in developing countries. Detailed and careful analyses and descriptions of such projects reveal that among other barriers, access to ICT resources is problematic in developing countries. The next section of the paper reviews empirical research which reveals that limited ICT resources and limited technical support are hurdles to successful integration of ICT in teaching and learning in developing countries or countries with limited resources. What exacerbates the problem of limited ICT resources in developing countries is financial constraints. In addition, the paper elaborates that what makes teaching and learning effective is not ICT (computer, internet, wireless connection, and related software) but effective design of instructional methods or strategies based on effective principles of learning and instruction. Here, it is concluded that instructional design models based on effective principles of instruction can facilitate quality teaching and learning in every higher educational settings irrespective of the nature of resources.

INTEGRATION OF ICT PROJECTS IN DEVELOPING COUNTRIES

A major pre-occupation in the literature on ICT and education has been the question of the "digital divide" (OECD, 2004). According to an OECD (2004) report, digital divide is defined as the disparity in ICT diffusion and use between industrial (developed) and developing countries. This is reflected in the statement to the World Summit on the Information Society, Geneva, 10 December, 2003 by United Nations Secretary General, Kofi Annan that:
"The so-called digital divide is actually several gaps in one. There is technological divide – great gaps in infrastructure. There is content divide. There is gender divide…This can be true of rich and poor countries alike". More recently, OECD has come out with a second "digital divide" (OECD, 2011): between those people who are lost in the digital environment and those who have the skills to navigate efficiently and effectively through all the information now available to them through digital technologies. It is argued that the second definition of digital divide, more properly, suits those in developed and developing countries which have minimal or no problem with the access and use of ICT.

According to the report of the European Schoolnet and University of Liege (2013), in European schools, more than 9 out of 10 students are in schools with broadband, at most commonly between 2 and 30 mbps on average. Denmark, Estonia, Luxembourg, Norway and Sweden have the highest bandwidth at most if not at all grades (European Schoolnet and University of Liege, 2013). The European Schoolnet and University of Liege (2013) report, to some great extent, is in line with the report provided by the International Telecommunications Union (2010) on access to ICT in countries around the globe. According to the figures, in developed countries such as:

i) UK - 83.56 per every hundred people have access to the internet and for every hundred people, there are 130.55 mobile phones
ii) USA - 76.24 per every hundred people have access to the internet and for every hundred people, there are 94.83 mobile phones
iii) Australia - 74.00 per every hundred people have access to the internet and for every hundred people, there are 113.75 mobile phones (International Telecommunications Union, 2010).

In Europe, there are between three and seven students per computer; the older the student the lower the student to computer ratio in most countries (European Schoolnet and University of Liege, 2013). According to the report of European Schoolnet (2013), there is large variation between countries. Denmark, Norway and Sweden have the lowest ratios. Laptops, tablet and netbook are becoming pervasive, but only in some countries; on average, in the EU there are between eight and 20 students per laptop. As indicated in the report, ratios of students to laptops could be lower in some countries, as personal ownership grows and 'Bring your own technology' policies are implemented in some schools (European Schoolnet and University of Liege, 2013).
Whereas, according to International telecommunications Union (2010), in developing countries such as:

i) Ghana – 5.44 per every hundred people have access to the internet and for every hundred people, there are 63.88 mobile phones
ii) Nigeria – 28.43 per every hundred people have access to the internet and for every hundred people, there are 47.24 mobile phones.

Hepp et al. (2004) assert that developing countries have become anxious about the widening gap between their reality and the aggressive ICT policies and projects of some developed countries. Consequently, there is a more urgent need to improve the quality and equity of education to bridge the gap between developed and developing nations. ICT is perceived as a necessary tool for this purpose. The goals of such projects mostly focused on helping students and teachers to work with computers, helping teachers and students to communicate electronically, helping school administrators to use computers to aid administrative and management activities, more importantly to improve teaching and learning in the classroom. It is important to note that the

authors of this paper do not contest the role of ICT in education in general and they neither have any negative attitude towards the projects intended to integrate ICT into education in developing or developed countries. But it is worrying when such projects or those who are at the helm of such projects emphasize the point that only ICT (computer, internet, bandwidth, wireless connection and related software) can promote quality teaching and learning in the classroom. There are several barriers to successful integration of ICT into teaching and learning in both developed and developing countries (Bingimlas, 2009). However, in the present article barriers which have been given lavish attention are: accessibility of ICT resources; lack of technical support; lack of physical structures; and inadequate financial support of ICT integration in education projects in deprived countries such as Cameroon, Cote D'Ivoire, Ghana, and Egypt and other African countries.

Cameroon

Cameroon is one of the sub–Saharan African countries that are making tremendous progress in the use of ICT in various development sectors including higher education (Josue, 2007). A survey study conducted by Josue (2007) reveals that in Cameroon, ICT was officially introduced into higher education in 2001 by the President. The projects started slowly but are gradually gaining speed. The French Government plays a great role in the implementation and is a major partner both technically and financially. The major achievements of the projects include establishing multimedia resource centers (MRC) in universities, professional and technological institutions to facilitate teaching, learning and research. However, according to Josue (2007), the projects are solely based on external funding; thus putting the sustainability into question. Nearly all computers used in the tertiary institutions were donated, often second-hand, and they are now getting old, which means many of them are in need of repair (Josue, 2007). Due to lack of funding, institutions were not allotted any budget to purchase new computers or cover the cost of maintenance. Nearly all schools connected to the internet are not able to pay their internet bills to COMTEL, and the connectivity has not been cut off only for fear of creating a mayhem that could undermine the government's efforts to promote ICT in tertiary education (Josue, 2007).

Cote D'Ivoire

The Ivorian Government considered ICT a priority. In the 1970s, with support from French Government, Cote D'Ivoire decided to bridge the digital gap to keep with development of computers and related technology (Fall, 2007). It has made significant efforts to establish the integration of ICT in Ivorian colleges, universities, and teaching institutions. The tertiary education sector in Cote D'Ivoire is the first one in Africa to implement beneficial internet application. However, a survey study conducted by Fall (2007) indicates the following: equipment is lacking in higher education institutions; limited internet access for large number of students in urban and rural areas; and no fast access to reliable internet. Computer equipment is costly partially because of custom taxes.

Ghana

Many educationalists, students, teachers, policy-makers (including the government), and other agencies are optimistic that most problems in education in Ghana will be solved through the implementation of ICT in education (President's Committee on Review of Education in Ghana, 2002; ICT for Accelerated Development (ICT4AD), 2003; World Bank, 2007; Sarfo and Ansong-Gyimah, 2010). In 2004, the Parliament passed into law Ghana's ICT for Accelerated Development (ICT4AD) Policy. The policy indicates the vision of Ghana in relation to ICT in the knowledge economy. It addresses the exploitation and deployment of ICT to promote education and (other sectors) of Ghana economy. In line with these developments, many of the universities and polytechnics in Ghana have developed their own ICT policies; include an ICT levy for students, to enable them to have access to internet facilities and other ICT tools (Sarfo and Ansong-Gyimah, 2010; Mohhamedhai, 2008; Mangesi, 2007) to facilitate research and teaching and learning. However, these developments are not without problems relating to poor maintenance system; woefully inadequate resources (computer – hardware and software, internet facilities); very slow internet connectivity; high cost of internet usage; power interruption; and many others. In addition, not all tertiary institutions in the country are equally endowed and there are instances where computer facilities are run purely by the private sector as cyber cafes on campus. Not all students have access to computers due to high cost of ICT tools. Inability of some schools to charge the mandatory ICT levy, since it brings additional burden to parents, is also a problem (Mangesi, 2007). Sustainability remains an issue since most of the tertiary institutions rely on donor agencies. Lack of funding might be the most common reason for the inability to acquire adequate computer facilities and other teaching equipment in institutions and schools in Ghana as a developing country.

Egypt

Egypt sometimes referred to as "The mother of the World" and "The Land of Civilization" has made enormous efforts to initiate programs and projects to promote the integration of ICT into other sectors and

tertiary education. A survey study conducted by Hamdy (2007) shows that the current technological infrastructure is still insufficient, more especially at universities in the rural areas.

A survey study conducted by Farrell et al. (2007) initiated by the Information for Development Program (inforDev), World Bank presented a comprehensive report from 53 African countries. The report focuses on 1) how ICT is currently being used in the education sector in Africa, and the strategies and policies related to this; 2) the common challenges and constraints faced by African countries in this area, and 3) what is actually happening on the ground, and to what extent are donors involved.

The report depicts that there are only about six African countries (South Africa, Morocco, Botwana, Namibia, Mauritius, Seychelles) that do not face major challenges in integration of ICT into tertiary education. Even though the policies and projects of ICT integration into education in some of these six countries are supported by donor agencies such as World Bank, UN etc, the governments are able to provide adequate funding or budget to support that of the donors. These six countries in Africa, according to the report have a very sound socio-economic index and could be classified as the middle income countries. In the remaining 47 African Countries, some of them such as Burundi, Angola, Somalia, and others have not initiated any comprehensive policies on integration of ICT into education at all levels due to lack of funding and/or awareness. The use of ICT in the higher institutions of the countries which have not initiated comprehensive policies on integration of ICT are funded mainly by UNDP and other donors. However, there are huge problems with access and infrastructure.

Most of the remaining countries have initiated policies and both large and small scale projects on the integration of ICT into different sectors of the economy particularly all levels of education. All the projects (both large and small scale) on integration of ICT into education (tertiary) are technically and financially supported by the donor agencies and countries such as the UN, EU, World Bank, African Development Bank, French Government, US Government, British Government, Canadian Government, South African Government, and many others with little support from the governments themselves. However, according to the report by Farrell et al. (2007) there are numerous challenges regarding the integration of ICT into tertiary education in these countries. Among the challenges are (Farrell et al., 2007):

1. Inadequate ICT materials
2. Limited access to computers and internet to large number of students
3. Lack of technical expertise
4. High cost of ICT equipment
5. Inadequate or no internet connectivity in some of the learning institutions
6. Reliance on second-hand computers from the donors

7. Defective internet connectivity in most of the computer laboratories in the institutions
8. Poor telecommunication networks
9. In most of the countries only the urban areas have grid electricity thereby inhibiting the use of ICTs in rural schools
10. Most of the countries are not linked to the SAT3 underwater fiber-optic cable, and access to internet relies mainly on satellite, and is very expensive and sometimes unreliable
11. Lack of legal and internal framework to support ICT integration into education
12. Positive attitudes among the champions in government, civil society, and management of the higher education towards ICT integration in education. However, these positive attitudes have not translated into larger scale successful ICT programmes or projects in education
13. Remaining significant dependence on the external donor funding for ICT projects and equipment
14. Inability of the government to extent ICT infrastructure due to financial and budgetary constraints
15. Inadequate or no funding from the government and ministerial levels to support the ICT integration projects.

What exacerbates the above challenges is that the vast areas of most of these countries, recognized as developing countries, are still lagging behind in basic needs such as good drinking water, sanitation, adequate health care facilities, basic food, education, electricity, etc. Most of the people live below poverty line, and many of them live below $1 a day (Farrell et al., 2007). All the problems are necessitated from the universal and basic fact that there is lack of funding in the developing countries. It is synthesized from the above challenges that future absence of donor support may stall progress because of lack of funding from the government. With this regard there would be huge problems with access to ICT resources and technological infrastructure in educational sectors, particularly higher education, in developing countries. This situation triggers the proposition of developing effective instructional strategies for learning environment with limited ICT to facilitate teaching and learning in the classroom of higher education in developing countries.

It is important to note that the integration of ICT into education is at a particular dynamic stage in Africa and other developing countries. There might be new developments and therefore certain facts and figures might be changed at this particular moment (Farrell et al., 2007). This indicates that there might be improvement in integration of ICT in higher education in developing countries since 2007. However, taking into consideration some of the studies conducted recently in some of these countries as well as some reports from some of the donor agencies, and the fact that these countries still remain as developing countries it is argued that, to some large

extent, the improvements will not be significant. For instance, more recently, The PHEA ETI (a Partnership Institution from South Africa) supported three interventions at University of Education, Winneba (UEW) Ghana, namely: (i) A baseline study on the status of Educational Technology (ET) at UEW, (ii) the development and deployment of hybrid courses on MOODLE Leaning Management System, and (iii) an investigation into how academics and students use MOODLE for teaching and learning. The project started at the university in 2010 and ended in 2013. The results of the study, among others, reiterate that digital divide, constant power interruption, access to internet connectivity, inadequate computer skills, increased load of academics, and institutional culture are still constraints to academics and students for effective training and use of ICTs for effective teaching and learning (Idana and Sarfo, in press). In addition, according the report of the chairman of "Close the Gap", an European – based NGO, in 2012 Close the Gap sent 15, 500 sustainable second life computers to developing countries such as Kenya, Tanzania and others (Close the Gap, 2012).

Research on access to ICT resources and ICT integration in teaching and learning

Land and Hannafin (2000) indicate that pragmatic factors (e.g. lack of access of ICT) can inhibit full utilization of ICT (computer, mobile phone and internet) in teaching and learning. Access and use of ICT are variable assets in effective education. Hence the benefits of ICT in teaching and learning can be realised if students and teachers have access to ICT tools and use them pedagogically. Several research studies unveil that lack of access to ICT resources, including home access, is a complex barrier to integration of new technology into education (Sicilia, 2005; Bingimlas, 2009). According to Korte and Husing (2006), in some of the European schools lack of access (e.g., lack of computers, and lack of adequate materials) is the largest barrier to using ICT in education, in teaching and learning in specific.

Pelgrum (2001) explored the views of practitioners from 26 countries on what are the main obstacles to the effective implementation of ICT in schools. The results indicate that 4 of the top 10 barriers relate to accessibility, namely: 1) insufficient numbers of computers, 2) insufficient peripherals, 3) insufficient software, and 4) insufficient simultaneous internet access. In developing countries most of the schools located in the rural areas even do not have proper classroom structures and electricity likewise computers and internet. Meanwhile policy makers and governments are optimistic that only ICT is a key solution to the quality instruction/education. In a study, Toprakci (2006) found that low numbers of computers, oldness or slowness of ICT systems and scarcity of educational software in schools are barriers to the successful implementation of ICT into (science)

education in Turkey. According to Balanskat et al. (2006) even availability of accessibility of ICT resources does not guarantee its successful implementation in teaching; and this is not merely because of lack of ICT infrastructure but also because of other barriers such as lack of high quality hardware, suitable educational software and access to ICT resources. In addition, Osborne and Hennessy (2003) indicate that limitation on access to hardware and software resources influence teachers' motivation to use ICT in the classroom. In Sicilia's (2005) study, it was found that technical barriers such as waiting for websites to open, failing to connect to internet, printers not printing, malfunctioning computers, teachers having to work on old computers impede the smooth delivery of the natural flow of the classroom teaching and learning. These technical problems are rampant in most of the tertiary institutions in developing countries which have even insufficient access to computers and internet.

Kozma and Anderson (2002) proposed that even though ICT is now at the center of education reform efforts, not all countries currently benefit from the developments and advances that ICT can offer. Significant barriers that are often referred to as "the Digital Divide" limit the ability of some countries to take advantage of technological developments. Thus, developing countries are faced with challenges related to using ICT to improve and reform education (Kozma and Anderson, 2002).

Mere access, as already said, will not automatically lead to effective use of ICT in higher education. That notwithstanding, access to ICT can be considered as the necessary condition and the first step in the process of integration of ICT into teaching and learning. Since technology is financially expensive and there is lack of funding in developing countries, access to and use of technology in schools and higher institutions is problematic. The absence of internet at homes and most of the public schools is a basic problem in most developing countries; and this can be explained in line with the notion of Lima (2006:49) that "Undoubtedly, the internet and other ICT in general constitute a valuable channel for knowledge dissemination and opportunities for development and growth among nations in the world. But since technology is financially expensive, developing countries are facing a dilemma that is aggravated by their economic issues, the need of people to possess adequate and accurate information in order to feel included in the society".

However, Hepp et al. (2004) state that the literature contains many unsubstantiated claims about the revolutionary potential of ICTs to improve the quality of education. Hepp et al. (2004) also note that some claims are now deferred to a near future when hardware will be presumably more affordable and software will become, at last, an effective learning tool. The most important question is: Should we (those in the countries with limited ICT resources) stay as we are and do nothing

pedagogically to achieve quality education until we get adequate technological resources? Levine (1998) emphasizes the importance of having a plan that is based on real school needs and one that is realistic, achievable, and effective. The plan should be produced, not for the sole purpose of putting technology in the classroom but to reflect the real needs of schools in order to produce enhanced learning environments (Levine, 1998). Furthermore, Hepp et al. (2004) have been cautious to emphasize that there is no universal truth when it comes to applying ICT in education, and that there is no advice that can be directly applied without considering each country's reality, priorities and long-term budgetary prospects and commitment.

THE POSITIVE MESSAGE FROM THE LITERATURE

The positive message for countries with limited resources of ICT as already indicated by Clark in 1994 and as shown in the numerous 'non-significant'-research results (http://www.nosignificantdifference.org/) is that ICT in itself will not lead to better learning outcomes. Clark (2001) indicates that the necessary condition or active ingredient of treatment which is sufficient to cause learning from instruction is best characterized as instructional method, not media or ICT. It is the instructional method that activates, compensates or supplants the cognitive processes necessary for learning (Clark, 2001). He defines instructional method as provision of cognitive processes or strategies that are necessary for learning but which students cannot provide for themselves. All methods (e.g., examples, demonstration, and feedback) required for learning can be delivered by diversity of media (both low cost and high cost media). Small and inexpensive media such as OHP, printed text, models, charts, flashcards, etc if properly designed and used can make teaching or instruction effective as ICT (Smaldino et al., 2008; Christensen, 1997; Sarfo and Elen, 2007). Smaldino et al. (2008) emphasize that the 'magic' in computer technology, if it existed, all lies in the instructional design of the software, and not in the hardware. Moreover, after having thoroughly and comprehensively reviewed 375 empirical studies conducted in the past 70 years, Russell (1999) provides abundant evidence that technology (e.g., computer) does not directly improve learning. In addition, Salomon (2002) indicates that despite the infusion of information technologies with the internet and multimedia, e-mail and simulations, and endless other possibilities and affordances, classrooms today with the exception of few daring pioneering cases, are not very different from those of yester-years in terms of learning impact. Earle (2002) claims that despite the general sense that the computer revolution of the last decade has had a major impact in schools, the nature of this impact seems to be limited to access and information retrieval rather than improved teaching method to yield learning gains. The

results of the study conducted by Sarfo and Elen (2007, 2008) to test the effects of powerful learning environments with and without computer indicated no significant difference in terms of learning gain. In a study of the effectiveness of reading and mathematics with and without computer on standardized test scores, Dynarki et al. (2007) found no significant improvement in scores between treatment and control classrooms in either subject. According to Inan and Lowther (2009), there is insufficient empirical evidence to claim that access to technology has increased test scores or improved the quality of instruction to enhance learning. Irrespective of the concerted efforts made in the investment in ICT integration in higher education, evidence (Collis and van der Wende, 2002; Zemsky and Massy, 2004) gleaned from the literature indicates that ICT has not brought any significant improvement in teaching and learning. Youssef and Dahmani (2008) indicate that economic research has failed to provide a clear consensus on the effect of ICT investments on students' achievement in the higher education. There are contradictory results in the empirical literature in this field (Youssef and Dahmani, 2008). However, there is established evidence in the literature that good design of intervention, rather than ICT is the fundamental building block and therefore the most effective means of promoting successful learning. It is the pedagogy not the technology that matters. Achieving quality teaching in higher education, towards the development of the 21st century competencies depends more on the systematic design of the pedagogy or learning environment than on the use of ICT. ICT is not a guarantee for effective teaching methods to achieve quality higher education; it is not a solution to the development of the 21st century competencies; it is just a tool, like other low cost media, to aid the implementation of teaching method.

To promote successful teaching and learning in higher education in developing as well as developed countries, there is a need for instructional design models or effective principles for good design of intervention. These models or effective principles should be effective and successful in the context of limited, moderate, and adequate ICT resources.

TOWARDS INSTRUCTIONAL DESIGN MODEL

The Association for Educational Communications and Technology (AECT) in 1994 defined instructional design as the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning (Seels and Richey, 1994). According to Elen (1995), instructional design is a prescriptive field of study that aims at making theoretically sound, validated, and consistent research outcomes (both theoretical accounts and empirical data) applicable to practice by: 1) identifying design parameters, 2) offering design procedures that instrument

design parameters, and 3) providing process indications on how to develop instruction, in order to contribute to the optimization of instructional and learning process. The most important ingredients in the above definitions of instructional design are the inclusion of "theory" and "practice". Instructional design as a field of study provides theoretical foundations to principles of instructional design (Tennyson and Schott, 1997). Instructional design as a practice, based on instructional design theory and models, provides methods and techniques for creating learning environments to promote the acquisition of an integrated set of knowledge and skills.

Even though Instructional Design is considered as the youngest discipline in the behavioral sciences, its impact on learning activities of the military, business organizations, and other non-governmental organizations has been very remarkable, more especially in the U.S. Nevertheless, the impact of Instructional design models in the classrooms of public educations has not been notable as expected.

An instructional design model (ID model) describes or shows the main elements of an instructive program, and most often lists a number of variables to be considered in designing instruction (program). Instructional design models are regularly used to develop specific aspects of instruction or teaching (Seel, 1997). Many instructional design models have been developed. These models tend to pay attention to the unique conditions of various instructional settings as well as alternative orientation to the instructional process itself (Richey and Klein, 2011). Examples are:

a) Military settings with emphasis on learners differences, content analysis, etc (Branson et al., 1975).
b) Community health agencies setting with emphasis on programme administration, programme marketing, etc (Edwards, 1982).
c) Higher education setting with emphasis on design support team, faculty ownership, etc (Diamond, 1989).
d) General product development setting with emphasis on project management, diffusion of results, etc (Seels and Glasgow, 1998).
e) All settings with emphasis on cognitive psychology, instructional strategy selection and development, systematic problem solving (Smith and Ragan, 2005).
f) K-12 Education classroom setting with emphasis on learner characteristics, media selection, technology integration, and modification of existing materials (ASSURE model) (Smaldino et al., 2008). ASSURE is an acronym for: A (analysis of learners), S (statement of objectives), S (selection of instruction method, media and materials), U (utilization of media), R (required learner participation), and E (evaluation of content ant and media).

More specifically, an instructional design model for higher education in the context of limited, moderate, and adequate ICT resources as advocated in this article has not yet been identified in the instructional design literature. Most of these instructional design activities or models described in the literature were developed for other settings or purposes rather than classrooms of public higher education. Those models e.g., the ASSURE model by Smaldino et al. (2008) or the First five principles of instruction by Merrill (2002) which were developed for educational or public classroom purposes were tested in the contexts different from the intention of this paper. The first five principles are: 1) task-centeredness, 2) demonstration, 3) activation, 4) application, and 5) integration.

For instance, the ASSURE model by Smaldino et al. (2008) is the systematic procedural guide for designing teaching and instruction that incorporate media. ASSURE model might seem effective for designing powerful learning environments for learning in multiple contexts. However, the primary setting for ASSURE is K-12 education classroom and not enough emphasis on effective instructional strategies is given. Also, Merrill (2002) systematically reviewed instructional design theories, models and research and abstracted a set of interrelated prescriptive instructional design principles. Similar principles have been identified by other authors (Van Merriënboer and Kirschner, 2007) and supported by research. These first five principles are always true under appropriate conditions regardless of program or practice; they promote more effective, efficient, or engaging learning; and the principles are general in the sense that they apply to any delivery system (e.g., picture, models) or any instructional architecture (e.g. tutorial method, exploratory method) (Merrill, 2007).

As criticized by Reigeluth and Carr-Chellman (2009:58-59), "Merrill, characterized his principles as 'general' meaning that they apply to 'any instructional approach, including direct methods, tutorial methods, experiential methods, and exploratory method'. But clearly, to be of high quality, instruction must be different in different situations. This does not necessarily mean that there are no general principles of instruction, just that they are not sufficiently precise (or detailed) for practitioners to create high quality instruction. Instructional designers and teachers need more precise guidance about how to implement such general principles". This criticism by Reigeluth and Carr-Chellman (2009) on the first five principles generates the need for development/design of a systematic instructional design model probably based on the first five principles of instruction, which is sensitive to the contexts prescribed in this paper.

The Four-Component Instructional Design Model (4C/ID-model) was originally developed by Van Merriënboer (1997). It presents a blueprint for complex learning which is based on four different components (learning task, supportive information, procedural information, and part-task information) of learning processes and associated instructional methods. The

four-component instructional design model was originally designed for the learning of complex cognitive/technical skills in the training settings for the learning or training of application domain that requires a higher level transfer. Merrill (2002) indicates that 4C/ID model contains the elements that make learning environments powerful. In few instances (Hoogveld et al., 2002) the 4C/ID model has been tested in educational contexts and found effective. It is also effective for teaching in the traditional classroom of secondary technical education; even though there were little problems related to the provision of cognitive support to learners (Sarfo and Elen, 2007).

CONCLUSION

The campaign of integrating ICT in higher education to achieve quality instruction and education in the 21st century; and the notion of unequal distribution of ICT resources across developed and developing countries has generated instructional design problems which need urgent attention of instructional designers. Particularly, in the instructional design literature no instructional design model has been identified as sufficiently specific to solve this problem. Moreover and more specifically, the current instructional design models have not been sufficiently tested in the contexts of higher education with limited, moderate and adequate ICT resources as proposed in this paper. For these reasons there is a critical need to test, and if possible modify, the generalizability power of the basic instructional design models such as Merrill's (2002) first five principles of instruction, the 4C/ID model by van Merrienboer (1997), ASSURE model by Smaldino et al. (2008) in the context of classrooms of higher education with limited, moderate, and adequate ICT resources to promote the development of the 21st century competencies. The empirical research that will be carried out to test and modify the generalizability power of the suggested instructional design models could take the form of design-based research. Design-based research stems from the core idea that "Educational researchers, policymakers, and practitioners agree that educational research is often divorced from the problems and issues of everyday practice" (Design-Based research Collective, 2003:5). Design-Based research is a methodology for understanding how, when, and why educational innovations work in practice.

It is argued that having such an instructional design model for learning in multiple contexts is considered as a splendid attempt to extend the relevance and application of instructional design activities to promote quality higher education in developing and developed countries. Furthermore, the realization of such a model will set a stage for instructional designers and educational practitioners to have new insights and also investigate into instructional models (activities) and ICT integration in various levels of education from the perspectives of countries with limited, moderate, and adequate ICT resources. This ultimately will enable instructional designers and educational researchers and practitioners to investigate and improve on instructional design applications and research for excellence proactive in educational reform in various parts of the world.

REFERENCES

Akbaba-Altum, S. (2006). Complexity of integrating computer technologies into education in Turkey. Education Technology and Society, 9(1):176-187.

Avgerou, C. (1990). Computer-based information systems and modernization of public administration in developing countries. Information Technology in Developing Countries, 243, 50.

Balanskat, A., Blamire, R., and Kefala, S. (2006). The ICT impact report: A review of studies of ICT impact on schools in Europe. European Schoolnet, Retrieved from http://www.lopstechnology.com/fotos/editor2/relatorios/ict_impact_report_1_.pdf.

Bingimlas, K. A. (2009). Barriers to the successful integration of ICT in teaching and learning environments: A review of the literature. Eurasia Journal of Mathematics, Science and Technology Education, 5(3):235–245.

Branson, R. K., Rayner, G. T., Cox, J. L., Furman, J. P., King, F. J., and Hannum, W. H. (1975). Interservice procedures for instructional systems development. Fort Monroe, VA: US Army Training and Doctrine Command.

Christensen, P. R. (1997). Educational technology and educational reform: Lessons for South Africa. Proceedings of the Future World International Conference-Educating for the 21st Century, Cape Town (pp. 2–4).

Clark, R. E. (1994). Media will never influence learning. Educational Technology Research and Development, 4 (2):21-29.

Clark, R. E. (2001). What is the next in the media and methods debate. In R. E. Clark (Ed.), Learning from media: Argument, analysis, and evidence. Greewich, CT: Information Age Publishing. pp. 327-337.

Close the Gap (2012). Close the gap annual report, 2012.Retrieved from http://www.close-the-gap.org/

Collis, B., and van der Wende (Eds.) (2002). Models of technology and change in a higher: An international comparative survey on the current and future use of ICT in higher education. Retrieved from http://www.utwente.nl/mb/cheps/phdportal/cheps%20alumni%20and%20their%20theses/2006boezerooydissertation.pdf.

Design-Based Research Collective (2003). Design-based research: An emerging paradigm for educational inquiry. Educational Researcher, 32(1):5-8

Diamond, R. M. (1989). Designing and improving courses and curricula in higher education: A systematic approach. San Francisco, CA: Jossey-Bass.

Dynarki, M., Agodini, R., Heaviside, S., Novak, T., Carey, N., and Campuzan, L. (2007). Effectiveness of reading and mathematics software products; Findings from the first students cohort. Washington DC: Institute of Education Sciences, US Dept of Education

Earle, S. R. (2002). The integration of instructional technology into public education: promise and challenges. Educational Technology, 52(2):5-13.

Edwards, L. (1982). Delivering health education programs: a model. Health Values, 6(6):13-19.

Elen, J. (1995). Blocks on the road to instructional design prescriptions: A methodology for I.D. research exemplified. Leuven: Leuven University Press.

Elen, J., Lowyck, J., and van den Berg, B. (1999). Virtual University: will learning benefit? In G.E. Ortner and F. Nickolman (Eds.), socio-economic of virtual universies: Experiences from open and distances education in Europe Weinheim, DE: Deutscher studien Verlag, 29-51.

European Scoolnet and University of Liege (2013). Survey of schools: ICT in education - benchmarking access, use and attitudes to technology in Europe's schools. Brussels: European Union.

Fall, B. (2007). Survey of ICT and education in Cote D'Ivoire. Survey of ICT and Education in Africa (Volume 2): 53 Country Reports. Washington, DC: infoDev / World Bank.

Farrell, G., Isaacs, S., and Trucano, M. (2007) (Eds.). Survey of ICT and Education in Africa (Volume 2): 53 Country Reports. Washington, DC: infoDev / World Bank.

Hamdy, A. (2007). Survey of ICT and education in Egypt. Survey of ICT and Education in Africa (Volume 2): 53 Country Reports. Washington, DC: infoDev / World Bank.

Harvey, W. B. (1993). Educational technology and Third World development. Journal of Educational Technology and Systems, 11(3):265-270.

Hepp, P. K., Hinostroza, E. S., Laval, E. N., and Rehbein, L. F. (2004). Technology in schools: Education, ICT and the knowledge society. World Bank, Distance and Open Learning and ICT in Education Thematic Group, Human Development Network, Education. Retrieved from http://www.sca2006.tic-educa.org/archivos/modulo_1/sesion_1/ICT_report_oct04a_Pedro_Hepp.pdf.

Hoogveld, A. W. M., Paas, F., Jochems, W. M. G., and Van Merriënboer, J. J. G. (2002). Exploring teachers' instructional design practices from a systems perspective. Instructional Science, 30:291-305.

Idana, I., and Sarfo, F. K. (in press). Investigating how academics involved in the design of MOODLE-based courses use the hybrid mode of instructional delivery. Educational Technology and Society.

Inan, F. A., and Lowther, D. L. (2010). Factors affecting technology integration in K - 12 classrooms. A path model. Educational Technology Research and Development, 58(2):137-154.

International Telecommunications Union (2010). ICT Statistics Database Retrieved from http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#.

Jhurree, V. (2005). Technology integration in education in developing countries: Guidelines to policy makers. International Education Journal, 6(4):467–483.

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., and Ludgate, H. (2013). NMC horizon report: 2013 higher education edition. Austin, Texas: The New Media Consortium.

Josue, T. T. (2007). Survey of ICT and education in Cameroon. Survey of ICT and Education in Africa (2), 53. Country Reports. washington, DC:infoDev / world bank.

Korte, W.B., and Hüsing, T. (2006). Benchmarking access and use of ICT in European schools 2006 - Results from Head Teacher and Classroom Teacher Surveys in 27 European Countries. In: Méndez-Vilas, A., A. Solano Martin, J. Mesa González, J.A. Mesa González (des.). Current Developments in Technology-Assisted Education, 3:1652-1657.

Kozma, R. (2014). Technology in service of development: Personal statement. Retrieved from http://robertkozma.com/.

Kozma, R. B., and Anderson, R. E. (2002). Qualitative case studies of innovative pedagogical practices using ICT. Journal of Computer Assisted Learning, 18(4):387–394.

Land, S. M., and Hannafin, M. J. (2000). Student-centered learning environments. Theoretical foundations of learning environments, 1–23.

Levine, J. (1998). Planning strategically for technology integration. Technology and Teacher Education Annual, 293–295.

Lima, C. O. (2006). It's not all about access: A comparative study of global citizenship and ICT use between Brazilian and American students utilizing a social inclusion framework. University of Connecticut.

Mangesi, K. (2007). Survey of ICT and education in Ghana. Survey of ICT and Education in Africa (2), 53. Country Reports. washington, DC:infoDev / world bank.

Merrill, D. (2007). First principles of instruction: a synthesis. Trends and Issues in Instructional Design and Technology, 50(4):62–71.

Merrill, M. D. (2002). First principles of instruction. Educational Technology Research and Development, 50(3), 43–59.

Mohhamedhai, G. (2008). The effect of massification in higer education in Africa. Accra: The Association of Africa Universites.

New Vision (2013). ICT can Spur african's education - experts new vision 2013. Retrieved from http://www.newvision.co.ug/news/650433-ict-can-spur-africa-s-education-experts.html.

OECD (2004). "ICTs and Economic Growth in Developing Countries". Retrieved from http://www.oecd.org/dataoecd/15/54/34663175.pdf.

OECD (2011). Reading, the second digital device. Retrieved from http://oecdinsights.org/2011/06/28/reading-the-second-digital-divide/.

Osborne, J., and Hennessy, S. (2003). Literature review in science education and the role of ICT: Promise, problems and future directions. Retrieved from http://hal.archives-ouvertes.fr/docs/00/19/04/41/PDF/osborne-j-2003-r6.pdf.

Papert, S. (1980). Mindstorms: Children, computers, and powerful ideas. Basic Books, Inc.

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: results from a worldwide educational assessment. Computers and Education, 37(2):163–178.

Pelgrum, W. J., and Law, N. (2003). ICT in education around the world: Trends, problems and prospects.Retrieved from http://unesdoc.unesco.org/images/0013/001362/1.

President's Committee on Review of education Reform (2002). Meeting the challenges of education in the twenty first century. Accra: Adwinsa Publications

Reigeluth, C. M., and Carr-Chellman, A. A. (2009). Situational principles of instruction. C.M. Reigeluth and A.A. Carr-Chellman (Eds), Instructional-design theories and models: building a common knowledge base, Vol. III, pp.57-68. New York: Taylor and Francis.

Richey, R. C., and Klein, J. D. (2011). The instructional design knowledge base: Theory, research and practice. New York: Taylor and Francis Group.

Russell, T. (1999). No Significant Difference Phenomenon. Educational Technology and Society, 2, 3.

Sagahyroom, A. (1995). Computer education in developing countries: The Sudan case. World Conference on Computers in Education VI WCCE, 95:163–191.

Salomon, G. (2002). Technology and pedagogy: why don't we see the promised revolution. Educational Technology, 52(2):71-75.

Sarfo, F. K. and Ansong-Gyimah (in press). Ghanaian seniour high school students' access to and experiences in the uses of information and communication technology. In A. Méndez-Vilas (Ed.) Education in a technological world: communicating current and emerging research and technological efforts Formatex Research Center. p. 216-223.

Sarfo, F. K., and Ansong-Gyimah, K. (2010). The perceptions of students, teachers, and educational officers in ghana on the role of computer and the teacher in promoting the first five principles of instruction. Turkish Online Journal of Educational Technology, 9(3):85-95.

Sarfo, F. K., and Elen, J. (2007). Developing technical expertise in secondary technical schools: The effect of 4C/ID learning environments. Learning Environments Research, 10(3):207–221.

Sarfo, F. K., and Elen, J. (2008). The moderating effect of instructional conceptions on the effect of powerful learning environment. Instructional Science, 36:137-153.

Seel,. N. M. (1997). Model of instructional design: introduction and overview. In R. D. Tennyson, F. Schott, N. Seel, and S. Dijkstra

(Eds.), Solving instructional design problems, instructional design: International perspective Vol.1 (pp. 355-360). Mahwah, NJ: Lawrence Erlbaum.

Seels B. B., and Richey, R. C. (1994). Instructional technology: definition and domain of the field. Washington, DC: Association for Educational Communication and Technology.

Seels, B. B., and Glasgow, Z. (1998). Making instructional design decisions. (2nd ed.). Columbus OH: Merrill Publishing Company.

Sicilia, C. (2005). The challenges and benefits to teachers practices in constructivistic learning environments supported by technology. Unpublished Masters Thesis, Mcgill University, Montreal

Smaldino, S. E, Lowther, D. L., and Russel, J. D. (2008). Instructional technology and media for learning (8th ed.). Upper Saddle River, NJ: Pearson Education.

Smith, P. L. and Ragan, T. J. (2005). Instructional design (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Tennyson, R. D., and Schott, F. (1997). Instructional design, theory, research, and models. In R. D. Tennyson, F. Schott, N. Seel, and S. Dijkstra (Eds.). Theory, research, and models of instructional design, International perspectives Vol. 1 (pp. 1-6). Mahwah, NJ: Lawrence Erlbaum.

The Ghana ICT for Accelerated Development (ICT4AD) Policy (2003). The Republic of Ghana.

Toprakci, E. (2006). Obstacles at integration of schools into information and communication technologies by taking into consideration the opinions of the teachers and principals of primary and secondary schools in Turkey. Journal of Instructional Science and Technology (e-JIST), 9(1):1–16.

United Nations (2005). World Summit on the information society: Tunis commitment. New York: United Nations.

Van Merriënboer, J. J. G. (1997). Training complex cognitive skills: A Four-Component Instructional Design model for technical training. Englewood Cliffs, NJ: Educational Technology Publications.

Van Merriënboer, J. J. G., and Kirschner, P. A. (2007). Ten steps to complex learning: A systematic approach to four-component instructional design. Lawrence Erlbaum.

Wagner, D. A., and Kozma, R. (2003). New technologies for literacy and adult education: A global perspective. National Center for Adult Literacy, OECD report.

World Bank (2007). Country Brief: Ghana.

Youssef, A. B., and Dalmani, M. (2008). The impact of ICT on student performance in higher education: Direct effects, indirect effects and organisational change.Retrieved from http://www.artnodes.com/ojs/index.php/rusc/article/view/v5n1-ben-youssef-dahmani/v5n1-ben-youssef-dahmani.

Zemsky, R., and Massy, W. F. (2004). Thwarted innovation: What happened to e-learning and why? Retrieved from http://immagic.com/eLibrary/ARCHIVES/GENERAL/UPENN_US/P04 0600Z.pdf.