

Diffusion of Information Communication Technology in Selected Ghanaian Schools

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Introduction

The rapid development in Information Communication and Technologies (ICTs) have made tremendous changes in the twenty-first century, as well as affected the demands of modern societies. Recognizing the impact of new technologies on the workplace and everyday life, today's educational institutions try to restructure their educational programs and classroom facilities, in order to minimize the teaching and learning technology gap between developed and the developing countries. This restructuring process requires effective diffusion of technologies into existing context in order to provide learners with knowledge of specific subject areas, to promote meaningful learning and to enhance professional productivity (Tomei, 2005).

The use of Information Communication Technology (ICTs) in Ghanaian schools and African countries is generally increasing and dramatically growing (Tella & Adeyinka, 2007). However, while there is a great deal of knowledge about how ICTs are being diffused and used in high schools in developed countries, there is not much information on how ICTs are being diffused and used by teachers in Ghanaian schools. There is also an assumption that there are wide gaps in the use of ICTs between rural and urban schools (Aduwa-Ogiegbaen & Iyamu, 2005).

The Context

The Government of Ghana has placed a strong emphasis on the role of ICT in contributing to the country's economy. The country's medium-term development plan captured in the Ghana Poverty Reduction Strategy Paper (GPRS I&II) and the Education Strategic Plan 2003-2015 all suggest the use of ICT as a means of reaching out to the poor in Ghana (Government of Ghana, 2003). In 2004 the Ghanaian Parliament passed into law Ghana's ICT for Accelerated

Development (ICT4AD) policy, which is currently at various stages of implementation. Out of this policy the Ministry of Education produced an ICT in education framework document to integrate ICTs in schools.

It is worth noting that the ICT in education policy for Ghana had a long gestation period. An attempt at policy development for the sector predates the national ICT policy. A committee set up by the Ministry of Education, Science and Sports outlined an ICT in education policy framework and produced a document that remained untouched for a long time. The objectives of the policy were to:

- Ensure that students have ICT literacy skills before coming out at each level of education
- Provide guidelines for integrating ICT tools at all levels of education
- Provide means of standardizing ICT resources for all schools
- Facilitate training of teachers and students in ICT
- Determine the type and level of ICT needed by schools for teaching and administrative purposes.
- Promote ICT as a learning tool in the school curriculum at all levels. (Government of

Ghana, Ministerial ICT Policy statements, 2005)

The objective of the study

The purpose of the study explores the state of ICT integration of educational system in Ghana. The emphasis was on how ICTs are currently being used in the education sector in Ghana, what is actually happening on the ground, what are the strategies and policies related to the use of ICTs? What are the common challenges or constraints faced by Ghana schools in the area of

ICT integration in schools? Finally the study put forth suggestions for possible ways forward in terms of ICT diffusion in schools. For the purpose of this paper, the focus was on Junior and Senior high schools in Ghana. The research questions are:

(i) What are the perceptions of teachers pertaining to computer and technology facilities provided to them?

(ii) How does the Ghana ICT policy framework support ICTs integration in high Schools in Ghana?

(iii) How is ICTs education being integrated in high schools?

(iv) What are the obstacles that teachers face during the technology integration process?

Statement of purpose

Information and communication technologies (ICT) have become indispensable tools in today's information age, making a dramatic impact on the lives of people globally. This effect is most significant in education. The computer has become a motivating tool for teaching and learning in schools (Mossom 1986; World Bank 1999). The Internet allows cost-effective information delivery services, collaborative and distance education, more than has ever been imagined (Clyde 1995; Mbeki 1996; Todd 1997).

At the inception of the millennium, Ghana's education authorities embarked on a number of projects to introduce (ICTs) into the Ghanaian education set up; especially at the basic and secondary school levels. For instance, in the middle of the 1990s, educational providers realized that Ghanaian professionals could not compete on the global market for jobs, because they were limited in skill, especially in the area of Information Technology. Subsequently, the authorities incorporated the study of ICTs as part of the study of science. The government of Ghana with the

collaboration of Non-Governmental Organizations (NGO), philanthropists and Parent-Teacher Associations (PTAs) built about 110 science resource centres to help the teaching of science and ICTs. However, initiators found that the various programs were disintegrated, unstructured and did not cover all the schools (Nyarko, 2007).

In the later part of 1990s Ghana was host to a number of ICT initiatives supported by the government and NGOs. The Ministry of Education in conjunction with the Ghana Education Service (GES) and its allied partners undertook a critical situational analysis and review of the utilization of ICTs in education under the auspices of the United Nations Global E-Schools and Community Initiatives (GESCI). Many lapses were identified for which the stakeholders agreed to work together to make education complete with ICTs as a facilitator. The study therefore intends to provide a snapshot of ICT diffusion in Ghanaian Basic schools *Justification of the study*

The study is being carried against the backdrop of the assumption that utilization of modern ICTs in education potentially enhances the effectiveness and efficiency of teaching and therefore, provides a country with a pool of well-trained and skilled labor to meet the demands of both the public and the private sectors. In addition, it is assumed that ICTs create the opportunity for governments to provide distance-learning programs which make it possible for many more people, located far from the centers of learning programs to educate themselves. The study is therefore being carried out to justify the assumptions of the potential of ICTs in teaching and learning in Ghanaian schools.

Limitation of the study

The study has certain limitations. The sample size is small resulting in reduced generalizability. In addition, the study covers only two regions of Ghana namely Greater Accra and Volta regions. However, the literature review contextualizes the study and assist in

grounding the findings and conclusions in the literature. Further more, ICTs use in education is at a particularly dynamic stage in Ghana, which means that there are new developments and announcements happening on a daily basis somewhere in the regions. Therefore, the study needs to be seen as “snapshots” that were current at the time they were taken; it is expected that certain facts and figures presented in this study may become outdated very quickly due to rapid development. In addition, as a qualitative study, the focus of the study is therefore not on generalization, but on particularization which provide in-depth understanding of the state of ICT integration in the selected schools. Eventhough these findings will be particular to the selected schools there will be informational to other schools. Indeed when this paper was presented at a conference with a panel on 5 other cases many similarities were found among the cases some of which were from outside Ghana. The delimitations and limitations will therefore not affect the outcome of the study. It is therefore recommended that a follow up study with a larger sample would help to confirm and better understand of ICTs integration on national perspectives.

Methodology of the study

The study utilized qualitative methodology. Four schools were selected at random. One from peri –urban, 1 from urban and 2 from capital city. In each of the schools, the following were interviewed:

- 4 head of schools
- 4 technology coordinators (Computer laboratory teachers)
- 8 students In all, a total of 16 respondents were interviewed

The researchers also interviewed the Director of the National Science and Computer Resource Centre of Ghana Education Service. Semi-structured interview guide was used to conduct in-depth interviews among the respondents. All the interview processes were video tapped.**Problem**

Theoretical framework of the study

The study was grounded on the theory of Diffusion of Innovations (Rogers, 2003). According to Rogers, diffusion research centers on the conditions, which increase or decrease the likelihood that members of a given culture will adopt a new idea, product, or practice. According to Rogers people's attitude toward a new technology is a key element in its diffusion. Since Rogers uses the terms innovation and technology interchangeably (p. 12), the diffusion of innovation framework seems particularly suited for the study of the diffusion of ICT. Roger's Innovation Decision Process theory states that innovation diffusion is a process that occurs over time through five stages: knowledge, persuasion, decision, implementation and confirmation. Accordingly,

the innovation-decision process is the process through which an individual or other decision-making unit passes 1. from first knowledge of an innovation, 2. to forming an attitude toward the innovation, 3. to a decision to adopt or reject, 4. to implementation of the new idea, and 5. to confirmation of this decision.

(Rogers, 2003, p. 161)

Due to the novelty of computers and their related technologies, studies concerning technology diffusion in education have often focused on the first three phases of the innovation decision process. This is also because the status of computers in education is, to a great extent, still precarious. In cases where technology has been very recently introduced into the educational system, as is the case of most developing countries, studies have mainly focused on the first two stages, that is, on knowledge of an innovation and attitudes towards it.

Diffusion of innovation theory predicts that media as well as interpersonal contacts provide information and influence opinion and judgment. Studying how innovation occurs, Rogers (2003) argued that it consists of four stages: invention, diffusion or communication through the social system, time and consequences.

The information flows through networks. The nature of networks and the roles opinion leaders play in them determine the likelihood that the innovation will be adopted.

Innovation diffusion research has attempted to explain the variables that influence how and why users adopt a new information medium, such as the Internet. Opinion leaders exert influence on audience behavior via their personal contact, but additional intermediaries called change agents and gatekeepers are also influence the process of diffusion. The five adopter categories are: (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards. These categories follow a standard normal curve, very few innovators adopt the innovation in the beginning (2.5%), early adopters making up for 13.5% a short time later, the early majority 34%, the late majority 34%, and after some time, finally the laggards make up for 16%.

There are indications that teachers proceed to adopt ICTs in stages. Wells and Anderson (1995; cited in Myhre, 1998) report that teachers initially focus on their own interaction with the new medium, and as they gradually become comfortable with the technology they start deliberating upon potential learning benefits that would result from the use of the computer. Myhre (1998) concludes that this increased familiarity with computers allows teachers to turn their interest to the pedagogical use of technology rather than its operational issues, but also emphasizes that such change processes do not occur rapidly and are not easily achieved.

Literature Review

The literature review has been structured to ascertain the state of ICTs integration in schools and other relevant studies. The reviewed literature looked at factors that hinder ICTs integration in schools, teacher's attitudes and beliefs in ICTs use, teachers' ICT knowledge and skills, ICTs facilities and access to students and teachers as well as ICT infrastructure utilization.

Factors that hinder diffusion of ICTs in schools.

There are many factors identified as hindrances to the diffusion of ICTs in high schools. Pelgrum (2001) presents a list of ten such factors that impede ICT integration in schools. Out of the ten, we identified four major ones, namely; personal ideas about the contribution that technology can make to the processes of teaching and learning and classroom management; Teachers' lack of knowledge and skills; insufficient number of computers and ICT infrastructure; and difficulty in integrating ICTs instruction in classrooms. In related a study, Ely (1993) similarly distinguishes three major conditions, relevant to ICT integration in classrooms, These are: dissatisfaction with the status quo, existence of knowledge and skills, and availability of resources.

The two categories identify, more or less, the same issues: Ely's existence of knowledge and skills relates to Pelgrum's factor relating to teachers lack knowledge and skills. Also Ely's availability of resources is similar to Pelgrum's insufficient number of computers and ICT infrastructure. Finally Ely's dissatisfaction with the status quo is directly related to what Zhao and Cziko (2001) term as discrepancies that activate the individual. The problem of teachers' confidence in their ICT competence as a major factor for integrating technology in teaching is reported in other studies as well. Mooij and Smeets (2001) explain that if teachers are not confident in their ability or competence to handle computers this may hinder their willingness to

introduce technology in their classrooms. In their study (Smeets et al., 1999, cited in Mooij & Smeets, 2001) it is also reported that the most important reason teachers give for not using ICT is that they are not familiar with ICT or they feel unsure about it. This ICT competence factor is the same that Zhao and Cziko (2001) refer to as Control Principle. Some other important factors are also recorded as significantly influencing ICT use in schools. Teachers claiming to follow more innovative educational practices such as use of inquiry, project-oriented work and hands-on activities, are more likely to use new technologies than those who stick to the more traditional instructional approaches (Honey & Moeller, 1990, cited in Myhre, 1998). According to Mooij and Smeets (2001) school manager's policy and budgetary decisions and in general the attitude of the school manager (their commitment and decisions) are expected to be relevant to the ICT innovation process.

Teacher's attitudes and beliefs in ICTs use

International experience has shown that teachers play an important role in diffusing and utilizing ICTs in classrooms. Teachers' attitudes and beliefs affect the way technological innovation is applied in education. They tend to use technology in ways shaped by their own personal perspectives on the curriculum and on their pedagogical practices (Cohen, 1987; Cuban, 1986; Czerniak & Lumpe, 1996; Lai et al., 2001). Bullock (2004) found that teachers' attitudes are a major enabling or disabling factor in the adoption of technology. Similarly, Kersaint, Horton, Stohl, and Garofalo (2003) found that teachers who have positive attitudes toward technology feel more comfortable using it and usually incorporate it into their teaching. Woodrow (1992) asserts that any successful transformation in educational practice requires the development of positive user attitudes toward the new technology.

The development of teachers' positive attitudes toward ICT is a key factor not only for enhancing computer integration but also for avoiding teachers' resistance to computer use (Watson, 1998). Watson warns against the severance of innovation from the classroom teacher and the idea that "the teacher is an empty vessel into which this externally defined innovation must be poured" (p. 19).

The teachers' attitudes and beliefs also influence what they themselves learn from education and training programs and what didactic practices they make use of in their classrooms (Clark & Peterson, 1986; Fang, 1996; Pajares, 1992; Zeichner et al., 1987). Research has shown that many educational reform initiatives have failed precisely because they did not influence the beliefs or the practices of the teachers (Cohen & Ball, 1990; Elmore, 1987). However, significant positive correlations exist between teachers' attitudes towards ICTs and five independent variables namely cultural perceptions, computer competence, computer access and computer training (Albirini & Abdulkafi, 2004). However, what the review literature failed to explore is what are the teachers' perceptions pertaining to computer and technology facilities provided to them?

Teachers' ICT knowledge and skills

The effective use of computers by teachers depends not only on their attitudes, but also on the training they have received (Ashton & Webb, 1986; Fernandez & Saul, 2000; Madsen & Sebastiani 1987). Teachers' competence in ICT presupposes: positive attitudes to ICT, understanding of the educational potential of ICT, ability to use ICT effectively in the curriculum, ability to manage ICT use in the classroom, ability to evaluate ICT use, ability to ensure differentiation and progression and technical capability (Albirini & Abdulkafi 2004; Beck, 1997).

It is also worth noting that inadequate pre-service and in-service training is another

obstacle for many teachers to integrate technology in their classroom teaching (Yaghi, 1997; Yildirim, 2000). There is a large body of research in the literature that supports the same position that teachers should receive effective, timely and continuous training to promote technology in their teaching. (Wilson, Notar, & Yunker, 2003; Yildirim, 2000; Yildirim & Kiraz, 1999; Lemke, 1999; Northrup & Little, 1997).

In-service training is a key factor in cultivating positive attitudes to the computer (Dupagne & Krendl, 1992). How teachers construct and reconstruct their knowledge is a critical issue as teachers' thought processes determine largely what happens in the classroom. Teachers' pedagogical decisions and actions are closely tied up with their professional growth. Their professional knowledge might be changed by means of experience, curriculum directives and in-service training. In-service training of good quality could support the process of changing teachers' thinking and practice, recognizing that teaching is a difficult, complex and multifaceted process (Wood & Bennett, 2000). In a related study Lai et al., (2001) revealed that school-based professional development is better organized and facilitated by the ICT coordinators, who usually have adequate training and a deeper understanding of integrating computer technologies into the school curriculum and can provide role models for teachers.

However, research into in-service training has shown that what the training program has to offer all too often fails to meet the teachers' real needs (Tella & Adeyinka, 2007; Crook, 1994:). A decisive factor in the effective integration of computer use in the school curriculum is the provision of appropriate in-service training to the teachers, training which will show them how to use the new tools in their everyday teaching practice.

The IEA study in 1989 showed that a fair number of teachers had had some experience of in-service training in computer use, but the majority of programs at that time emphasized the

technical rather than the pedagogical and didactic aspects of computer use. In-service training needs to focus not on the technical, but on the pedagogical and didactic aspects of ICTs use in the classroom (Lai et al, 2001; Pelgrum & Plomp, 1996).

Many recent research studies on the state of ICT's diffusion in schools also show that many institutions are failing to integrate technology into existing context. Bauer and Kenton (2005) stated in their study that although teachers were having sufficient skills, were innovative and easily overcame obstacles, they did not integrate technology consistently both as a teaching and learning tool. Reynolds, Treharne and Tripp (2003) also underlined continuing problems in the adoption of ICTs by teachers and stated the need for further research on how ICT can improve education. It is worth noting that what the reviewed literature failed to explore is how the ICT policy framework supports ICT's integration in schools in the various countries. Without any clear cut policy, ICTs integration would be implemented based on the whims and caprices of the teachers.

ICT facilities and access to students and teachers

Another important variable of ICTs integration in schools is availability of ICT infrastructure. In his doctoral dissertation, Ottesen (2006) reveals that one fundamental problem facing ICT integration in schools is the lack of computer infrastructure. In a related study Norris et al., (2003) reveal that appropriate access to technology infrastructure is another key factor in the effective technology integration process. The study reveals substantive correlation between technology access and use. In another study, Yildirim (2007) reveals that teachers agreed that access to ICT infrastructure is one of the effective means to integrate ICT in classrooms.

Together, education and employment are key building blocks of strategies to eradicate poverty. ICT is increasingly being used to improve access to education and employment

opportunities. ICT has the potential to improve young peoples' access to educational opportunities as well as to enhance the quality of that education through the new modes of learning they enable. Through ICT, curricula can be more easily updated, adapted, enriched and personalized to satisfy a broad range of learning needs. Using ICTs access to a curriculum can be made available more efficiently over a wider area. Even within more traditional learning environments, ICT is changing the way classrooms operate; the integration of multimedia subject presentations, online research, changing teacher-student dynamics, and innovative project approaches are making the learning process more interactive and participatory (UN Youth Report, 2005).

ICT infrastructure utilization

Waite (2004) indicates that even though teachers show great interest and motivation to learn about the potential of ICTs, in practice, the use of ICT is relatively low and it is focused on a narrow range of applications, with word processing being the predominant use. The research reveals that the use of other ICT tools such as video conferencing, emailing and the Internet are rarely used. The study further reveals the lack of ICTs infrastructure as one of the factors for non-usage of those tools. Another research study suggests that ICT as a tool to promote learning is not generally well embedded in teachers' practice (Cox et al., 1999; Pedretti et al., 1999; Zhao & Cziko, 2001) and that "information technology in the classroom is used in an ineffective way and it has proven difficult to integrate within traditional curriculum settings" (Van Belle & Soetaert 2001, p. 38).

Key Findings/Discussions

Understanding of ICTs integration in Education in Ghanaian schools.

In general almost all the respondents understand the notion of ICTs integration in education. The respondents indicated ICTs integration call for the introduction of modern communication tools to infuse teaching and learning in classroom. However, almost two thirds of the respondents limited ICTs tools to computer and Internets. One third of the respondents enumerated other technological tools like radio, television, video, audio among others as media in diffusing teaching and learning in schools.

ICTs infrastructure

Apart from one school the other three schools involved in the study they have some form of Internet access. Out of the three schools, one had a satellite dish, the other 2 had Digital Subscribed Line (DSL). Even though all the schools have computers, only two of the schools have high speed computers (Pentium 4). The other two schools have in place slow paced computers and most of these computers were broken down. It is worth noting that the availability of internet connection is important for the success of teaching and learning, particularly its centerpiece of online collaboration. The schools that have had the most successful results in terms of teaching, learning and administrative purposes are those that have adequate and modern technology infrastructure and reliable internet access. The schools that have the ICTs infrastructure for example were able to the facilities to promote research, learning and data management.

The state of ICTs diffusion in schools

The process of adoption and diffusion of ICT in Ghanaian schools is in transition. The diffusion of ICT in both junior and high schools are driven through individual schools' initiatives.

Apart from a few individual pilot projects initiated by Ghana Education Service, such as NEPAD E-Schools and computer for schools projects there is a wide gap between ICT integration in schools in peri-urban, urban and capital cities. There are other private and NGOs like World Links for Development, the Global Teenager Project, among others, whose initiatives have gone long way to promote ICTs use in some selected schools. There appears to be the beginnings of a marked shift from over a decade of experimentation in the form of donor-supported, NGO-led, small-scale, pilot projects towards a new phase of systemic integration informed by national government and multi-stakeholder-led implementation processes. One of the primary features of this new phase is the priority that governments are giving to policy development. Ghana's ICT4D Policy document is a backbone to the new shift of paradigm where ICTs are being integrated in the school curriculum at all levels of educational system. Ghana's quest in integrating ICT in the educational system is being bedevilled by numerous problems. Notable among them are lack of adequate ICTs infrastructure. Access to a reliable supply of electricity is a general problem but is particularly severe in peri-urban areas because of power crisis the nation is facing as of the time of collecting the data for the study. There is a general lack of human resource capacity to provide ICT training and equipment servicing, and there is a lag between the availability of ICT infrastructure and the ability to integrate it in the educational system. The situation have resulted to schools hiring private computer technicians and tutors instead of trained and qualified personnel.

ICTs integration impact on students

Most student respondents feel that the introduction of ICTs in their education institutions has had beneficial impact both on them and on their teachers. According to the students, ICTs are enhancing their learning process. Information gathered on subject based courses on the Internet,

radio and on Television are used as extra reference materials that help to deepen their understanding of the subjects being taught in classrooms. Almost all of the respondents feel the use of ICTs in learning and research have enhanced the development of higher order skills has been achieved. By higher order skills the respondents meant their computer skills have been enhanced and have resulted in using those skills in other areas of discipline. They cited online collaboration projects like the Global Teenager Project and other interactive projects have enhanced their global awareness and knowledge of other cultures as positive benefits. Many also feel that online resources have helped them in their academic achievements.

“ICT tools have helped me to create my own website to broadcast myself to the whole world. The tools have also aided me to research on my academic courses.”

(Eugene Dadzie – StudentAccra Academy, Accra)

ICTs integration impact on school administrators

In terms of how ICTs is helping shape education, heads of schools cited situations where computer software are used to track progress of students performances like grades. One of the heads of the four schools spelt this out clearly

“ICTs integration in my school is helping the teachers to record grades of the students, the administration is using to track the general performances of the students”
(Mrs. Abena Kwakye-The head of administration Morning Star School, Accra)

ICTs integration Impact on teachers

The teachers interviewed indicated a transformational process through which they not only begin to integrate technology into their daily practices, but also to change their pedagogical approaches. Be it for its novelty or its effectiveness, the targeted use of technology seems to facilitate the move towards more student-centered pedagogies that allow students to develop higher order thinking skills. The use of technology, particularly among teacher help in motivating them and

improve teacher-student interactions. In addition to new skills, teachers are impacted in other ways. Teachers use their new acquired skills in other searching for other job opportunities alongside teaching. Furthermore, teachers interviewed express a sense of increased self-confidence and increased excitement about teaching.

ICT policy framework

In spite of the benefits of a policy framework to guard ICT integration in schools, as at the time of conducting this study, Ghana's Ministry of Education had not established a clear framework for the implementation of ICT. An educational policy framework can help to define the roles and responsibilities of educational actors, which include policy makers, administrators, teachers, students, funding agencies, development organizations, and civil society. As a blueprint, an educational policy framework can be a process through which various actors and policy makers translate educational policy into practice.

Challenges facing teachers in implementing ICT integration in classrooms

The challenges facing teachers in integrating ICTs in classrooms are enormous. Teachers and administrators recounted the following: in addition to been under-paid, over-worked and struggling in resource-poor environments, they often confront opposition to changes in classroom practice from fellow teachers, school administrators and parents yet they manage to find the extra time and energy required to integrate ICTs in schools.

It is worth noting that the focus of ICTs integration is changing teaching and learning, the process in Ghanaian schools is varied. Among the four schools, only two of them can be classified as early adopters whereas the other two can be classified as late adopters. The reason being that the schools in question have advanced in terms of integrating ICTs course on school time table. Moreover, the most of their students show high sense of proficiency in computer and

technology use. Another major problem associated with ICTs integration are high student/computer ratios, computer breakdowns, and slow or inconsistent Internet connectivity. There is also lack of professional development programs for teachers to upgrade their skills on emerging technologies. There appears to be a gap between policy of the Ministry of Education on ICTs integration and actual implementation process. . By the time of this research, there was no clear-cut policy framework on ICTs integration in schools.

“The Ministry of Education is talking about ICT integration in schools. But we do not see what they are talking about materializing yet” (Mr. Emmanuel Lithur- Chemistry tutor Awudome High School, Awudome Tsito)

“The Ministry of Education is a bit slow with its implementation of ICT integration in schools” Mr. Edward Tetteh- Computer tutor Accra Academy

Suggestions

The set of social, economic, and environmental challenges that confront ICTs integration in schools are significant and requires an education system that can develop a nation's citizenry and workforce to its full creative and productive capacity.

The Ministry of Education Science and Sports as well as Curriculum Research Development Division of the Ghana Education Service who provide policy direction to schools have to address the challenges confronting ICTs integration in schools. They should not only introduce computers but also look at the broad range of educational policies, programs and structures that must also be changed if the introduction of computers is going to contribute to social and economic development of the nation. The policy direction has to address issues such as provision of computer laboratories, staffing the laboratories with permanent technology coordinators among others. The voice of one of the administrators of the selected schools will emphasize this point

*“The Ministry of Education should employ permanent computer teachers in the schools”
(Mr Asamoah Ochoga- Assistant Headmaster- Ola Girls High School, Ho)*

Secondly, one of the corollary changes that would be needed to produce students with skills, attitudes, and propensities needed to address 21st century challenges is a revision of the curriculum.

In addition, beyond the memorization of established facts and the reproduction of standard procedures, students will need to be able to apply school subject knowledge to solve complex, real world problems. They will need to be able to work in teams on extended projects that cut across subject matter lines utilizing technology to search for, organize, evaluate and create knowledge.

Furthermore, students should be allowed to set their own technology learning goals, evaluate their progress and the quality of their projects, and continuously revise and refine what it is that they know. Educational policy makers who are desirous about the introduction of new skills into the curriculum must create assessments that provide students with ongoing opportunities to apply their knowledge in complex, real world settings, to work in teams, and to assess themselves and each other with challenging standards for success.

About enhancing human capacity of teachers, there is the need to provide extensive teacher professional development for teachers. Such capacity building programs can be online teacher professional training, face to face training workshops among others. The professional development includes more than training in equipment operation. The new pedagogical models required in the adoption of constructivist and constructionist learning outcomes call for training of teachers in these skills and knowledge base.

There is the need also to provide technical support to schools in terms of installation and

maintenance of ICT infrastructure. There appears to be an underestimation of the magnitude of effort needed for the large-scale installation and maintenance of hardware, software, and networking equipment for an effective integration of ICTs. Computer coordinators alone cannot maintain the system. An extensive network of skilled technicians must be developed to support schools, administrators, teachers, and students.

There is the need to improve upon ICTs infrastructure. Canonical example is the telecommunications and Internet infrastructure. At the recent launch of 2nd ICT award, the Deputy Minister for Communication, Mr. Opare-Ansah hinted that the first phase of the national fibre optic communication backbone project expected to reduce the cost of communication and other related services in the country has been completed. The first phase of the project, which is dubbed the Southern Loop with an extension to Tamale, is currently on trial. The ICT backbone project was part of the broadband infrastructure expected to be used to undertake and implement Information Communication Technology (ICT) programs in governance, health, education, commerce and agriculture. In addition, it is expected that the completion of the first phase of the project would pave the way for ICT programs to be undertaken nationwide and thereby bridge the digital divide between the rural and urban schools.

Conclusion

The integration of ICT in Ghanaian school systems in Ghana is a major step in promoting innovation. However, the educational system currently is bedeviled with a myriads of problems enumerated: lack of adequate computers and other ICTs tools especially in rural schools, poor internet connectivity, lack of adequate manpower, lack of coherent ICT policy framework. In conclusion, the introduction of ICTs in education in Ghanaian schools had a demonstrated benefit for the future life of students in participating schools, through the acquisition of both

technology and academic skills. Other areas, such as collaboration, global awareness and working in projects both with students in their countries and other countries, have also shown marked improvement. For the educational system to leap frog in its quest of ICTs integration, there is the need to take look at the recommendations enumerated above.

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