

Promoting teaching and learning in Ghanaian Basic Schools through ICT

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ABSTRACT

The Basic School Computerization policy was created in 2011 to introduce computers and e-learning into the entire educational system to promote training and life-long learning. Using data obtained by Connect for Change Education Ghana Alliance, this paper investigates the extent to which school administration, and teaching and learning are promoted through the use of ICT in Ghanaian Basic Schools. The data was obtained through a cross-sectional survey involving a random sampling of 333 Primary and 295 Junior High Schools across four regions (Northern, Upper East, Upper West and Volta) in Ghana. Expert interviews on ICT policy implementation were also conducted with ten District and four Regional Directors of Education. The findings show that there are relatively low computers at Primary Schools (4%) compared to the Junior High Schools (10%). In the Primary Schools, 69% of female teachers and 50% of male teachers use ICT tools to teach. The ability of teachers to use computer to teach and research is weak due to lack of access to internet, electricity/power problem, inadequate number of computers and technical know-how. The study recommends a strong and sustainable Public-Private-Partnership between the government, private sector and civil society organizations to map out plans and strategies in order to minimize the problems associated with the integration of ICT in the education system.

Key words: *Education, Basic school, ICT, Policy, and Region*

INTRODUCTION

Although many developing countries are pursuing a wide range of policies and programmes aimed at achieving universal elementary and primary education, access to quality education continues to hamper the achievement of the Dakar Educational Goals and Millennium Development Goals two and three – “universal primary education”; “promoting gender equality and empower women” (Gan Siowck 2000). Available evidence indicates that no adequate attention has been paid on the quality of education albeit, significant strides have been made on achieving equity and regional parity. Van Reijswoud (2009) points out that there are problems in the educational system, which requires reforms at various levels - pedagogical, curricular and institutional. Van Reijswoud (2009) argues that the emergence, acceptability and adoption of various information and communication technologies (ICTs) by society provide clear practical opportunities for enhancing quality teaching and learning. Gunton (1993) defines ICT as electronic devices or technological equipment for collecting, processing, storing, retrieving and communicating information. According to Gunton (1993) ICT includes a wide range of computer hardware and software, ‘network’, ‘video’, ‘audio’, ‘television’, ‘digital camera’, et cetera, capable of converting information into digital forms for users.

Information and communication technology can be successfully employed to enhance effective teaching and learning (Gholami et al. 2010). In this study, the authors define effective teaching and learning as the repertoire of instructional strategies that embrace all human interactive skills and materials employed by the teacher to promote, facilitate and communicate learning in the classroom situation leading to improved performance on the part of the learner. The authors also define ICT accessibility as the extent to which ICTs can be used by all persons irrespective of whether the person is having a disability or not to achieve a certain specific goal.

In the last decade, the Government of Ghana has championed the use of ICT in education for improved educational outcomes. The Education Strategic Plan (2003-2015) and (2010-2020) of the Ghana Education Service identified the need for ICT in education to help achieve the objectives of the Education Strategic Plan, which are carved into *Access, Quality, Gender and Inclusiveness, and Education Management*. Consequently, the government of Ghana developed the ICT for Accelerated Development (ICT4AD) Policy (2003), which explicitly outlined the plans and strategies in a framework of how ICTs can be used to facilitate the national goal of “transforming Ghana into an information and knowledge-driven ICT literate nation” (Government of Ghana 2008, p.10). The ICT4AD policy has 14 cardinal pillars of which promoting ICT in education is the 2nd pillar, which emphasizes “the deployment and exploitation of ICTs in education”.

On the basis of promoting ICT in education, the Ministry of Education launched the ICT in Education Policy in 2008 as a way of addressing the ICT needs in education. Similarly, the Basic School Computerization policy was created in 2011 to introduce computers and e-learning into the entire education system. Hence, in 2012, the Ministry of Education through rLG, an ICT company in Ghana introduced the “teacher laptop and ICT project” where teachers are trained in ICT and provided with laptops to aid in research, teaching and learning across a variety of subject areas. The use of ICT for teaching and learning is important since it guarantees unrestricted access to relevant information and development in subject areas as well as the provision of efficient and effective tools to take care of students’ individual differences including people with special needs (Bede, Termit, & Fong 2015; Kwache 2007).

Therefore, the critical question that needs answers is how can teaching and learning in Ghanaian basic schools be promoted through the use of ICT? This study aims at investigating the extent to which school administration, and teaching and learning are promoted through the use of ICT. The objectives of the study were to: determine the availability of ICT tools and infrastructure in public schools; assess the accessibility of ICT tools for pedagogical and administration purpose in public schools; and examine gender differences in the use of ICT tools to aid in teaching and learning.

This study is relevant because its results will give an idea on how far the basic school computerization policy in particular has been implemented and the gaps that exist. This will serve as a strong basis for policy and decision makers as well as advocacy work by civil society organizations to address the gaps that may exist. The paper is organized into five sections. The succeeding section provides the literature review. The third section presents the materials and methods of the study. The penultimate section presents the results and discussion. Conclusion and recommendations constitute the last section.

LITERATURE REVIEW

Gender differences and use of ICTs

Through the surfacing of information and communication technologies, the world is experiencing a unique revolution in information and knowledge diffusion (Dawson 2008). One area that has

experienced intrusion of ICT is in the field of education, which is strengthening efficiency in teaching, learning and researching. Gholami et al (2010) argue that investments in ICTs not only facilitate economic growth and poverty reduction, but enhance students' academic performance through the use of computers for teaching and learning. A study by the International Institute for Communication and Development (2007) indicates that 60% of teaching and learning are directly and positively influenced by the use of ICT, which results in better school performance. Recognizing the importance of ICT in teaching and learning, investments in ICT have been initiated by many governments in both developed and developing countries (Buabeng-Andoh 2012a). For example, the United States of America has since 1989 invested in excess of US\$6billion in the use of ICT for public education (Johnston & Barker 2012).

The purpose of ICT in education can be grouped into three namely, teaching purpose, administration purpose and personal purpose (Kellenberger & Hendricks 2000). Bhalla (2013) grouped computer technology in education as non-instructional for record keeping, communication between instructors and learners; and pre-instructional purpose for developing teaching materials, researching, teaching, et cetera. A survey by the National Center for Education Statistics in the United States found that teachers use computers mostly for administration (32%) and pedagogical (36%) purposes to improve overall quality of time for preparing teaching materials, recording students' school attendance, filling students' academic records and delivering students' academic reports to parents online (Rowand 2000). Through the use of ICTs for teaching and learning, there is improved memory retention, improved problem solving abilities and improved students' role-playing activities (Forcheri & Molfino 2000).

Studies also indicate that gender difference play important roles in ICT use both at home and at school (Janssen & Plomp 1997). According to Janssen and Plomp (1997) boys use computer at school for a wider range of activities than girls in both primary and secondary education. Durndell and Thomson (1997) indicate that boys have more access and use of ICT tools more than girls. Also, Volman and van Eck (2001) show that girls have low levels of computer compared to boys due to girls' limited access to ICT, lack of skills, experience and interest in the use of ICT tools. Kay (2006) asserts that boys use more ICTs in learning than their girl counterparts because boys have more disposal time to practice ICTs. Jamieson-Proctor et al. (2006) using 929 teachers in Queensland State indicate that male teachers are integrating technology into teaching more than female teachers because male teachers pursued courses that have to do with the use of ICTs. Dawson (2008) argues that fewer teachers routinely instruct mathematics, science, social studies and ICT using the computer. According to Dawson (2008) only ICT teachers sometimes use computers to give instructions during ICT lessons in developing countries. The literature so far cited shows that there is enough studies on gender difference and ICT use by students but very little is known about instructors use of ICTs in teaching and learning.

Types of infrastructure to support integration of ICT in education

The use of computer in education is insufficient to make significant strides to achieve the education for all goals. The provision of computer along with other infrastructure including local area network (LAN), open educational resources (OER), computer-assisted-instructions (CAI), television-assisted-instruction (TAI), internet, power, et cetera will help in effective teaching and learning. The reason is that instructors and learners will have varieties of choice to make in the selection of ICT tools that can best help them to gain knowledge. However, many schools in developing countries have limited access to these types of infrastructure due to inadequate investment in ICT by governments. It is generally agreed that access to ICT infrastructure and programs will support and promote teaching and learning (Tondeur, Valcke, & van Braak 2008).

According to the Institute of Electrical and Electronics Engineers (IEEE), LAN is defined as “a datacom system allowing a number of independent devices to communicate directly with each other within a moderately sized geographic area over a physical communications channel of moderate data rates”. Local area network can improve interaction between teachers and students and improve information management in schools. Therefore, there is the need for governments and stakeholders in education to think of making LAN available to schools which do not have regular internet access.

Another important ICT infrastructure needed to help in the achievement of education is open-educational resource (OER). According to OECD (2007) open-educational-resource is defined as “digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research”. The OECD (2007) indicate that there are more than 3000 open access courses from over 300 universities worldwide, with the United States and China contributing about 1750 courses.

Other important ICT infrastructure includes computer-assisted-instruction. Bhalla (2013) defines computer-assisted-instruction as the mode of instruction in which a computer is used by a student to directly interact and learn programmed lessons from it. Computer-assisted-instructions use tutorial softwares that do not necessarily need the presence of a teacher to guide the learner. Ford and Chen (2001) indicate that CAI can enable learners to learn in ways that suits them either slowly or quickly, repeat task over and over again without the program complaining of repetitions and skipping information that is not needed. With CAI, learners decide what they want to learn, in what order and time. However, the use of the ICT infrastructure is dependent on the availability of power. This is because the lack of power not only affects the use of computer, but also affects access to internet materials.

MATERIALS AND METHODS

Data for this study was provided by Connect for Change Education Ghana Alliance (C4C-EGA). The study design was a cross-sectional survey. The study was conducted in Northern, Upper East, Upper West and Volta regions of Ghana. The population and list of public basic schools for the 2013/2014 academic year was obtained from the Ghana Education Service indicating in Northern region (2,042 Primary; 621 Junior High School), Upper East region (688 Primary; 408 Junior High School), Upper West region (561 Primary; 404 Junior High School), and Volta (1,493 Primary; 967 Junior High School). A simple random sampling technique employing the lottery method was used to select 333 Primary and 295 Junior High schools in forty districts. The distribution was 142 Primary, 90 Junior High Schools in Northern region; 42 Primary, 47 Junior High schools in Upper East region; 38 Primary, 37 Junior High schools in Upper West region; and 111 Primary, 121 Junior High schools in Volta region. Expert interviews on ICT policy implementation were conducted with ten District and four Regional Directors of Education. Secondary literature consisting of scholarly reports and journal articles were used to support the findings of the study.

Data collection covered pupils' enrolment, staff number and status, number of computers in schools, proportion of computers available for pedagogical and administration purposes, learner-to-computer ratio for pedagogical purpose, and learner-to-computer connected to the internet. Other areas of data collection are availability of local area network (LAN), telephone communication facility (TCF), internet access (INT), computer laboratories (CL), electricity (ETY), solar panel (SP), generator (GRT), internet-assisted-instruction (IAI), open educational resources (OER), and television-assisted-instruction (TAI). Data was also collected on use of ICT to teach (prepare and deliver lessons) and research.

Quantitative data was analyzed using Statistical Package for Social Scientists. The results are presented in descriptive statistics, frequency, percent and charts. The study was guided by ethical issues from the beginning to the end of the study. The specific ethical issues considered for the study include informed consent, right to anonymity and confidentiality, and right to privacy. Ethical issues in studies of this nature are critical first for ensuring participation and secondly for guaranteeing reliability and traceability.

RESULTS

Background characteristics of schools

The findings show that the average number of teachers in the study regions is 10. The results indicate that there are more male teachers ($M = 6$, $SD = 3.90721$) than female teachers in the study regions ($M = 4$, $SD = 3.26934$) (Table 1). The data in Table 1 shows that there are more professional teachers in the schools ($M = 8$, $SD = 4.31545$). The results show that the enrolment of boys ($M = 170$, $SD = 97.91871$) and girls ($M = 165$, $SD = 96.71904$) in Primary is higher than the enrolment of boys ($M = 104$, $SD = 68.45428$) and girls ($M = 92$, $SD = 58.23118$) in JHS. This finding suggests that there is gender parity at the Primary level. However, at the JHS level it appears that there is no gender parity. The downward enrolment of pupils at the JHS may be as a result of socio-cultural factors such as early marriages, forced marriages, and the lure of the 'galamsey' (illegal mining) business in the study regions, which attracts most of the young boys and girls to drop out of school in pursuit of economic activities.

Table 1: Average number of staff and pupils per school in all regions

Variables	N	Minimum	Maximum	Mean	Std.
Male staff	624	0	59	6	3.90721
Female staff	600	0	22	4	3.26034
Professional teachers	625	1	27	8	4.31545
Non professionals	428	0	12	1	1.47496
Pupil teachers	438	0	23	1	2.06923
Boys enrolment in Primary	328	16	526	170	97.91871
Girls enrolment in Primary	329	14	547	165	96.71904
Boys enrolment in JHS	291	12	564	104	68.45428
Girls enrolment in JHS	298	10	319	92	58.23118

Source: Connect for Change Education Ghana Alliance (C4C-EGA), 2014.

Availability of ICT tools in schools

Table 2 shows that the Volta region has more ICT tools (projector = 62%, printer = 46%, desktops 40%, etc) compared to the other regions. With the exception of the Volta region where three public basic schools are supplied tablets and e-readers by Pencils of Promise, a USA based non-governmental organization, none of the sampled schools have these tools. The tablets and e-readers are equipped with over 300 books which are user friendly to both teachers and pupils to

teach and learn. The results also indicate that the Upper West region is the least supplied with ICT tools.

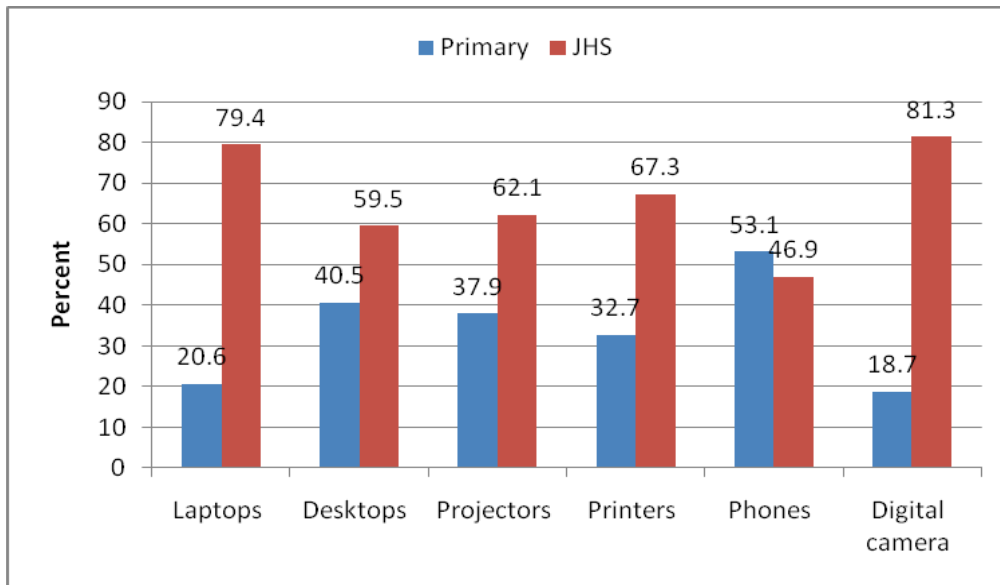
The data in Table 2 shows that the most available ICT tool in the regions is personal mobile phone. Teachers in the Northern region recorded the highest proportion of personal mobile phone (48%), while the Upper East recorded the lowest proportion of personal mobile phone (12%). The high availability of mobile phones suggests that mobile phone learning programs can be targeted at teachers to teach familiar and short interesting stories.

Table 2: Number of ICT tools in the schools

ICT tools	Northern		Upper East		Upper West		Volta	
	Region		Region		Region		Region	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Laptop	1047	32.0	513	15.0	564	17.0	1194	36.0
Desktop	409	38.0	172	16.0	60	6.0	444	40.0
Projector	25	30.0	7	8.0	0	0.0	52	62.0
Printer	49	36.0	12	9.0	12	9.0	63	46.0
Personal mobile phone	2487	48.0	623	12.0	694	13.0	1373	27.0
Digital camera	38	39.0	8	8.0	9	9.0	42	44.0
E-reader/Tablet	0	0.0	0	0.0	0	0.0	32	100.0

Source: Connect for Change Education Ghana Alliance (C4C-EGA), 2014.

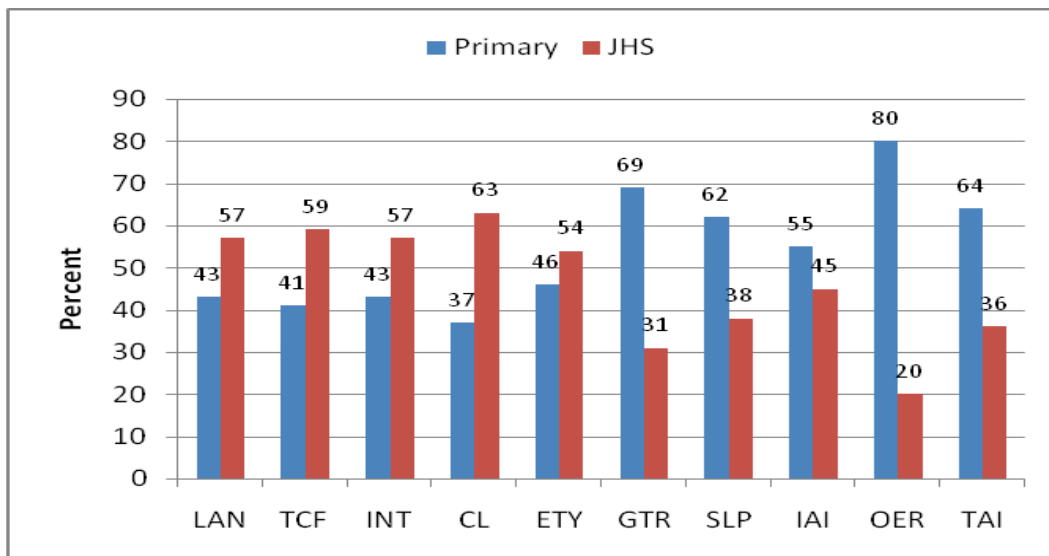
Figure 1 shows that there is disproportion in the availability of ICT tools in basic schools. Apart from personal mobile phones, which are high in the Primary (53%) compared with the JHS (47%) perhaps due to the high number of teachers in Primary, all other ICT tools (laptops, desktops, projectors, printers and digital cameras) are higher in the JHS. This finding contradicts what pertains in countries such as India, Japan, Malaysia and Singapore where the government pays more attention in the provision of ICT tools in Primary schools (UNESCO 2014). The argument is that children need these tools in order to adopt ICT skills at tender ages and grow up with knowledge and skills in ICT (Bandura 1997).



Source: Connect for Change Education Ghana Alliance (C4C-EGA), 2014.

Figure 1: Proportion of ICT tools in basic schools

Figure 2 also illustrates that there is fairness in the distribution of ICT infrastructure in Primary and JHS. The results show that whereas JHS have more computer laboratory (CL) (63%), internet (INT) (57%) and electricity (ETY) (54%), the Primary can boast of more open educational resources (OER) (80%), generators (GTR) (69%), television-assisted-instruction (TAI) (64%) and solar panel (SLP) (62%).



Source: Connect for Change Education Ghana Alliance (C4C-EGA), 2014.

Figure 2: ICT infrastructure by school category

Television-assisted-instruction is one of the most effective ICT tools that aids in teaching and learning in basic schools in Ghana. This is because of the efforts of the Government of Ghana's Presidential Special initiative on Distance Learning as well as efforts of some NGOs in the distribution of television sets to schools for distance learning.

Accessibility of ICT in schools

The results reveal that about 60% of teachers have access to computers for pedagogical purposes. Table 3 shows that teachers who have access to computers is (M = 6, SD = 4.93681) and while teachers' with personal computers is (M = 3, SD = 5.62962). The use of computers for pedagogical activities is high in the JHS (79%) compared with Primary (21%). Some important programmes installed in computers meant for pedagogical purposes include Skool, Encarter and Mavis Beacon. The findings show that learner-to-computer ratio is 189:1 in Primary compared with 27:1 in JHS. This finding is at variance with international standards which require that learner-to-computer ratio be 4:1 in public schools (Babette & Reitzes 2011). UNESCO (2014) defines learner-to-computer ratio as the mean number of learners sharing one computer for pedagogical purpose in an education system.

The data in Table 3 shows that the average number of computers available for school administration is one. In terms of school category, the results specify that 4% and 10% of the computers are used for administration purpose in Primary and JHS, respectively. The findings on the use of computers for administration purposes include typing terminal examination questions, entering academic records of pupils, storing vital school information such as school infrastructure, enrolment and teacher attendance.

The average number of computers connected to the internet for both administration and pedagogical purposes is one (Table 3). The results of the study show that 13% of computers are connected to the internet in Primary schools compared with 87% in JHS showing a significant difference. The reason is that in JHS, there is a teacher for ICT and some of whom are provided with modems for instructions. The study also shows that the ratio of learner-to-computer connected to the internet is 355:1 in Primary compared with 186:1 in the JHS.

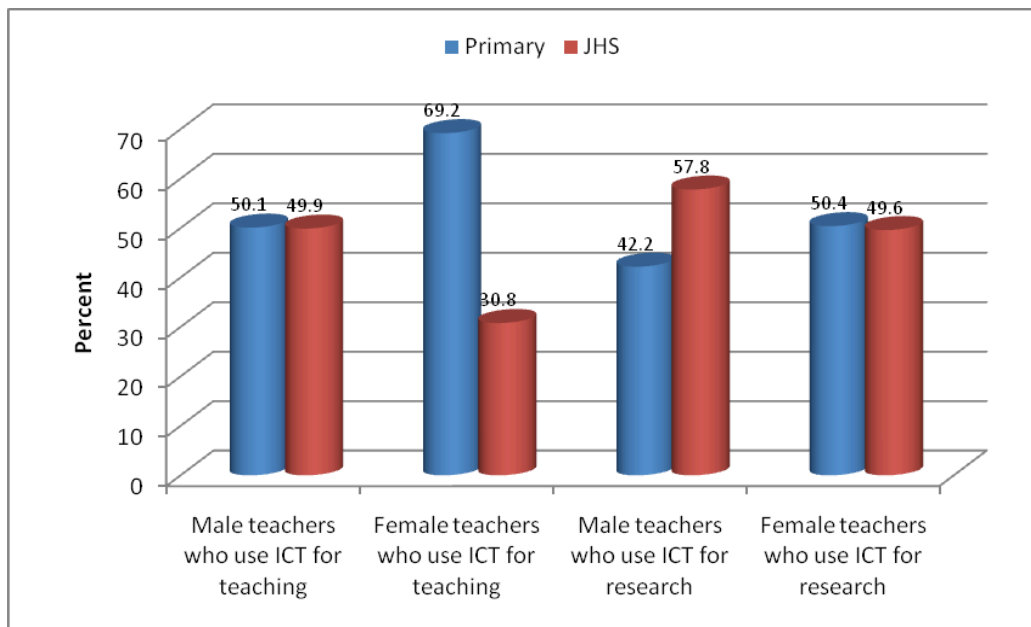
Table 3: Use of computers for pedagogical and administrative purposes

Variables	#	Min	Max	Mean	Std.
Teachers with own computers	569	0	121	3	5.62962
Teachers who have access to computers	593	0	30	6	4.93681
Computers connected to the internet	391	0	46	1	4.32738
Computers available for pedagogical use	485	0	46	6	8.93940
Computers available for administrative use	415	0	25	1	2.56031

Source: Connect for Change Education Ghana Alliance (C4C-EGA), 2014.

Use of ICT tools by gender

Ghana's ICT Policy in education stresses the need for a balance in terms of ICT tools usage in schools. The study found significant differences between male and female teachers' use of ICT tools to teach and do research. Figure 3 shows that about 50% of male teachers use ICT tools to teach in JHS compared with 31% of female teachers. In Primary, 69% of female teachers and 50% of male teachers use ICT tools to teach. The teachers said that they use ICT tools to prepare, enrich and deliver lessons. The results indicate that there is disparity between male and female teachers in the application of ICT tools for teaching. This is because female teacher the results show that more female teachers use ICT tools for teaching than male teachers in Primary. This finding agrees with Adams (2002) who found that female teachers applied ICT more than male teachers in basic schools. For research activities, about 58% and 50% of male and female teachers, respectively use ICT tools to do research in JHS (Figure 3). In Primary, more female teachers (50%) use ICT tools to carry out research compared with male teachers (42%).



Source: Connect for Change Education Ghana Alliance (C4C-EGA), 2014.

Figure 3: Gender and use of ICT for teaching and research activities

CHALLENGES

Notwithstanding the important role and obvious need for mainstreaming ICTs in teaching and learning, many factors constitute constraints to its use at basic school level. Such factors include lack of electricity/power, poor internet access, and lack of computer laboratories. Also, insufficient number of computers, poor technical know-how and capabilities of teachers to use ICT for teaching and research are other factors identified as facing the integration of ICT in education. These challenges if not addressed are likely to thwart effort geared at integrating ICT into the educational system in Ghana. This is observed by Lundell and Howell's (2000) study of South

African schools where they found that the lack of computer skills and knowledge prevent schools to effectively do teaching and learning with computers.

DISCUSSION

Even though, the Government of Ghana recognizes the need for ICT in education, the state of ICT infrastructure and tools on the ground is not encouraging as access is below standard and school needs compared with other developing countries. This implies that schools in these regions are in the early phase of adopting ICT. Also, the evidence gathered from the study suggests vast disparity in the provision of ICT tools and infrastructure between Primary and JHS. The study showed that there are more ICT tools and equipment at the JHS compared to the Primary school. This is contrary to our expectation because experience has shown that pupils learn better at the tender age than their youthful/adult age (Kraemer, Dedrick, & Sharma 2009). Hence, supply of ICT tools should rather focus more at the Primary and elementary level so that pupils can begin to be abreast with the use of technologies.

Since accessibility and utilization of any resource is dependent on availability, the fundamental fact is that ICT has not been used effectively for teaching and learning. This is because many of the schools especially do not have ICT tools and equipment and the few schools with ICT tools and equipment complained of inadequacy. For instance, in 628 schools surveyed, a total of 3,217 computers are provided for pedagogical and administration use to a population of over 100,000 pupils. The availability of some of the ICT tools has been possible through the efforts of the Ghana Investment Fund for Electronic Communication (GIFEC), Partnership for Education Grant in Ghana (GPEG) and a number of civil society organizations.

The proportion of computers for administration use is very poor and this slows down communication between schools and the outside world. It also affects decision making and implementation of education related activities in schools and contributes to high ICT illiteracy rate. The learner-to-computer ratio is about 189 pupils chasing every single computer. The inadequacy of computers in Primary school suggests that pupils face challenges in accessing ICT tools for learning. This also puts computers at high risk of damage since many hands are manipulating them. It also means that time on task is limited per student to enhance meaningful learning. This is consistent with Buabeng-Andoh's (2012b) study of some Ghanaian second cycle schools in Ghana.

However, teachers' access to ICT tools is encouraging as the study shows a ratio of 2:1. It means that teachers have better access to ICT tools as compared to learners probably due to computers supplied to teachers pursuing distance education and the distribution of laptops to teachers under the "teacher laptop and ICT Project" of the Ministry of Education. It is also commendable that civil society organizations such as Savana Signatures, Ibis in Ghana, Ghana Information Network for Knowledge Sharing, Producers Enterprises Promotion Center, Women and Development Projects, World Vision, EDUKANS, International Institute for Communications and Development, Discovery Learning Alliance, Pencils of Promise, rLG and multilateral organizations such as UNICEF have been instrumental in the provision of ICT tools and equipment to schools as well as building the capacity of teachers and pupils. All the efforts or contributions of these CSOs are geared towards the realization of the ICT policy.

Despite teachers' access to ICT tools such as computers, the ability to use them to teach is weak. The evidence suggests that the capacity of teachers to effectively deliver in ICT is low because of lack of regular training and poor internet access to do research. This suggests that policy and decision makers perhaps are putting more emphasis on availability rather than productivity.

CONCLUSION AND RECOMMENDATIONS

Although, many schools lack computers, internet access, electricity/power, among others, ICT tools use continues to be a distant dream. A quantum leap of successes in the use of ICT for teaching, learning and research can be achieved if all stakeholders carefully integrate computers and internet into schools. This is because computers when connected to the internet will aid teachers and pupils to have access to volumes of educational resources on-line rather than stocking libraries with books, which sometimes are not properly handled by users. Also, in order to ensure that the “ICT for Accelerated Development (ICT4AD) Policy”, the “ICT in Education Policy” and the “Basic School Computerization policy” are effectively implemented, the study recommends a strong, vibrant and sustainable Public-Private Partnership among key educational stakeholders including government, private sector and civil society organizations to map out plans and strategies to seriously tackle the problems hindering the smooth integration of ICT in the education system.

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