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Analysis of Technology Integration in Teacher Education in Ghana

Douglas D. Agyei

Ghana's Education Reforms launched in June 2007 introduced Computer literacy not only as a new subject, but also as a tool to enhance teaching and learning. This study provides a situational analysis of the pedagogical issues associated with Information and Communication Technology (ICT) use in teacher education in Ghana. The methodology used in the study focused on meta-data analysis in which issues associated with integrating ICT in Ghana's education were re-examined to provide a better picture that will support future achievement of teaching and learning with ICT. The evidence suggests that the challenges of ICT use in education do not lie only in the lack of availability of technological resources, but also in the shortage of skilled human resources and other institutional factors. Implications that relate to teacher "readiness" to deliver 21st century education through the use of technology are discussed and analyzed.

Introduction

Integration of Information and Communication Technology (ICT) is high on the education reform agenda worldwide particularly in developed countries (Tilya, 2008). Often ICT is seen as an indispensable tool to fully participate in the knowledge society (Peeraer & Van Petegem, 2011). ICTs are therefore perceived to provide a window of opportunity for educational institutions and other organizations to harness and use technology to complement and support the teaching and learning process. Although a large body of research on factors determining the integration of ICT in education emerge from developed countries, recent research indicates that developing countries are finding means to participate effectively in the global information society and to address challenges regarding ICT in education (Tilya, 2008).

For instance, in 2006 education ministers in the sub-Saharan region adopted a ten-year plan in which science and technology teaching is to undergo reform at all educational systems levels (African Union, 2006). The plan recommends teaching methods highlight links between science and technology on one hand, and the learner's culture and environment on the other. The task for the education sectors is to identify ways of creating necessary conditions within the education system to maximize the benefits of ICT, and thus support development. At different levels, sub-Saharan governments are focusing on strategies to increase access to and improvement of the quality of education through ICT (United Nations Economic Commission for Africa, 2006). For example, also in 2006, 28 of the sub-Saharan countries had developed national ICT policies aimed to facilitate the realization of national development goals (UNECA, 2006).

Ghana is an interesting case for research on integration of ICT. Ghana's efforts to use ICT in education began to receive governments' attention only recently (Ghana

ICT4AD Policy, 2003). The integration of ICT into Ghana's educational system was formally introduced as part of educational reforms which began in September 2007 as part of the government's initiative to improve the quality of teaching and learning in the nation's schools. One major requirement of the 2007 educational reform was to ensure that all students in pre-tertiary institutions in Ghana acquire basic ICT literacy skills (including internet use) and apply these not only in their studies but also in a variety of ways in their everyday life activities (CRDD, 2007a, 2007b, & 2007c). These efforts notwithstanding, Ghana's recent participation in the latest international ICT development index revealed that the country ranked on different measures between 100th and 140th out of 154 countries surveyed (International Telecommunication Union, 2009). Clearly, this is an indication that Ghana, like many other African countries, lags behind integration of ICT in teacher education. Important questions such as "What can teachers do with ICTs to promote integration of technology in curriculum or to extend instructional methods?" and "What can teachers do with ICTs to improve students' outcomes?" still remain. For Ghana to be able to fully integrate ICT into teaching and learning, a situational analyses of the different contexts and challenges that exist within her educational institutions regarding ICT use is a necessary first step to explore. Most importantly, stakeholders and decision makers must be aware of what situation exists within educational institutions as they relate to the "readiness" of teachers including the availability of ICT facilities and skilled human resources that will support the achievement of teaching and learning with ICT. This study has a focus in this direction. The study provides arguments to better understand Ghana's educational institutions readiness of pedagogical integration of ICT to improve the quality of teaching and learning in her educational system.

Background

ICT and Educational Change

Although many countries are still at the beginning of using new technologies, its use in education cannot be underestimated (Carnoy & Rhoten, 2002). Tilya (2008) indicated that ICT appears to have the potential to transform the nature of education: where and how learning takes place and the roles of students and teachers in the learning process. Naidoo (2003) presents three key points, or benefits of ICT: (1) ICT can result in improved learning; (2) ICT offers the greatest support to learners from disadvantaged backgrounds; and (3) it impacts the society in which the learners reside. Despite its potentials, a number of critiques on the use of ICT in education have emerged. Two particular observations serve to temper expectations: first, there has been a disappointingly slow uptake of ICT in education even though high investments have taken place in improving access to technologies and in improving the skills of teachers and learners; secondly, there hasn't been an educational revolution in teaching and learning (Selwyn, 2007). According to Becker (2000) computers have not transformed teaching practices until now. UNESCO (2004) argues that the potential of ICT may not be optimized if there is no shift in the education paradigm. There is a rhetorical paradox in national ICT policy: on the one hand ICT is conveyed as having beneficial effects on the educational system and contributing to successful competition in the global market; on the other hand, the driving force behind the use of ICT in educational practice should take its point of departure in

pedagogy (Bryderup & Kowalski, 2002). In practice, this inherent paradox too often leads to pedagogical issues being subjugated to matters of technique. Researchers, such as Kirkup and Kirkwood (2005), indicate an abundance of computers and technological infrastructure in higher education institutions, but indicated that teaching staffs learn to use those technologies, which can be incorporated into their teaching activities most easily, rather than those which could most radically change teaching and learning practices (Kirkup & Kirkwood, 2005).

A Conceptual Framework for the Study

The purpose of the study was to provide arguments to better understand teachers' readiness of pedagogical integration of ICT and to integrate and summarize findings from a body of research on trends in ways that ICT can be understood and used to improve the quality of teaching and learning in the educational system in Ghana. Much research in the developed world has suggested many theories or models for evaluating factors that influence or constrain individual acceptance behavior on information technology and information systems, acceptance and diffusion of innovations, integration of ICT in education in general or use of ICT for teaching practice in particular. These models include the Theory of Reasoned Action, Theory of Planned Behavior, Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology, and Diffusion of Innovations. TAM proposed by Davis (1989), seems to be one of the most popular theories that is used widely to explain information system usage. In spite of its popularity, many studies (Moon & Kim, 2001; Venkatesh & Davis, 2000) have recommended changes in the originally proposed model due to its limitations. TAM has been widely used to scrutinize individual technology acceptance behavior along only two factors: perceived usefulness and perceived ease of use. Thus, just like most of the other theories, the major limitation of TAM lies in its weakness to include other important factors such user behavioral intentions, system characteristics, user training, user participation in design, nature of the implementation process, etc. in the model. Groff and Mouza (2008) distinguish between critical factors including legislative level factors, district and school level factors, factors associated with students and teachers, factors inherent to the technology itself, and factors associated with the technology-enhanced project. Mumtaz (2000) in a review study identifies three factors for continued ICT integration to include institution, resources, and the teacher. In practice factors that guide human actions to change or influence technology acceptance behavior may be varied and cannot be assumed to be static. As a result, it was difficult adopting a single existing overarching theory as a framework to guide the conduct of this study.

Therefore, the author identified critical success factors for ICT integration drawn from literature and used these critical success factors as the benchmark to analyze the current work. In this study, literature on factors driving integration of ICT in education is presented in fivefold:

- Existence of national ICT policy;
- Availability of ICT infrastructure, including computer hardware and software, and communication network (bandwidth/access);
- Teacher preparedness and willingness;

- Professional development training and the lack of skilled human resources that support the achievement of teaching and learning with ICT; and
- Resistance to change from traditional pedagogical approaches of teaching to more innovative, technology-supported methods.

Factors Promoting/Constraining the Development of ICT Use in Education

Existence of National ICT Policies

A large body of research has shown that a rapid integration of ICT into learning environment demands the development of effective ICT policy. Thus, an ICT policy implementation strategy or framework for a nation's education sector is very essential to revolutionizing learning and teaching processes and open new learning opportunities. ICT needs to be enhanced by an ICT policy that ensures people are capable of using it to source and assimilate information and transform it into useful knowledge (Tilya, 2008). Unless a specific policy exists and decision makers have a clear strategy in place, it is difficult to integrate ICT effectively and bring about desired improvements in the reach and quality of education (UNESCO, 2007).

Latchem and Jung (2010) recommended that countries and institutions have clear visions, strategic plans, commitment, and implementation capability regarding ICT use in education. According to Kozma (2008), strategic policies can provide a rationale, a set of goals, and a vision for how education systems might best introduce and integrate ICT. Pick and Azari (2008) remark that the results for a single nation seeking improved ICT depends on political will and leadership that appreciates how multidimensional factors need to be combined for development. In the context of globalization as an economic process, researchers identify a deterministic conception of ICT (Bryderup & Kowalski, 2002; Sawchuk, 2008; Shin & Harman, 2009; Tondeur, van Braak, & Valcke, 2007), however researchers describe a gap between rhetoric in government policy and reality of education practice (Cheng, 2009; Kozma, 2008; Selwyn, 1999; Tondeur et al., 2007). The studies emphasize that without de-centralized supportive measures, national policies will not easily result in changes in instructional practices. Tondeur et al. (2007) discusses a way forward as stressing the responsibilities of local educational institutions to translate the national ICT guidelines in an ICT plan as part of an overall school policy.

Walker (1989) has also discussed three preconditions for a successful introduction of new information technologies into an education system:

- i. An appreciation by the government of the financial, resource, and operational requirements and the resulting consequences.
- ii. A commitment by government to give time and take responsibility for decision making and implementation strategies.
- iii. A commitment to a policy of an integrated support service encompassing teacher and technician training, curriculum, and assessment, together with software and hardware provision.

Walker's conditions buttress Naidoo's (2003) idea which noted that attempts to integrate ICT into the education system entail the leadership of the government and the education

ministry, working together with other relevant ministries. Clearly, the literature suggests that leadership must have a clear vision of the mechanism that the government intends to use to implement ICT. This vision then needs to be integrated with national policies, and then effectively communicated and supported at the school level.

Availability of ICT Infrastructure

According to Mumtaz (2000), limited resources within schools are a great impediment to the take-up of technology. For instance, lack of computers and software in classrooms can seriously limit teachers' use of technology. Studies have shown that only a small proportion of the African population has access to computers (Murphy, Anzalone, Bosch, & Moulton, 2002) and 4% has access to the internet (Resta & Laferrière, 2008). Aguti and Fraser (2006) reiterated that lack of ready access to technologies by teachers is a key barrier to technology integration in most developing countries. Other researchers (Benson & Palaskas, 2006; Snoeyink & Ertmer 2002) have identified resources as an important part of implementation of an innovation. In the study, adequate resources refer to the amount of ICT resources currently available and accessible to the teachers to successfully use in their classrooms when planning and teaching their lessons.

Teacher Preparedness and Willingness

In order to make an implementation succeed, "the people who will ultimately use the innovation must possess sufficient knowledge and skills to do the job" (Ely, 1999, p.). This is especially the case when the innovation involves the use of a certain tool or a technique. Without enough preparation to use the tool or technique, the innovation will die out soon. According to Webb and Cox (2004), one of the reasons for the unenthusiastic response to ICT-based innovation amongst teachers might be that technological knowledge and skills is either absent or lacking in the processes that underpins teachers' planning. This idea has recently been developed by Mishra and Koehler (2006) and Harris, Mishra, and Koehler (2009), who propose that there is a tendency for teachers not to synergize their content and pedagogical knowledge with their technological knowledge, and that this can result in mundane ICT implementation in the classroom. Alongside the need to develop teachers' knowledge and skills, their attitudes towards ICT integration also need to be understood. Christensen and Knezek (2008) indicated that teachers' attitude plays a key role in determining computer use as a learning tool and the likelihood that teachers will effectively use ICT for teaching.

Professional Development and Training

The issue of how ICT is to be covered in pre-service teacher education and in-service teacher professional development has received significant attention. Baylor and Ritchie (2002) have indicated that training has an important influence on how well ICT is embraced in the classroom. A review of the recent teacher education research around ICT shows numerous examples of teacher education programs that have implemented instructional technology in ways that encourage integration (for examples see Goktas, Yıldırım,

& Yıldırım 2008; Kay, 2006). Most of these approaches have involved providing teachers and teacher candidates with experiences with real educational problems to be solved by technology. Thus, the literatures makes it explicit that there seem to be more to teacher preparation than training teachers on how to use tools—it requires appreciation of the complex set of interrelationships between artifacts, users, tools, and practices.

Resistance to Change

Over the years, there have been studies and explorations of the resistance factors that thwart diffusion and implementation efforts. Prominent among those who have journeyed into this puzzling morass are Zaltman and Duncan (1977). These authors define resistance as “. . . any conduct that serves to maintain the status quo in the face of pressure to alter the status quo.” A number of studies have indicated that schools are resistant to ICT change.

For example, Mumtaz (2000) explained that due to schools resistant to change, institutions give little time to teachers to manage and familiarize themselves with ICT-based innovation and classroom timetabling does not allow time for teaching with ICT. Several studies (e.g., Bate, 2010; Dawson & Rakes, 2003; McGarr & Kearney, 2009) also support the claim that leadership promoting change is a key factor when it comes to merging ICT and instruction. The basic argument has been that if we knew what types of resistance exist, we could design strategies to combat them.

Research Questions

The purpose of this review was to provide arguments to better understand teachers’ readiness of pedagogical integration of ICT and to review trends in ways that ICT can be understood and used to improve the quality of teaching and learning in the educational system. The study was guided by the following questions: “What are the pedagogical issues and situational contexts associated with ICT use that exist within Ghana’s educational institutions?” and “What are their implications for teachers’ pedagogical practices?”

Research investigation and re-analysis of literature to integrate and summarize findings from a body of research on the rationales driving integration of ICT will help stakeholders and decision makers to be informed of situations within the educational institutions relating to ICT and skilled human resources that will support the achievement of teaching and learning with ICT.

Data Collection and Analysis

Meta-analysis was the method adopted for this study. Meta-analysis refers to the analysis of analyses. It refers to the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the casual, narrative discussions of research studies which typify an attempt to make sense of the rapidly expanding research literature (Glass, 1976).

Although few researches regarding ICT in education have been conducted in Ghana, it is becoming increasingly difficult to understand what these research results tell us as they accumulate. For this reason the meta-analysis method was appropriate to provide a

focus on contrasting and combining results from the different studies, in the hope of identifying patterns among study results, sources of disagreement among those results, or other interesting relationships that may come to light in the context of multiple studies.

Data was collected from various sources including: statistical publications, qualitative data, and previously published meta analyses or synthesis of several studies including policy documents and curriculum materials. Most of the information was derived from well-established and reputable paper-based and electronic information sources but other internet searches were also used. The analysis focused on elements which have been identified in literature that offer critical success factors for the pedagogical use of ICT in teacher education and was done qualitatively, using data reduction techniques in which major themes (e.g., availability of ICT resources, training opportunities, teacher preparedness, etc.) were identified and clustered (Miles & Huberman, 1994).

The criteria for selecting the meta-data was mainly purposive focusing on ICT in education-related studies conducted in Ghana; however, studies from European countries and the United States were used to support the literature review provided it could be assumed that the arguments were relevant in the Ghanaian context as well. The methods used in these prior research studies included both quantitative and qualitative evidences such as quantitative surveys, interviews, and document analysis.

Results

From the meta-analysis and the literature review discussed in this study, the following issues associated with integrating ICT in Ghana's education are re-examined with a goal towards achieving a better understanding about the future of ICT attainment and pedagogy in Ghana.

Availability of National Policy on ICT

Ghana introduced ICT into the school curriculum in September 2007 following the recommendations of the Ghana Information and Communication Technology for Accelerated Development (ICT4AD) policy document (Republic of Ghana, 2003) and the Anamuah-Mensah National Education Review Committee Report (2002). Both documents highlight the importance of integrating ICT into the curriculum at all levels. The ICT4AD policy document seeks to provide a national framework on which the deployment of ICTs in the education sector is to be based. It also provides a framework in which ICT will be used to transform the educational sector, allowing all Ghanaians to pursue quality life-long learning opportunities regardless of their geographical location. The policy identified the Ministry of Education, Science and Sports, the universities, polytechnics, colleges of education, and research institutions, as well as local and foreign educational and training provision organizations (multilateral institutions and non-governmental organization) as the key implementation agencies, players, and stakeholders. Though the policy has been criticized for having over ambitious plans requiring technology expertise, infrastructure, and commitment on the part of politicians, educational administrators, and educators, some aspects have been implemented either on an ad hoc or small project basis. The Ministry of Education is in the process of developing a new "ICT in Education Poli-

cy” (Ministry of Education, 2009) to replace the one developed in 2003 in order to outline strategies and implementation procedures and modules that would guide the development and deployment of ICT across the educational system. This is a welcomed next step and augers well for the country’s effective use of ICT in Ghana’s educational system. It is however important that the new ICT policy statement addresses gaps that were observed in the original ICT in education policy. For example, the policy statement should address the type of hardware, operating systems, and software conducive to school environments in the country. Moreover, teachers need to understand how to apply ICT to support their teaching and administration. Therefore, policies should identify ways of improving teacher capacity in the use of ICT as well as their specific integration. The policy should also outline the type of additional staff required to support computers and related technologies in schools (Mereku, Yidana, Hordzi, Tete-Mensah, Tete-Mensah & Williams, 2009).

Resources for ICT Integration in Education

Ghana, like most sub-Saharan countries confront challenges regarding inadequate ICT infrastructure, including computer hardware and software, and communication network (bandwidth/access); however, some studies conducted in Ghana have shown that some opportunities exist regarding ICT infrastructure and accessibility in educational institutions (namely secondary schools and teacher education institutions), to enhance teaching and learning. For example, Agyei and Voogt (2011a, 2011b) reported that the government of Ghana and other institutions have invested huge sums of money in procurements of computers and establishment of computer labs in most secondary institutions following the introduction of ICT into the school curriculum in September 2007.

In 2009, a baseline survey covering 501 secondary institutions (representing 97.6% of all secondary institutions in Ghana) was conducted to assess the ability of educational institutions to effectively use ICTs in fostering the achievement of educational and management objectives through the use of appropriate tools, processes, and skilled human resources.

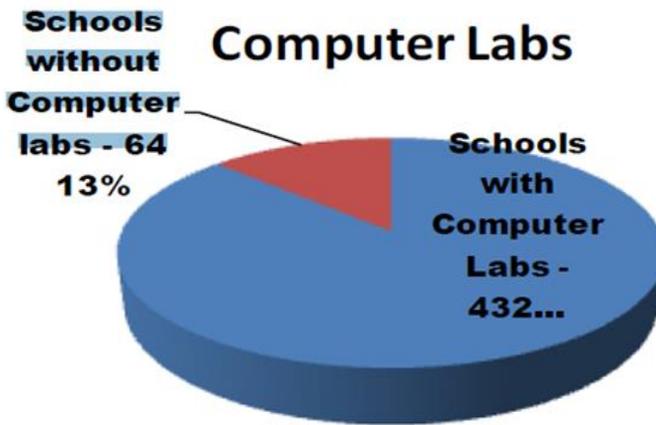
The e-readiness survey conducted by the Ministry of Education sought to provide validated data that informs on the categorization of secondary schools, and on issues that need to be addressed in planning for the deployment of ICTs to schools (MOE, 2009). The report showed that 87% of all secondary institutions are reported as having at least one computer laboratory. A study of the e-readiness survey report and other relevant documents on the status of availability of ICT resources in education in Ghana provide the following overview:

Limited number of computers available in the schools and computer labs

Though the e-readiness report indicated that the number of schools having access to computer lab seemed relatively high, the statistics collected on the number of functioning and non-functioning computers was revealing. While 494 schools reported as having computers, and seven schools as not having, the number of functioning computers was only 56.92%. Significantly, only 231 schools, representing 46.1% had computers that met the minimum computer specifications (MOE, 2009). Mireku et al. (2009) reported that at

the pre-tertiary level, the few computers that the schools have easily broken because of lack of air-conditioners, unstable electrical power supply, and virus infections. Based on the data collected, the average ratio of students to computers at the national level is 42:1 (i.e., 42 students to one computer), with the Northern Region having the highest (or worst) at 50:1 and Volta Region the lowest at 33:1 (MOE, 2009). The statistics collected on the student computer ratio at the regional level is shown in Table 1.

Figure 1. Schools with and without computer Lab.



Source: MOE (2009) Report on e-Readiness Assessment.

Mireku et al. (2009) also reported an average of 30 students to a computer at the senior high school level. A similar trend has been observed at the pre-service teacher training level. Pre-service teacher training in Ghana is offered at two levels: one is the teacher education at the university level (which focuses mainly on training teachers to teach in senior high schools and colleges of education) and the other is the college of education (formerly referred to as teacher training college which focuses on training teachers for primary and junior high schools) level. Mireku et al. (2009) reported a ratio of 50 students to a computer at the tertiary level, while Agyei and Voogt (2011a) in their study conducted among pre-service teachers from a teacher education university, reiterated that lack of ICT infrastructure among others was a major barrier of ICT integration in Ghana. While Agyei and Voogt (2011a) further reported that Computer Laboratories where teaching of ICT takes place exist in most faculties/departments of the training institutions, these labs could only be accessed periodically and only a small proportion of the educators in these institutions use ICT in teaching/training their students.

Table 1: Student Computer Ratio According to Regions

Region	Student Computer Ratio
Northern	50:1
Ashanti	48:1
Upper West	48:1
Brong Ahafo	44:1
Greater Accra	43:1
Western	41:1
Upper East	41:1
Central	39:1
Eastern Region	38:1
Volta Region	33:1

Source: MOE (2009) Report on e-Readiness Assessment.

The analysis here seems to show at a first glance, that Ghanaian educational institutions are well equipped, however closer observation reveals that the majority of such facilities fall way below an acceptable standard that could be used to support teaching and learning objectives. Existing facilities especially in the training institutions however provide a window and necessary first step to use existing hardware and software in creative and situation specific ways to enhance teaching and learning with ICT (Agyei, 2012).

Connectivity and Accessibility

Network related challenges include a lack of connectivity, frequent internet breakdown/disruptions, and high down-time of equipment in both secondary institutions and teacher education institutions in Ghana. For example, the e-readiness report indicated that of the 501 secondary schools, only 111 had local area networks in place and 390 did not. With regards to internet access, 89 representing 17.7% of the total number of schools had internet. In a similar study conducted in Ghana, Mireku et al. (2009) found out that at the pre-tertiary level, none of the computer labs were networked and only four computers in one of the schools had internet connectivity. This situation is likely to have serious implications on teachers' technology use for enhancing pedagogy and content knowledge in didactic teaching approaches which rely on resources from the internet. Students are also limited in their exploration of the use of internet inside and outside the classroom to construct their own knowledge. There is therefore urgent need to provide technology infrastructure in secondary institutions to support teachers and students to use technology and the internet whether in the computer lab during lessons or as individual to access resources that are aligned to curriculum needs in the various subject matter. The teacher education institutes are not doing much better in this regard. Although instructors could access internet on individual basis for personnel use, there is hardly any internet connectivity being used in the classroom situation.

Other Resources

Lack of resources like LCD projectors and specialized computer software for teaching various subjects prevail in both teacher and secondary institutions.

Power supply/maintenance

Unreliable power supply, frequent breakdown of computers, and poor maintenance of the existing machines contribute to the problem of availability and accessibility of ICT infrastructure. Generally, it was observed that significant investments would have to be made in the ICT infrastructure—both for present computer labs as well as available rooms earmarked for conversion to include: flooring, security, power stability, furniture, and temperature control.

Teacher Preparedness and Willingness

The recent education reforms launched in June 2007 called for the introduction of information and communications technology (ICT) at the secondary institutions through:

- The introduction of ICT as a core subject;
- The introduction of ICT as an elective subject;
- The integration of ICT as a teaching tool for all subject areas; and
- The integration of ICT to support educational management and administrative functions.

As a result, evidence drawn from the literature showed that teachers had been trained and hired in schools to serve this purpose. In examining the data to determine schools with and without ICT teachers, the e-readiness survey (MOE, 2009) reported that 97.4% of the schools did have ICT teachers, with 2.6% of the schools not having ICT teachers.

Furthermore, the report indicated that 68.8% of the teachers were professional ICT teachers while the remaining 31.2% were not. They were trained teachers in other subject areas who were willing to help with ICT teaching because there were not enough ICT teachers in the school system. Such evidence suggests that some attempts have been made by the government, the ministry of education, and teachers to move the goal of transforming teaching and learning through ICT innovations beyond rhetoric. Although this augers well for the nation, more needs to be done. The ICT teachers as reported had only basic ICT skills: basic knowledge in application software such as word processing, spreadsheet, internet, and a presentation application, and this is the focus of ICT courses they teach. The integration of ICT as a teaching tool for all subject areas is not a common practice because ICT teachers do not have the levels of competence (pedagogical combination with technological skills) to enable them to use ICT tools and equipment in the teaching and learning process. This contention has been corroborated by a number of studies (Agyei, 2012; Agyei & Voogt, 2011a; Mereku et al., 2009; MOE, 2009; Ottevanger, van den Akker & de Feiter, 2007) conducted in Ghana to analyze the experiences of teachers to integrate ICT in teaching. This seems to suggest that most teachers' experience to integrate ICT in teaching is limited and the question of whether properly trained teachers are sufficiently prepared for new teaching methods which are flexible

and involve appropriate use of technology remain. For ICT to be used meaningfully in education, teachers are required to develop knowledge and skills that enables them to integrate ICT with a suitable pedagogical approach for teaching specific matter in a certain context. The findings reported here therefore highlight areas that require opportunities to develop pedagogical skills in integrating ICT to ensure that desired effects in the teaching and learning with ICT as well as administrative processes are achieved.

In spite of inadequacies in their preparedness to integrate ICT in teaching, it was however encouraging to note that contemporary teachers in Ghana appear generally supportive and willing to use ICT in their classrooms. The review of the literature provided evidence that both in- and pre-service teachers are prepared for the integration and infusion of ICT into and across the curriculum. More importantly, they show a lot of enthusiasm to be part of any professional development programme related to integrating ICT in teaching and learning (cf. Agyei & Voogt, 2011a, 2011b). Agyei and Voogt (2011a, 2011b) reported that these teachers' positive attitudes and willingness to integrate ICT in teaching and learning is a necessary condition for them to participate in an ICT related programme and a predictor of their future classroom ICT integration. Of equal importance to ICT integration in the educational system is the role of teacher preparatory programs. Evidence from the review also showed that the teacher education programs just like secondary institutions are open to any such ICT innovation.

Lack of Skilled Manpower and Inadequate Training

ICT training in pre-service teacher education programs

The pre-service teacher training programs of colleges of education and teaching universities provide little opportunity for trainees to learn skills necessary to integrate ICT into teaching. Research has shown that such programs have not adequately modeled the use of technology in their method courses or incorporated effective approaches to technology integration into a single technology courses (cf. Brown & Warschauer, 2006). There are only two teacher education universities in the country—the University of Cape Coast (UCC) and the University of Education, Winneba (UEW). Only one department each in UEW and UCC offer a program which trains teachers to teach computer education in secondary schools (Mireku et al., 2009). This is an indication that integrating ICT in other content areas in teacher training is needed to enable increased and better use of ICT in the curriculum as spelled out in the new curriculum for education (MOESS, 2007). This includes the production and consumption of appropriate ICT-education content relevant to the local context. Thus, the added value of ICT in schools will be best realized when appropriate content is developed and used to enhance and support learning, teaching, administration, and management.

ICT training in in-service teacher education programs

Teachers who teach ICT and also integrate it in other subjects require specific levels of competence (pedagogical combined with technological skills) to enable them to use ICT tools and equipment in the teaching and learning process. The current review of research studies also sought to determine the ICT competency levels of teachers in the schools. Table 2 shows ICT competency levels of teachers from the secondary institutions who were involved in the e-readiness survey.

Table 2: Teacher (Staff) ICT Competencies

	Total Staff Population for all schools surveyed	Basic ICT Skills	Advanced ICT Skills	ICT Integration Skills	Trouble Shooting Skills	Networking Skills	Content Development Skills
No	17953	7920	2593	1686	1161	531	698
%		44.1	14.4	9.4	6.5	3.0	3.9

Source: MOE (2009) Report on e-Readiness Assessment

Only 9.4% of the 17,953 total teaching staff was ranked as having integration skills, indicating that very few teachers were using available ICT facilities to teach other subject areas, or had the skills to do so. The report also showed that only 3.9% of teachers were rated as possessing content development skills. Review of the literature indicate that most teachers believe that the heavy demands on available computer facilities to teach ICT (either as a core or elective subject), leave very little time available for other subject matter teachers to use the facilities (Agyei, 2012; MOE, 2009). Perhaps more needs to be done at the school level to offer teachers sufficient time and access to manage and familiarize themselves with ICT and to provide support network for them to take up the challenge of using ICT to teach. The findings here also indicate that practical knowledge and skills needed to enable them to use ICT tools and equipment in the teaching and learning process are lacking (Agyei & Voogt, 2011a, 2011b; Ottevanger et al., 2007).

Mireku et al. (2009) analyzed the development of ICT pedagogical integration in different institutions at different levels in Ghana and identified that at the teacher education universities; there were reports of planned school-based in-service training or professional development activities involving ICT. In one of the institutions, UEW, most of the faculty had participated in ICT workshops organized by the university to equip staff with basic skills and knowledge in ICT literacy, information management, and to limited extent, ICT integration across the university curriculum. Their study indicated that about 90% of teacher educators who took part in the study reported to have participated in continuing professional development activities that did not exceed 50 hours and included ICT integration. For continuing professional development activities beyond 50 hours, only 3% reported to have participated in such activities (Mireku et al., 2009). This means

that even at the tertiary level, there is still a lot to be done to empower educators for effective ICT integration across the curriculum.

Thus this current analysis shows that at both the pre-tertiary and tertiary levels, continuing professional development activities to enhance teachers' knowledge and skill in teaching with ICT is not a common practice. In few instances where teachers have participated in any professional development the emphasis was on basic ICT skill acquisition (Agyei & Voogt, 2011a; Mireku et al., 2009; Ottevanger, et al., 2007). This means continuous in-service training is necessary for teachers and teacher educators to update and use digital resources in the teaching learning process.

Challenges Relating to Change, Coordination of ICT and Other Stakeholder Involvement

The current review and analysis of research studies provides evidence that an attempt to integrate ICT into the education system in Ghana in order to enhance the quality of learning and teaching is faced with more challenges than inadequate ICT infrastructure and lack of skilled manpower and training. Other challenges include resistance to change from traditional pedagogical methods to more innovative, technology-based teaching and learning methods by both students and teachers/academics. The most frequently used strategy in the secondary institutions is the chalk and talk approach in which teachers do most of the talking and intellectual work, while students are passive receptacles of the information provided (Agyei & Voogt, 2011a; Ottevanger, et al., 2007). At the teacher education programs, most instructors mainly depend on lecture-based instruction. This practice has roots in the educational tradition of the Ghana education system which emphasizes teacher-centered exposition as a main educational method (Adu-Gyamfi & Smit, 2007). There is overdependence of educational system on government for everything, which has limited schools' and institutions' ability to collaborate with the private sector or seek alternative funding sources for ICT educational initiatives.

Towards Sustainable Integration of ICT in Education

Despite the daunting challenges facing ICT use in education in Ghana, there is the need to take careful and necessary steps that will be helpful in gauging the extent to which objectives regarding ICT in education can be enhanced. In light of the analysis conducted in this study, emerging issues associated with ICT use and their implications for teachers' pedagogical reasoning and practices in teacher education in Ghana have been discussed. In particular, continuous in-service training should be provided for subject matter teachers possibly through their various subject associations to be able to evaluate and use digital resources in the teaching learning process. There is also need for teacher education institutions to include ICT-related courses in their programs that help prospective teachers develop ICT integration skills in order to better integrate ICT in their instructional delivery.

Conclusion

Studies reviewed here reveal that there is not yet widespread use of ICT in education in Ghana. To successfully implement ICT to enhance the quality of learning and teaching in education significant investment in ICT infrastructure and skilled personnel will be required. The challenge of providing modern technologies to Ghanaian schools in order to enhance the quality of learning and teaching requires a significant investment. Parent-teacher associations, school management, and boards must join forces and put priority on the provision of ICT facilities in Ghanaian schools (e.g., mathematics and science laboratories, computers and projection devices in classrooms) to facilitate and increase access to ICT of teachers. At the teacher education institution/universities, students ICT user fees and Ghana Education Trust Funds (GETFunds) should be maintained as the main source of funding for ICT projects. In addition, the institutions should source funding from donors to support its ICT initiative. Easy access to ICT facilities will certainly contribute to teachers' use of ICT innovations. Partnerships between government and the private sector, development agencies, providers of pre-service education, and school communities is advocated. Policies must be developed that include clear implementation strategy to integrate ICT effectively and bring about desired improvements in the quality of education. When such issues are adequately addressed, the chances that ICT education will thrive in teacher education in Ghana will increase dramatically.

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