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ICT Usage in Senior High School Education in Ghana: Effects of Demographic Antecedents

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Abstract

This study examines the factors that influence ICT use in secondary schools in Ghana, the progress which the usage of ICT has brought into learning outcomes and teaching productivity as well as related challenges in Ghanaian second cycle institutions. Embedded on a quantitative method, the study used a sample size of forty-six (46) teachers and two hundred and ninety-four (294) students. A questionnaire and documentary review were the instruments used for the collection of data, drawing its conceptual foundations from e-services and supplementing this from ICT for education literature.

The study indicated a positive relationship between ICT usage, teaching and learning. Thus, the more teachers and students used ICT, the better their teaching activities and learning productivity became enhanced. However, lack of adequate computers, other multimedia apparatus and constant power supply were the important performance antecedents impeding utilization of ICT in Ghanaian senior high schools.

Underpinned by the findings, the study recommended among others: an effective implementation of ICT usage in the learning environment as proposed by the country's educational reform programmes and the "one computer per child" policy; provision of computers in second cycle institutions in the classrooms and not limited in the computer laboratories; and adequate technical support given to both teachers and students to make ICT usage relatively easier for pedagogical purposes.

Keywords: Second Cycle Institutions, Teachers, Students, ICT Usage, Pedagogy, Antecedents, Policy

Introduction

Globalization and technological change are processes that have accelerated in tandem over the past fifteen years, and have created a new global economy "powered by technology, fuelled by information and driven by knowledge"[1]. Information communication technology (ICT) is indispensable and has been accepted as part of the contemporary world, especially in the industrialized societies. In fact, African cultures and societies in general and Ghana in particular have adjusted or are still adjusting their economies to meet the challenges of the knowledge age [2]. The emergence of this new global economy has serious implications for the nature and purpose of government (e-governance), its administration (e- Administration), the services it provides to the citizens (e-Public Service), businesses (e-business or e-commerce) and education (e-learning). The contemporary society is marked by a growing need for information skills at all levels, including the pre-tertiary schools, universities, workplace and ordinary life [3]. Ghana's policy goal for ICT in education aims at producing "…right types of skills and human resources required for developing and driving Ghana's information and knowledge-based economy and society"[4]. The government thus introduced ICT usage in the educational milieu in order to promote effective teaching and learning, while producing citizens with relevant ICT skills to fit into the knowledge economy of the 21st century.

Statement of the problem

The computer and its related technologies have become a motivating tool for teaching and learning in schools. The internet allows cost-effective information delivery services, collaborative and distance education, more than has ever been imagined [5]. Evidence from literature proves governments in developing countries have been implementing initiatives on ICT integration in education at both secondary and tertiary levels. However, Research on ICT use in education in developing countries has primarily, focused on tertiary education [6]. While a conceptual model of the adoption process in developed countries has been widely studied, coupled with much research on ICT usage in second cycle education, not a great deal has been conducted in developing countries, especially in Ghana where ICT penetration rate is rather low. This study is positioned to fill that research gap by seeking to find the factors that influence ICT use in secondary schools, its benefits, challenges and how it affects teaching and learning.

Based on this premise, the study attempted to find answers to the following questions;

1. What factors influences the use of ICT in secondary schools in Ghana?
2. How does ICT use affect teaching and learning in second cycle schools?
3. How has the use of ICTs in education benefited Ghanaian second cycle schools?
4. What challenges undermine the use of ICTs in secondary schools in Ghana and how can they be mitigated?

Also, the following hypotheses were investigated by the researchers;

Hypothesis

H_0: The use of ICTs does not significantly improve learning in second cycle institutions in Ghana.
H_1: The use of ICTs significantly improves learning in second cycle institutions in Ghana.
H_0: The use of ICTs does not significantly improve teaching in second cycle institutions in Ghana.
H_2: The use of ICTs significantly improves teaching in second cycle institutions in Ghana.

Significance of the Study

There have been many studies into the factors that influence the successful or failure of ICT integration in education worldwide. However, current studies have been skewed towards the tertiary institutions and mostly in the advanced countries. According to [6], research on ICT use in education in developing countries has primarily focused on tertiary education. Most studies undertaken in the developed countries suggest that, the use of ICTs improve teaching and learning [7]. However, not much empirical studies have been undertaken in developing countries in general, and Ghana, to be specific. Ghana's ICT in education policy is nascent and as with most African-related policies, implementation is an issue. It is after further investigations, modification and recommendations that real potentials of this policy can be actualised. Against this background, the purpose of this study was to investigate the antecedents that influence ICT use in secondary schools in Ghana, the progress which the usage of ICT has brought into learning outcomes and teaching productivity in Ghanaian second cycle institutions. It is also anticipated that the outcome of the study could form the basis for identifying areas of deficiency or improvement in the use of ICT in Ghana's second cycle schools.

Review of Relevant Literature

The study reviewed relevant literature on the concept of ICT, rational for ICT integration in public and secondary education, effects of ICT use on teaching and learning, benefits of using ICT in teaching and learning, and challenges of ICT usage in secondary education. A conceptual framework was also developed for this study.

The concept of Information and Communication Technology (ICT). The shift of the world economy from goods to services and the rapid expansion of information economy and electronic networks convergence,encapsulate the concept Information and Communication Technology (ICT). ICT has been defined by [8] as "those technologies that are used for accessing, gathering, manipulating and presenting or communicating information" (pp. 4-5). They could include hardware (computers and other devices); software applications; and connectivity (access to internet, local networking infrastructure, video- conferencing" (pp. 4-5). ICT then becomes a technology that supports activities involving information (gathering, processing, storing and presenting) which can also involve collaboration. At the senior high school level, there is the general aim of developing interest and use of ICT for learning in other subjects, knowledge acquisition for application of ICT in education and business, and use of the internet to communicate effectively [8].

Rationale for introduction of ICT in the public sector and secondary education. The motivation for introducing ICT in public sector (organisations) is its promise to deliver a number of benefits to these organisations and their clientele. This is backed by a project for setting up computer laboratories in all science schools in the country. A development which has led to a significant number of computers being installed in schools across the country. A computer levy of GH¢30.00 (USD$3.20) is allowed to be collected in most secondary schools [9][10]. Furthermore, a curriculum has been developed for ICT training and examination at the Senior Secondary School Certificate Examination (SSSCE) Level. In addition, every effort is being made to provide telephone facilities to all senior secondary schools and training colleges to enable them have access to the internet [9]. Stakeholders believe that these efforts are to improve education delivery as has been the case in the developed world.

Effects of ICT use on teaching and learning. The use of ICT seems to have some positive effects on both teaching and learning. Notable positive effects that result from the use of ICT in teaching include; improvement in research work, reduction of time and effort spent in preparing lesson notes, improvement in quality of lesson notes, provision of platform for interactive and collaborative work and emphasizing student-centered approach to teaching. [11] continued to show that, when learners are able to use ICT based on their own particular style of learning and processing of information, their motivation, initiative and resultsimprove. [12], apart from confirming that the effective use of technology requires the pedagogical paradigm shift toward more student-centered learning, further suggested that three broad sets of changes should accompany this shift which may affect teacher and teaching, learners and learning and teachers' interactions with students and parents.

Effects of ICT use on teachers and teaching. Professional development of teachers is the heart of any successful technology and education program. According to [13], professional development has a significant influence on how well ICT is embraced in the classroom. However literature reveals that teachers' training programmes often focus more on basic literacy skills and less on the integrated use of ICT in teaching [14]. Teachers have received little training in this area in their teacher education programs. Opportunities to practice using technology during their teacher training programs will enable teacher trainees to be abreast of ways in which technology can be used to augment their classroom activities and have adequate preparation to use ICTs in their classes [15].Another area ICT has affected is increased efficiency in planning and preparations of lesson notes and work [7]. Other studies also substantiate that teachers can use ICT to plan lessons more efficiently and more effectively [16].

Effects of ICT use on learners and learning. Research in the learning sciences has established that constructivist theories of learning provide a more reliable understanding of how humans learn than previous behaviourist frameworks [12]. Studies have identified a variety of constructivist's learning strategies such as students

working collaboratively in groups or students creating products that represent what they are learning, which in turn change the way students interact with the content [17]. Using ICT as a tool for learning enables students to:

1. efficiently and effectively access digital information to assist with investigating issues, solveproblems, and make decision.
2. produce creative solutions to support learning and develop new understandings in areas oflearning.
3. communicate, share and work collaboratively in local and global environments.
4. develop new thinking and learning skills to support learning [18].

Benefits of using ICT in teaching and learning. It would be reasonable to say that ICT was introduced in schools to increase student engagement, motivation, and attendance—key requisites to improved performance. According to [19], ICT-based learning environments offer students more autonomy over their learning processes. They have a substantial amount of control over their rate of learning and learning sequences, which better positions them to make judgments about their progress, monitor their own learning needs and construct their own knowledge based on the information available. This ultimately enables the adoption of a more favourable approach towards learning and operates more efficiently in the learning environment. ICT has the capability of engaging students in instructional activities to increase their learning, and also assist them to solve complex problems to enhance their cognitive skills [20]. Many sites offer free downloadable resources than can be adapted for one's own use [21]. [22] reiterated the need for schools to provide ICT capacity to ensure that all teachers and students have immediate access to all software that is required to support the curriculum and provide adequate support to implement its use. According to researchers such as [23], ICT can also improve the efficiency of school administrative functions. The use of ICT has the tendency to increase transparency in assessment and evaluation procedures. For instance, assessments conducted using computers leave little room for manipulation of the grades by the marker, hence increasing the reliability of data [24]. [7] also indicated that an overwhelming majority (90%) of teachers in Europe use ICT to prepare their lesson; thus, making it more efficient and effective.

Challenges of ICT usage in secondary education. The use of ICT in the classrooms in developing countries has been challenging. Confidence, training and independent exploration on the part of teachers; lack of institutionally appropriate specialised technical support; lack of incentives participate in ICT use; high cost of innovation coupled with limited resources for both the institution and individual academics; lack of adequate ICT infrastructure [25], [26], [27], [28], [29]. Further challenges include loss of time to devote to research and other activities that lead to more tangible rewards, such as academic promotion and tenure; students' resistance to electronically-provided materials, due to loss of face-to-face interaction, lack of access to the required hardware, software and computing skills; academic members' perception of their ability to work effectively with technology (self-efficacy) [30], [31], [33].

Conceptual Framework. There are a number of factors which have been identified that might influence and support teachers and students in using ICT in the classroom. Teachers and students characteristics such as individual's educational level, age, gender, educational experience, experience with the computers for educational purposes and financial position can influence the acceptance and use of an innovation [14]. Based on Afshari's postulation, a research model as depicted by Figure 1 was developed for this study. The model contains two dependent variables, teaching and learning which are influenced by ICT usage. ICT sage in turn is dependent on six independent factors (school type, gender, age, class level, educational level and years of experience).

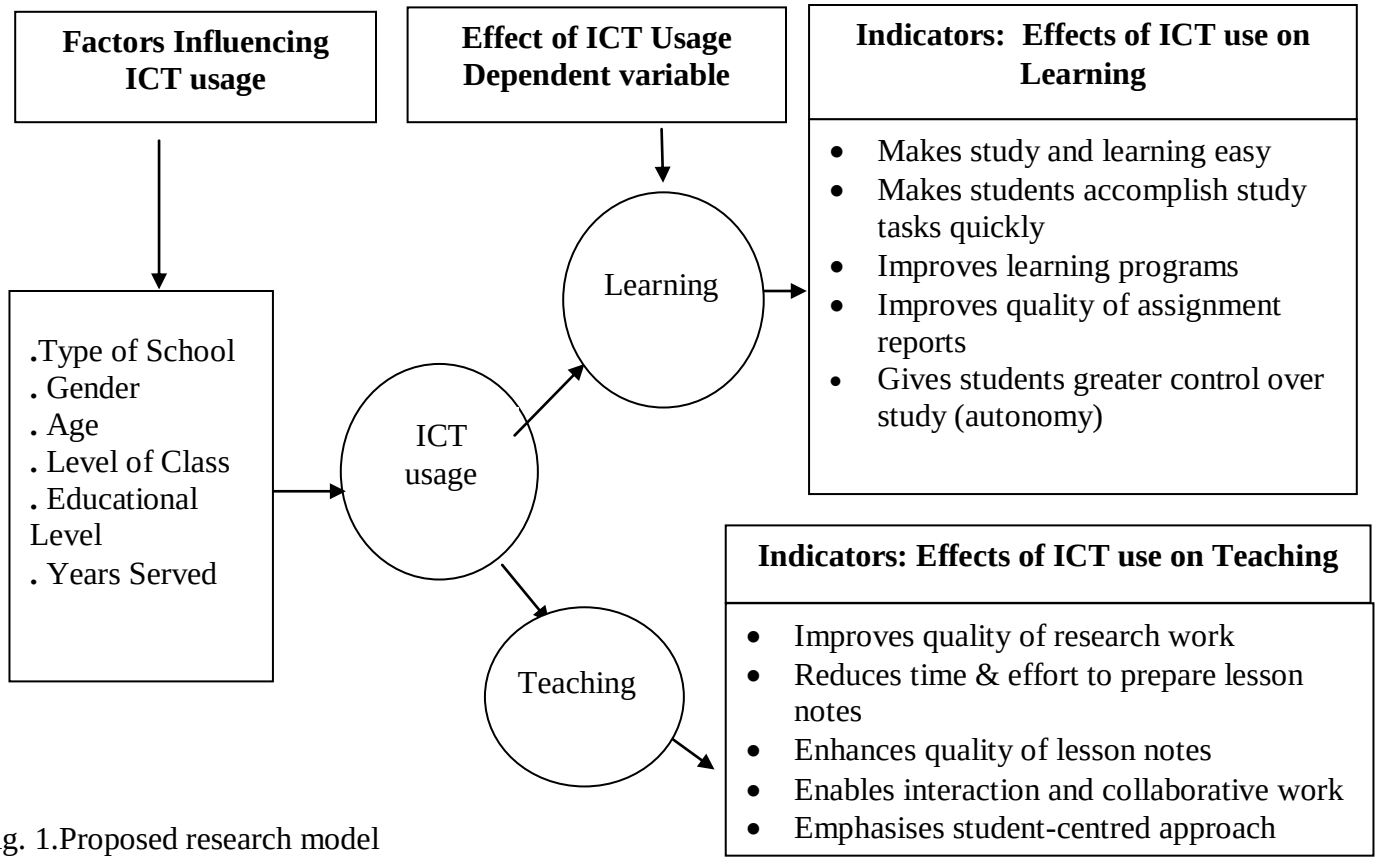

Fig. 1.Proposed research model

Methodology

The study was conducted in three (3) second cycle institutions in the Tema Metropolitan Assembly in the Greater Accra Region. These schools were selected, in the first place, for ease of accessibility because they are evenly dispersed within the Metropolis. Secondly, the ICT facilities and departments in these schools were functioning and the ICT applied in the curriculum. Both quantitative and qualitative approach was adopted. These approaches were adopted with the belief that they complement each other and minimize inherent weaknesses in them which may influence the results of the study.

The study targeted the population of teachers and students in Tema Metropolitan Assembly. A total sample size of three hundred (300) students and sixty (60) teachers was selected to answer the research questionnaires. Out of the 360 respondents sampled, 341 were able to complete the instrument and returned them. This comprises 295 from the students (representing a response rate of 98.3%) and 46 from the teachers (representing a response rate of 76.7%). The 360 respondents sampled were large enough to require the use of questionnaires, which served as most sufficient ways to collect data for this study.

Results of the Study

The study sought to assess ICT usage in senior high school education: effects of demographic antecedents. This section presents factors that have influence on students and teachers' knowledge of ICT and the extent of its usage. The schools of the respondents were Tema Methodist Day Senior High School (MEDASS), Tema Presbyterian Senior High School (PRESEC-TEMA), and Tema Secondary School (TEMASCO).

Demographic Profile of Respondents

Table 1. Demographic details of the student respondents

Item		Frequency	Percentage%
School	MEDASS	100	33.9
	PRESEC	96	32.5
	TEMASCO	99	33.6
Gender	Female	144	48.8
	Male	151	51.2
Level	SHS 1	40	13.6
	SHS 2	99	33.6
	SHS 3	156	52.9
Age	15-20	272	92.2
	Over 20	23	7.8
N		295	

Table 1 presents the demographic details of the students used for the study. In all 100 (33.9%), 96 (32.5%) and 99 (33.6%) respondents were from MEDASS, PRESEC-TEMA, and TEMASCOrespectively. Even though the representation was not equal, it can be said to be even since the percentage differences among them do not exceed 2%. There was however a highly uneven representation as far as the level of class was concerned with year 3 being the modal level of class. One hundred and fifty-six (156) representing (52.9%) of the respondents were in their third year of secondary education while the remaining were 40 (13.6%), 99 (33.6%) were in their first and second years. Gender was almost even with 144 (48.8%) being females and the remaining 151 (51.2%), males. As many as 272 (92.2%) of the student respondents were between the ages of 15 and 20 years with only 23 (7.8%) being over 20 years.

Table 2. Demographic details of teachers' respondents

Item		Frequency	Percentage%
School	MEDASS	18	39.1
	PRESEC	15	32.6
	TEMASCO	13	28.3
Gender	Female	13	28.3
	Male	33	71.7
Highest Class handled	SHS 1	4	8.7
	SHS 2	8	17.4
	SHS 3	11	23.9
Age	30 – 50	36	78.3
	Over 50	1	2.2
	Under 30	9	19.6
Educational level	Higher Degree	27	58.7
	Specialization	2	4.3
	Undergraduate Degree	17	37
Years Served	Below 5	10	21.7
	5 – 10	11	23.9
	11 – 15	8	17.4
	15 – 20	13	28.3
N		46	

With regards to the teacher respondents, out of the 46 respondents, 18 (39.1%), 15 (32.6%) and 13 (28.3%) were from MEDASS, PRESEC and TEMASCO respectively, as Table 2 showed. Only 13 (28.3%) of the respondent teachers were females with the remaining 33 (71.7%) being males. The modal age group of the teacher respondents was between 30 and 50 years which recorded 36 (78.3%) of the respondents. The remaining respondents were 9 (19.6%) and 1 (2.2%) being under 30 years and over 50 years respectively. Twenty-seven (58.7%) of the teachers indicated their highest educational level as a higher degree whilst 17 (37.0%) were indicated undergraduate degree.

The remaining 2 (4.3%) indicated their highest educational level as a specialization. The highest class handled by the teachers have been SHS 1 (4 representing 8.7%), SHS 2 (8, representing 17.4%), SHS 3 (11, representing 23.9%) and SHS 4 (17, representing 37.0%). Six (13.0%) of the teachers did not indicate any level of class. These can be deemed to be handling general and administrative issues in the school. The highest number of 13 (28.3%) of the teachers have served for between 15 and 20 years. Only 10 (21.7%) of the teachers indicated serving for less than 5 years. Table 4.2 presents the personal profile of the teachers' respondents used for the study.

Table 3a. Influence of gender on knowledge of computer

Gender		Knowledge of computer		Total
		No	Yes	
Female	Count	12	132	144
	% within Gender	8.3%	91.7%	100.0%
Male	Count	2	149	151
	% within Gender	1.3%	98.7%	100.0%
Total	Count	14	281	295
	% within Gender	4.7%	95.3%	100.0%

Out of the 295 students, only 14 (4.7%) indicated no knowledge of computers. Upon a more detailed analysis, knowledge of computer was found not to depend on any of the independent variables of the students except gender. As indicated in Table 3a, whilst only 2 (1.3%) of the male students indicated "No" for knowledge of computer, as many as 12 (8.3%) of the female students indicated same.

Table 3b. Dependency test for Knowledge of Computer on Gender

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig (1-sided)
Pearson Chi-Square	8.010[a]	1	.005		
Likelihood Ratio	8.788	1	.003		
Fisher's Exact Test				.005	.004
N of Valid Cases[b]	295				

Table 3b presented the chi-square dependency test results for knowledge of computers and gender. The significance dependency of knowledge of computer on gender at 5% significance indicated by both the Pearson chi-square and the likelihood ratio was confirmed by the Fisher's exact test at both 1- and 2-tail levels. P-values for both the asymptotic significance for 2-sided test, the exact significance for 2-sided test and that for the 1-sided test are all less than 0.05 signifying significant dependency of knowledge of computers on gender at 5% significance. The result suggests a significant likelihood of knowledge of computers being determined by the gender of the student.

Table 4. Number of computers in school

	Frequency	Percentage%
NR	1	0.3
Less than 5	56	19
5 - 20	44	14.9
Above 20	194	65.8
Total	295	100

Only 1 (0.3%) of the students indicated that there were no computers in his/her school. The result suggests the existence of computers on the various campuses of the surveyed schools. As indicated in Table 4, 19.0%, 15.0%, and 66.0% of the valid responses indicated that the number of computers in their school to be less than 5, between 5 and 20, and more than 20 respectively.

Table 5a.Influence of type of school on number of computers in school

			Number of computers			Total
			5 – 20	Above 20	Less than 5	
School	MEDASS	Count	3	97	0	100
		% within School	3.0%	97.0%	.0%	100.0%
	PRESEC	Count	39	3	54	96
		% within School	40.6%	3.1%	56.2%	100.0%
	TEMASCO	Count	2	94	2	98
		% within School	2.0%	95.9%	2.0%	100.0%
Total		Count	44	194	56	294
		% within School	15.0%	66.0%	19.0%	100.0%

Table 5b Test for the dependency of number of computers in school on type of school

	Value	Df	Asymp.Sig. (2-sided)
Pearson Chi-Square	2.518E2[a]	4	.000
Likelihood Ratio	295.055	4	.000
N of Valid Cases	294		

0 cells (.0%) have expected count less than 5. The minimum expected count is 14.37.

Tables 5a and 5b presented the cross tabulation and the test of dependency for number of computers and type of school. When subjected to a dependency test, the number of computers in school was found to significantly depend on the type of school at 5% significance level. The Pearson chi-square dependency test indicated a Pearson statistic and corresponding p-value of 2.518 and 0.000 respectively ($N = 294$, $df = 4$, $\alpha = 0.05$). The likelihood test also indicated a similar result with the likelihood ratio and its corresponding value being 295.055 and 0.000 respectively. The dependency of the number of computers on the type of school is even highlighted in the cross tabulation of number of computers and type school. Whilst 97.0% and 95.9% of the valid responses in MEDASS and TEMASCO indicated number of computers to be more than 20, 56.2% and 40.6% of respondents from PRESEC-Tema indicated less than 5 and between 5 and 20 respectively.

Table 6. Classes at which computers and related ICT tools are used

Classes / Subject	Frequency	Percentage of Respondents
Computer class	271	91.9
Mathematics	9	3.1
Science	56	19.0
Social sciences	12	4.1
Languages	7	2.4
Arts	13	4.4
Music	23	7.8

Irrespective of the type of school, the computers and related ICT gadgets were found to be mostly used during the computer class as Table 6 showed. As many as 271 (91.9%) of the respondents indicated the use of the computers during the computer class whilst 56 (19.0%), 23 (7.8%), 13 (4.4%), 12 (4.1%), 9 (3.1%) and 7 (2.4%) indicated usage during science, music, arts, social sciences, mathematics and language classes.

Tables 7a and 8a presented the cross tabulation of the use of ICT application for doing assignment, lessons, homework and type of school respectively. Also, Tables 7b and 8b presents the tests of dependency of the use of ICT application for doing academic workon the type of school and that of level of class respectively.

Table 7a. School and usage of ICT applications for assignments, lessons and homework

			Usage of ICT application No	Yes	Total
School	MEDASS	Count	45	55	100
		% within School	45.0%	55.0%	100.0%
	PRESEC	Count	49	47	96
		% within School	51.0%	49.0%	100.0%
	TEMASCO	Count	66	33	99
		% within School	66.7%	33.3%	100.0%
Total		Count	160	135	295
		% within School	54.2%	45.8%	100.0%

Table 7b. Test of dependency result for usage of ICT applications on type of school

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.995[a]	2	0.07
Likelihood Ratio	10.135	2	0.07
N of Valid Cases	295		

Most of the students were also found not to use ICT application in doing assignments, lessons and homework as wells as ICT resources for collaborative school works as Table 7a showsed. As many as 160 (54.2%) of the total studentssampled indicated not using ICT applications in doing assignments, lessons and homework; and for collaborative work respectively. Whilst 55.0% of the students from MEDASS do use ICT applications for such purposes, 51.0% and 66.7% of the students from PRESEC-TEMA and TEMASCO respectively do not.With regards to the use of ICT resources for collaborative work, it was only significantly dependent on the level of class and not on type of school, gender or age of the student. Most of the students who do not use ICT resources for collaborative school work were found to be in SHS1 whiles the SHS 3 students made the most use of ICT resources for collaborative schools work.

Table 8a. Form and usage of ICT applications for class assessment, lessons and homework

			Usage of ICT applications		Total
			No	Yes	
Level	SHS 1	Count	20	20	40
		% within Level	50.0%	50.0%	100.0%
	SHS 2	Count	45	54	99
		% within Level	45.5%	54.5%	100.0%
	SHS 3	Count	95	61	156
		% within Level	60.9%	39.1%	100.0%

Table 8b. Test of dependency result for usage of ICT applications on level of class

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.154[a]	2	.046
Likelihood Ratio	6.168	2	.046
N of Valid Cases	295		

The significant dependency of use of ICT resources on level of class was confirmed by both the Pearson chi-square and the likelihood ratio tests as indicated in table 8b.When subjected to the dependency test, the use of ICT applications for doing assignments, lessons and homework was found to depend on both the type of school and the level of class of the students. The Pearson chi-square statistics and their corresponding p-values for the dependency test results for the two as presented in tables 7b and 8b are as follows:

1. Dependency of ICT usage on type of school: 9.995 and 0.07 respectively ($N = 295$, $df = 2$, $\alpha = 0.05$).
2. Dependency of ICT usage on level of class: 6.154 and 0.046 respectively ($N = 295$, $df = 2$, $\alpha = 0.05$)

Influence of demographic characteristics on usage of ICT by Teachers

Table 9. Extent of ICT usage by teachers

ICT Usage Indicator	Mean	Std. Dev.
The use of ICTs have improved e-competence	4.04	1.01
ICTs has enhanced career growth and professional development	3.89	1.197
ICTs have made me more skilful and effective in teaching	3.85	1.173
Frequent usage has given a positive ICT attitude	3.74	1.324
Using ICT to aid planning and development of lessons	3.52	1.188
Facilitates students to use ICTs	3.43	1.241
ICT has changed my classroom role from information dispenser and controller to facilitator	3.33	1.248

Table 9 showed that teachers put ICT into great use for teaching purposes. All the ICT usage indicators employed by the study registered mean scores that were above the neutral score of 3 out of a scale of 1 (Low Usage) to 5 (High Usage). The aggregate mean score (standard deviation) recorded for all the usage indicators employed by the study was 3.69 (0.265).There was also high consistency in the ratings of the usage indicators for the teachers an indicated in the Cronbach's alpha value of 0.916. This suggests that, the probability of getting a similar rating from a teacher was observed to be 91.6%. The extent of ICT usage was also found not to depend on any of the teachers' independent variables of the study like gender, age, highest level taught by the teacher, type of school, number of years in service, and educational level.

Table 10a. Level of class and usage of ICT resources for collaborative school work

			Use of ICT resources		Total
No	Yes				
Level	SHS 1	Count	32	8	40
		% within Level	80.0%	20.0%	100.0%
	SHS 2	Count	52	47	99
		% within Level	52.5%	47.5%	100.0%
	SHS 3	Count	93	63	156
		% within Level	59.6%	40.4%	100.0%
Total		Count	177	118	295
		% within Level	60.0%	40.0%	100.0%

Table 10a presented the use of ICT resources for collaborative school work and the level of class of students. Majority of the students (60%) do not use ICT resources for collaborative school work. Specifically, SHS1 students with the SHS 3 students making the most use of ICT resources for collaborative schools work.With regards to the use of ICT resources for collaborative work, it was only significantly dependent on the level of class and not on type of school, gender or age of the student.

Table 10b. Test of dependency for ICT usage resources for collaborative school work

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.981[a]	2	.011
Likelihood Ratio	9.598	2	.008
N of Valid Cases	295		

0 cells (.0%) have expected count less than 5. The minimum expected count is 16.00.

Influence of type of school on ICT Hardware Availability and Usage in School

Table 11. Mean scores and standard deviations for basic computer applications

Basic computer applications	Mean	Std. Deviation
Basic internet browsing	3.15	1.595
Basic E-mailing	2.83	1.601
Spreadsheet	2.82	1.287
Word processing – prepare papers	2.73	1.42
Use of chatting platform	2.62	1.575
Presentation tools (PowerPoint)	2.14	1.3
Graphics	1.87	1.177
Web page designing	1.63	1.073

Table 11 showed that for basic – simple-use of applications for purposes other than classroom learning, basic internet browsing recorded the highest mean score of use by students. In all, the mean (standard deviation) score of basic computer application usage was 2.47 (0.532) which indicates a level below the average score of3.0 The only basic computer application that achieved a mean score of greater than the average was basic internet browsing which recorded a mean score (standard deviation) of 3.15 (1.595). Basic computer applications were found to be basic e-mailing and spreadsheet which recorded mean scores (standard deviations) of 2.83 (1.601) and 2.83 (1.287) respectively. The least used basic computer applications were found to be presentation tools (PowerPoint), graphics, and web page designing which recorded mean score (standard deviations) of 2.14

(1.300), 1.87 (1.177) and 1.63 (1.073) respectively. The findings on the basic computer applications usage by the students was highly consistent as indicated in the Cronbach's alpha value of 0.857. The result suggests that internal consistency for the usage of the basic computer application is 85.7%.

Table 12a. Gender and mean aggregate skill of students

			Mean Aggregate Skill Rating					Total
			No Capability	Fair	Good	Very Good	Excellent	
Gender	Female	Count	41	59	32	11	1	144
		% within	28.5%	41.0%	22.2%	7.6%	.7%	100.0%
	Male	Count	10	42	52	42	5	151
		% within	6.6%	27.8%	34.4%	27.8%	3.3%	100.0%
Total		Count	51	101	84	53	6	295
		% within	17.3%	34.2%	28.5%	18.0%	2.0%	100.0%

Table 12b. Test of dependency of mean aggregate skill of student on gender

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	47.126[a]	4	.000
Likelihood Ratio	49.988	4	.000
N of Valid Cases	295		

As indicated in table 4.12a, the aggregate skill level of the female students is relatively lower than that of their male counterparts. For instance, whilst 28.5% and 0.7% of the females recorded "No Capability" and "Excellent", 6.6% and 3.3% of the males recorded the same ratings respectively. As indicated in table 4.12b, the registered Pearson chi-square and the corresponding p-value for the dependency of level of skill in the use of the basic computer applications on gender were 47.126 and 0.000 respectively ($N = 295$, $df = 4$, $\alpha = 0.05$) suggesting a significant dependency at 5% significance level.

Table 13. Test of dependency of mean aggregate skill of student on type of school

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.207[a]	8	.001
Likelihood Ratio	29.119	8	.000
N of Valid Cases	295		

As indicated in table 13, the registered Pearson chi-square and the corresponding p-value for the dependency of level of skill in the use of the basic computer applications on type of school were 27.207 and 0.001 respectively ($N = 295$, $df = 8$, $\alpha = 0.05$) suggesting a significant dependency at 5% significance level.

Table 14 Students' perception thatthe computer provides attractive learning environment

Rating	Like Computer	Enjoy using computer	Attractive learning environment
Not very much	16.3	6.8	6.1
Not much	19.7	7.8	7.1
Not sure	4.7	3.4	5.4
Much	15.3	14.2	17.6
Very Much	44.1	67.8	63.7
Total	100.0	100.0	100

Notwithstanding the limited availability, access and usage of ICT by the students, most of the students indicated they like and enjoy using the computer apparently because computer provides an attractive learning environment for them. Table 14 showed that 59.4% of the respondents liked computers "much" or "very much" as against 26.0% who did not; a high percentage (82.0%) enjoyed using computers "much" or "very much" as against 14.6% who were nonpartisan with computer usage; and finally an overwhelming 81.3% of respondents agreed that computer provided an attractive learning environment whiles 13.2% did either "Not very much" or "Not much" agree with this assertion.

Regression analysis of Effect of ICT on learning

Table 15a.Model summary for effect of ICT use on learning

Model	R	Square	Adjusted R Square	Std. Error of the Estimate
1	305	.093	.090	.8317793

a. Predictors: (Constant), Purpose and Degree of ICT usage in schools
b. Dependent Variable: Effects of ICT usage on learning

Table 15b. ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	20.718	1	20.718	29.945	.000
	Residual	202.714	293	.692		
	Total	223.432	294			

a. Predictors: (Constant), Purpose and Degree of ICT usage in schools
b. Dependent Variable: Effects of ICT usage on learning

Table 15c. COEFFICIENTS

Model		UnstandardizedCoefficients B	Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	3.179	.116		27.286	.000
	Purpose and Degree of ICT usage in schools	.244	.045	.305	5.472	.000

Dependent Variable: Effects of ICT usage on learning

This section presents a test of the statistical significance of the effect ICT use has on teaching and learning. Tables15a-c presented the summary of the results of the simple linear regression of ICT usage on teaching and learning. A regression shows the significance of relationship between variables at a 95.0% confidence level. Also the study found a positive relationship between usage of ICT and learning from the linear regression analyses. In the first model, which had ICT usage as the independent variable and level of learning as the dependent variable, a positive coefficient of 0.244 for the independent variable which was significant at 5% significance level as indicated in the p-value of 0.000 was registered. This result suggests that students' use of ICT enhances their (students') learning activities. The predictive power of ICT usage is indicated by an R squared of 0.093 which was also found to be significant at 5% significance level indicated by the p- value of 0.000.

Effect of ICT on teaching

Table 16a Model summary for effect of ICT use on teaching

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.853[a]	.728	.721	.5023873

Predictors: (Constant), Degree of usage of ICT by Teachers

Table 16b ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29.660	1	29.660	117.515	.000
	Residual	11.105	44	.252		
	Total	40.765	45			

a. Predictors: (Constant), Degree of usage of ICT by Teachers

b. Dependent Variable: Effects of ICT use on teaching

Table 16c COEFFICIENTS

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	.586	.292		2.009	.051
	Degree of usage of ICT by Teachers	.829	.077	.853	10.840	.000

a. Dependent Variable: Effects of ICT use on teaching

In the second model, ICT usage was again used as the independent variable and level of teaching as the dependent variable. This also recorded a significantly positive coefficient of 0.829 for the independent variable, as indicated in Table 16c. This coefficient was significant at 5% significance level, indicated by the p-value of 0.000. The result further indicates that the more teachers use ICT, the more their teaching activities and functions are enhanced. The extent ICT usage could cause these effect is explained by the value of R squared of 0.728 which was also found to be significant ($p< 0.05$) as indicated in Table 16a.

Benefits of ICT Use to Teaching

Table 17. Areas in teaching that has benefited from ICT use

Benefits	Mean	Std. Deviation
Enhances research work	4.11	1.059
Reduces time and efforts	3.85	1.192
Improves lesson preparation	3.72	1.205
Enables interactions	3.50	1.188
Enables organized collaborations and team work	3.48	1.26
Enables adoption of student-centered teaching approaches	3.48	1.188
Supports differentiation and project based teaching	3.37	1.236

ICT use in second cycle institutions was found to have benefited teaching in several ways including research and teaching, interaction and cooperation of teachers, management of work, monitoring, and assessment of students among others. As indicated in Table 17, the surveyed teachers mostly agreed to the statements that the

use of ICT has enhanced research work and made it easy and faster; improved lesson preparation and development; enabled interaction with colleagues, superiors and parents of students; enabled the adoption of student-centered approaches in teaching; and has supported differentiation and project based teaching. However from Table 17, research for teaching is the area that scored the highest mean of 4.11. Supporting differentiation and project based teaching was the least identified area that has benefited from the use of ICT. This area registered a mean score of 3.37 which is proportional to a rating of neutrality. This was confirmed by the students' survey where 60.0 and 45.8% of the students indicated that they do not use ICT resources for collaborative school work; and for assignments, lessons and home works respectively. The degree of agreement to the various areas of teaching that has benefited from the use of ICT was highly consistent as indicated in the Cronbach's alpha of 0.906.

Benefits of ICT Use to Learning

Table 18. Areas in learning that ICT use has benefited

Benefits to Learning	Mean	Std. Deviation
Makes it easier to learn or study	3.99	1.038
Enables the accomplishment of study tasks more quickly	3.83	1.015
Enhances the effectiveness of learning activities	3.81	1.079
Improves the quality of assignment reports	3.8	1.117
Improves learning productivity	3.8	1.086
Gives greater control over studies	3.33	1.132

The benefits of the use of ICT were even higher with reference to learning than recorded in teaching. The aggregate mean score for the extent of agreement to the beneficial effects of ICT use to learning was 3.76 as against the 3.64 in the case of teaching. With exception of only the increase in control over studies which recorded the mean of 3.33, all the others recorded means that were above 3.5. Thus, the level of agreement was more skewed towards the score of 4, which denotes a rating of "Agree". Table 18 gives the detail scoring of the various benefits of ICT uses in learning. As indicated in the table, an area of learning that ICT was found to have greatly benefited was the ease in learning or study. This registered a mean of 3.99 rating in agreement of a maximum score of 5. The degree of agreement to the various areas of learning that has benefited from the use of ICT was highly consistent as indicated in the Cronbach's alpha of 0.895.

Demographic factors. On the gender factor, the results showed that gender was significant in the usage of ICT by students. In contrast, it had no influence on the teachers' extent of usage. This finding confirms an earlier one of [14] that individual characteristics such as gender can influence the ICT usage, in the case of students but not in the case of teachers.

The study also shows that the degree of computer (ICT) use for various purposes (informative functional and communication) is influenced by the age of students. Whereas 42 students between 15-20 years indicated they "often" use computers for the required purposes and 9 answered "very often", only 8 and 2 students above 20 years indicated "often" and "very often " respectively. This confirms the opinion that, users who are older are likely to use computers to a lesser extent [14]. The study of [22] that the degree of computer application in the classroom depends on some factors such as age is also in line with the present findings.

The use of ICT applications for doing assignments, lessons and homework was dependent on the level of class of students. This result may be due to the concentration of ICT use at the first year (level) of students' secondary education. The dependency of ICT usage on the level of class was 6.154 and 0.046 respectively ($N = 295$, $df = 2$, $\alpha = 0.05$). With regards to the use of ICT resources for collaborative work, it was the only one significantly dependent on the level of class. This finding is in line with that of [14] that individual's

educational level can influence acceptance and use of technology. The extent of ICT usage was also found not to depend on the teachers' educational level. The study showed there was no significant relation between the number of years teachers havebeen in service and ICT usage. This finding is in contrast to that of the [33], that teachers with fewer years served use computer more of the time.

Effect of ICT usage on Teaching. The result indicates a positive relation between ICT usage and teaching. That is the more teachers use ICT, the more their teaching activities and functions are enhanced. From the regression analysis, teachers use of ICT in teaching and other related assignments accounts for 72.8% of improvement in their teaching recording a coefficient of 0.829 which was significant at even 5% significance level as indicated in the p-value of 0.000. Hence the null hypothesis is rejected and the research hypothesis that the use of ICT significantly improves teaching in second cycle institutions in Ghana accepted. This result confirms previous studies on how ICT as a tool has been used to enhance service delivery in public organisations in general [34], and improve teaching where teachers provide powerful learning opportunities for students [12].

Effects of ICT usage on Learning. On the effects the use of ICT has on learning, students' use of ICT registered a coefficient of (0.244) at a p value of (0.000). This result shows that students' use of ICT in learning can significantly explain increase in their learning productivity. Therefore the null hypothesis could be rejected and the research hypothesis (the use of ICT significantly improves learning in second cycle schools in Ghana) accepted. However, it should be noted from the regression that, ICT use explains only 0.093 (9.30%) of the tested variables while the remaining 0.907 (90.70%) is explain by extraneous variables which are not covered in this study. Again, the low value of the R Squared may indicate that little of the variation of learning can be explained by the variation in ICT use. However this finding corroborates the report by [18] on the improved learning levels students attain with the use of ICT as a learning tool. The findings further agrees with conclusion that increase in five variables (level of multimodality, Man-machine interactivity, level of congruence, degree of reference modelling, quality of information representation) involved in psychological impact of ICT use leads to an increase in students level of learning. Even though, the explanatory power of ICT usage to improve learning productivity was recorded only 9.30%, yet it is significant. This may imply that students either underutilise ICT or do not fully apply it to their learning activities. This agrees with [12] finding that teachers can provide powerful learning opportunities when students are responsible for their own learning.

Benefits to Learning. On the use of ICTs application for various subjects taught in schools, the results showed there is increased productivity in learning. Subject areas that benefited from ICTs usage are the computer science class, Mathematics, Science, Social Sciences, Languages, Arts and Music classes. This finding agrees with [35] report that word processors which allow Students to formulate, edit and finalize text, in order to prioritize information could be used in English, history, mathematics, science and other subjects' presentation. Apart from these benefit students now find it easy to learn or study promptly, accomplish study tasks quickly, effectively organize learning activities, improve quality assignment reports, and have greater control over studies. The findings also indicate ease of learning or study to have greatly benefited from ICT use. This is represented by a mean of 3.99 rating in agreement of a maximum score of 5 and this was highly consistent with the Cronbach's alpha of 0.89. The overall benefit of improved learning productivity is consistent with the preceding research of [38] who concluded that students often learn more in less time, and that their learning productivity increases, when they use computer support appropriately.

Benefits to Teaching. The teacher respondents believe that the use of ICT has made research work easy and faster; improved lesson preparation and development; enabled interaction with colleagues, superiors and parents of students; and enabled the adoption of student-centered approaches in teaching. Even though much benefit has not been registered in the area of differentiation and project based teaching, one area which was found to have greatly benefited from ICT usage is research in teaching. These findings agree with earlier findings of [37] on transparency and reliability of assessments data if conducted using computers; it also mirrors [7], on increased.

efficiency and effectiveness on lesson and work preparation through the use of ICTs;[38], on the idea that ICT enables teachers to cooperate more and share curriculum plans with colleagues and managers

Challenges faced by Teachers and Teaching. The first and major challenge facing teachers in their use of ICT identified according to the findings is the absence of computers in the classrooms to enhance teaching and learning. Their opinion is that currently, computer availability may be limited only to the laboratories. On the other hand, for ICT to be used effectively in teaching and learning, it must also be made available in the classrooms. Teachers' readiness to integrate ICT in teaching became apparent from their request made for the provision of other multimedia facilities like overhead projectors.

To 74% of teachers, the second demanding challenge to ICT use is unreliable power supply. This seems to be getting worse due to recent frequent power cuts from the National grid. Knowledge and understanding of how these barriers prevent teachers from using ICTs may help educators come up with means to tackle them.

Challenges faced by Students and learning. On the issue of challenges faced by students, about 83% of the students who responded to the questionnaire indicated lack of adequate computers, computer laboratories and total absence of computers in the class rooms as the major problems they contend with, which confirms reports of previous studies done by [38]. Another finding relating to the limited number of computers is restriction of their usage mainly to computer classes. In addition to this is limited time period of ICT class lessons which debars them from having practical appreciation of the ICT in their studies. [30] explains that students' lack of time stems indirectly from educators, and teachers inadequate time in the use of ICT in teaching. Mostly students are now been taught about ICT with it limited to the teaching of mathematics, music and science. This may imply that, the Ghana government ability to implement the "one computer per child" policy would be a step in the right direction to solve these challenges.

Conclusion

The study has shown that, the null hypothesis (use of ICT does not significantly improve teaching and learning in second cycle schools in Ghana) did not hold and therefore was rejected. ICT can be a useful tool to enhance education delivery in Ghana, specifically teaching and learning. Notwithstanding the positive effects and the usefulness ICT has on teaching and learning, its application in subjects or lessons teaching in the secondary schools have not been extensive. Mostly students are now being taught about ICT limited to the teaching of mathematics, music and science. Lack of adequate computers, other multimedia apparatus (overhead projector) and non-constant power supply impede the maximum utilisation of ICT by students and teachers.

Therefore, contrary to the envisaged outcome as proposed by the model on effects of ICT use on teaching and learning, constructed for the study, ICT use in public Secondary Schools studied has seen little success which seems mostly to be present in the well-endowed schools.

Consequently, for the maximum benefits of the use of ICT in second cycle institutions, there is the need for the government, educators and stakeholders to ensure effective implementation of the ICT in Education programme in various schools across the country.

Recommendations

The study strongly recommends the following:

Firstly, the government, educators and other stakeholders must ensure the effective implementation of ICT usage in the learning environment as proposed by the 2007 Educational Reform Programme Committee, the Ministry of Education ICT for Education Programme, as well as the "one computer per child" policy.

Secondly, the government of Ghana through the Ministry of Education must put in place sustainable strategies and modalities to ensure adequate supply and provision of computers to the second cycle institutions in order to make computers available in the classrooms and not only limited to the Computer Laboratories.
Thirdly, the government and school authorities should partner with organisations (especially from the private sector) to organize training, workshops and in-service training on ICT for teachers. In addition, adequate technical support should be given to both teachers and students to make ICT use easy.
Finally, the government should assist schools to acquire power generators to provide continuous electricity where power from the national grid is cut off. However measures must be put in place to solve the intermittent supply of electricity permanently.

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