Impact Assessment of Information and Communication Technologies on Lesson Delivery and Students' Performance in Selected Tertiary Institutions in Ghana

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Abstract Information and Communication Technology has been part of Ghana's education system since 1995. However, despite the huge economic investments in providing computer infrastructure, rigorous assessment of the impacts of its integration in lesson delivery and academic performance of students has not been carried out to be able to judge its effectiveness and challenges in its usage that requires improvement(s). This assessment is even more crucial in higher institutions of learning where students are instructed in Information and Communication Technology to utilize them for the world of work. A concurrent triangulation design of the mixed method research design was used to examine the impacts of the integration of Information and Communication Technology on lesson delivery and student performance. A descriptive study method with interviews, questionnaire and observations as instruments were used in generating data from a random and a stratified random sample of 496 respondents from four tertiary institutions in Ghana. The quantitative data were analyzed using the Statistical Package for Social Scientists software while the qualitative data was analyzed via thematic analysis. The findings from the study revealed that Information and Communication Technology has impacted favourably on the lesson delivery of lecturers and students' learning outcomes in the areas of research, easy dissemination of information and assessment procedures. The study contends that to enhance the integration of Information and Communication Technology in the lesson delivery of lecturers and the academic performances of students, educational policies must be changed to factor in modern technological advancement to groom students with requisite skills to fit into the job market while professional technological training must be periodically organized for instructors to hone their skills to deliver effectively.

Keywords: information and communication technology, lesson delivery, student performance, tertiary institution, impact assessment

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1. Introduction

According to reference [1], preparing societies and governments for globalisation and information and communication revolution is one of the many challenges facing developing countries today. Policy-makers, business executives, non-governmental organisation (NGO) activists, academics and ordinary citizens are increasingly concerned with the need to make their societies competitive in the emerging information economy. Globalisation and technological change – a process that has accelerated over the past 15 years – has created a new global economy powered by technology, fuelled by information and driven by knowledge.

The appearance of this new global economy in many serious ways affects the modern society [2]. Educational, financial, social and professional development sectors have been benefiting from information and communication technologies (ICTs) for years. ICT has become one of the fundamental building blocks in education with the integration of ICT placed high on the educational agenda. To this end, many countries now regard the mastering of the basic skills and concepts of ICT as an inevitable part of the core of education. Various new models of education are evolving in response to the new opportunities that are becoming available by integrating ICT and in particular web-based technologies into the teaching and learning environment.

The effective integration of such applications, however, depends to a large extent on the teacher's familiarity and

ability with the information technology (IT) learning environment. Teachers need to know exactly how ICT is used as a teaching and learning tool, for their own purposes and to help students to use them. As the half-life of information continues to shrink and access to information continues to grow exponentially, schools cannot remain mere venues for the transmission of a prescribed set of information from teacher to student over a fixed period of time. Rather, schools must promote learning to learn, that is, the acquisition of knowledge and skills that make continuous learning over the lifetime possible. Futurist, [3], referred to the illiterate of the 21st Century not as those who cannot read and write, but as those who cannot learn, unlearn and relearn.

Concerns over educational relevance and quality coexist with the imperative of expanding educational opportunities to those made most vulnerable by globalisation – developing countries in general, low-income groups, girls and women, and low-skilled workers in particular. Global changes also put pressure on all groups to constantly acquire and apply new skills. [4] defines the requirements for education and training in the new global economy simply as "Basic Education for All", "Core Work Skills for All" and "Lifelong Learning for All".

ICTs, which include radio and television as well as newer digital technologies such as computers and the Internet, has been touted as potentially powerful enabling tools for educational change and reform. Often, ICT is seen as an indispensable tool to fully participate in the knowledge society. ICT needs to be seen as an essential aspect of the teaching's cultural toolkit, affording new and transformative models of development that extend the nature and reach of teacher learning wherever it takes place [5]. When used appropriately, different ICTs are able to help expand access to education, strengthen the relevance of education to the increasingly digital workplace, and raise educational quality by, among others, helping to make teaching and learning into an engaging active process connected to real life.

Although ICT is now at the centre of education reform efforts, not all countries are able to benefit from the developments and advances that technology can offer [6]. [7], in their consideration of Education for All (EFA), asserted that developing countries could dismiss the idea of ICT in schools in developing countries as a blind alley. [8] therefore, indicate that all but a handful of African countries already has an ICT policy in place or under development.

[8] mention that while some of the African countries define their national policies in terms of goals and implementation strategies for ICT in the education sector, nearly half the countries have chosen to develop an ICT policy that is specific to the education sector. For example, South Africa, with its extensive infrastructure and mature economy, is clearly an outliner in terms of being able to implement its ICT in education agenda. Thus, the new phase of ICT for education in Africa is occurring within national, and emerging regional, policy frameworks that are providing the basis for partnerships and donor participation. However, the experience of introducing different ICTs in the classroom and other educational settings in Ghana over the past several decades suggests

that the full realisation of the potential educational benefits of ICT is not automatic. The effective integration of ICT in the educational system is a complex, multifaceted process that involves not just technology, but also curriculum and pedagogy, institutional readiness, teacher competencies, long term financing, among others.

[9] specifies that constraining factors to the integration of ICT in education can be categorised in different ways. These include challenges associated with both students' and teachers' use of the technology, the technology itself and the factors associated with technology-enhanced projects. [9] distinguishes the challenges into three interlocking factors which are institution, resources and teacher. At the school level, important contextual factors are socio-cultural setting of a school and structural characteristics like government ICT policy, ICT infrastructure and school type. At teacher level, two types of barriers are common – external or first-order barriers, such as limited resources or lack of technical support, and internal or second-order barriers, which include teachers' attitudes to ICT. Therefore, there is the need to assess the impacts of I.C.T. integration in the lesson delivery of lecturers and in the academic performance of students while suggesting proactive ways of mitigating the challenges associated with such integration. This happens to be the main thrust of the research pivoted on three main research questions:

1. What is the extent of the relationship between I.C.T. integration and the lesson delivery of lecturers?

2. What is the extent of the relationship between I.C.T. integration and the academic performances of students?

3. What challenges are encountered in the integration of ICT in education and what are the possible solutions to those identified challenges?

Seeking for reliable answers to these important questions would assist the researchers in assessing thoroughly, the impacts of I.C.T. into the teaching and learning activities in higher institutions to evaluate whether the Ghana Education System is making giant headways in the adoption of modern technologies in delivering effective education to learners. This would aid in improving the education system of Ghana while furnishing graduates with the right I.C.T. skills needed for the socio-economic development of the country.

1.1. The Importance of ICT in Education

The use of ICT in education is essential for providing opportunities for students to learn to operate in an information age. [10] argues that traditional educational environments do not seem to be suitable for preparing learners to function or be productive in the workplaces of today's society. [11] mention that the revolutionary potential of ICTs improves the quality of education. [12] posits that considerable resources have been invested to justify the place of technology in education, and many research studies have revealed the benefits and gains that can be achieved by students, teachers and administrators. ICTs are beneficial to teachers as they play an important role in transforming education and training [13]. ICTs enhance educational reforms by enabling teachers and learners to move away from traditional approaches to teaching and learning. It transforms teaching from teacher-

oriented, task-oriented to inclusive and integrated teaching environment. ICT is useful in teaching and assessment methods since it helps teachers to ensure that teaching and assessment is reviewed and modified continuously to nurture thinking skills and creativity and to encourage the generation and application of knowledge.

ICT helps teachers to order questions and make them interact with various materials. Other significant issues cited by [14] are listed as follows:

1. ICT integrates technology in the curriculum and assessment. Teachers play a pivotal role in the integration of ICT in the school curriculum and assessment. When teachers perceive ICT as a tool to meet curricular goals, they are more likely to integrate ICT in their lessons. Equipping students with ICT skills facilitates the effective integration of ICT in schools. However, when ICT is introduced into the assessment process, there is a need to reconsider the assessment approaches.

2. The integration of ICT in the students' curriculum helps to shift in pedagogy. Even though shifting pedagogical approaches, redesigning the curriculum and assessment to the use of ICT in education and providing more autonomy to the schools is time-consuming, they help to optimise the use of ICT. Thus, shifting pedagogical approaches is facilitated through appropriate professional development of teachers.

3. Contents and services that support continuous improvement of curriculum practices attract well-established foreign education software developers to work with local companies and to develop high quality ICT-based resources. Establishing a clearing house or digital libraries of ready-to-use and customisable ICT-based resources promotes better use of ICT in teaching and facilitates quick and easy access to resources for making lesson plans and for teaching.

4. ICT helps in the development and selection of culturally-sensitive content. As a mechanism in place, ICT helps in evaluating content developed for schools and ensures political and cultural validity, reliability and correctness. While local content in the local language promotes better use of ICT-based resources and materials, the use of English in schools optimises the potential of ICT, especially the Internet for teaching and learning.

[14] summarises that the integration of ICT in education creates equity in access to learning opportunities, redresses equalities, improves the quality of learning and teaching and delivers lifelong learning. It also helps teachers to create more open learning opportunities for students and pupils. ICT has a major impact on teaching and learning methods. [13] report that ICT plays various roles in learning and teaching processes. It enhances students' achievements and teacher-learning. [15] also point out that ICT plays a part in supporting face-to-face teaching and learning in the classroom. It therefore helps students to be knowledgeable, reduces the amount of direct instruction given to them, and gives teachers an opportunity to help those students with particular needs. [16] specify that ICT plays a role in student skills, motivation and knowledge. It can be used to

present information to students and help them to complete learning tasks. It again accommodates differences in learning styles and removes barriers to learning by providing expanded opportunities and individualised learning experiences [20]. Thus, ICT plays an important role in the transformation of education and training by enhancing educational approaches to teaching and learning.

ICT may be used as a mediating tool in education to engage students in a higher level of thinking [17]. [6] specify that ICTs are transforming schools and classrooms by bringing in new curricula based on real world problems, providing scaffolds and tools to enhance learning, giving students and teachers more opportunities for feedback and reflection, and building local and global communities that include students, teachers, parents, practising scientists, and other interested parties. [11] justify the reasons for the application of ICTs in education. First, it is because a new society requires new skills. As ICTs are the pre-eminent tools for information processing, new generations need to become competent in their use in order to should acquire the necessary skills, and therefore must have access to computers and networks during their school life. Second, it is because of productivity enhancements. That is, as schools are knowledge-handling institutions, ICTs should be fundamental management tools at all levels of an educational system from classrooms to ministries. Finally, it is because of a quest for quality learning. Schools should profoundly revise present teaching practices and resources to create more effective learning environments and improve life-long learning skills and habits in their students.

[17] also argues that ICTs are used to improve the delivery of and access to education. This is done by improving education on the margin by increasing the efficiency by which instruction is distributed. [17] further indicates that ICTs are the focus of learning whereby students become better prepared for work that increasingly involves the use of ICTs. ICTs can be used to improve students' understanding, increase the quality of education, and thereby increase the impact of education on the economy. ICTs also help in knowledge creation, technology, technological innovativeness, and knowledge sharing which can contribute to the transformation of the education system and to sustain economic growth and social development [18]. [11] state that ICTs play essential pedagogical, cultural, social, professional and administrative roles in the educational system. [19] identified the uses of ICT in school administration as relating to assessment, recording and reporting activities. Much of the information needed about the status and use of resources in schools can be provided by existing information systems or obtained from available records that schools may keep on their servers and computers. ICT assists in building the capacity of administrators to answer key policy questions into management systems, either for staff or instructional support. It can also lead to better data with less effort.

1.2. The Impact of ICT on How Students Learn

Just as technology influences and supports what is learned in schools and universities, so it supports changes

to the way students learn. Moves from content-centred curricula to competency-based curricula are associated with moves away from teacher-centred forms of delivery to student-centred forms. Through technology-facilitated approaches, contemporary learning settings encourage students to take responsibility for their own learning. The growing use of ICT as an instructional medium is changing and is likely to continue to change many of the strategies employed by both teachers and students in the learning process [20].

ICT has the capacity to promote and encourage the transformation of education from a very teacher-directed enterprise to one which supports more student-centred models. This is manifested through the proliferation of capacity, competency and outcome focused curricula, moves toward problem-based learning and increased use of the web as an information source. The use of ICT in educational settings by itself acts as a catalyst for change since ICTs by their very nature are tools that encourage and support independent learning. Students using ICTs for learning purposes become immersed in the process of learning and as more and more students use computers as information sources and cognitive tools, the influence of the technology in supporting how students learn will continue to increase [21].

The emergence of ICT as a learning technology has also coincided with a growing awareness and recognition of alternative theories of learning. The theories of learning that hold the greatest sway today are those based on constructivist principles [22]. These principles posit that learning is achieved by the active construction of knowledge supported by various perspectives within meaningful contexts. In constructivist theories, social interactions are seen to play a critical role in the processes of learning and cognition. Learning approaches using contemporary ICTs provide many opportunities for constructivist learning through their provision and support for resource-based, student-centred settings and by enabling learning to be related to context and to practice [23]. The use of ICT in learning settings acts to support various aspects of knowledge construction and as more and more students employ ICTs in their learning processes, the more pronounced the impact of this will become.

1.3. Effects of ICT on the Pool of Teachers and Students

From the uptake of technology, other issues have emerged, including changes to the make-up of the teacher pool, changes to the profile of learners and changes in the costing and economics of course delivery. [24] reports that ICTs help in the achievement of the Millennium Development Goal two (MDG 2) by increasing the supply of teachers through ICT-based distance education and enabling greater access to education for all which will strengthen the knowledge equity on technology. [24] describes distance learning as any educational approach which aims to reach learners in the place where they are providing learning resources or permitting them to become qualified without the need for physical presence in the classroom.

Technology-facilitated learning offers the opportunities to extend the teaching pool beyond the role given to only highly qualified people. The changing role of the teacher has seen increased opportunities for others to participate in the process, including workplace trainers, mentors, specialists from the workplace and others. Through the capabilities of technology, today we have a much expanded pool of teachers with varying roles able to provide support for learners in a variety of flexible settings [18]. This trend seems set to continue and to grow with new ICT developments and applications. Within the changed pool of teachers will come changed responsibilities and skill sets for future teaching involving high levels of ICT and the need for more facilitative than didactic teaching roles [25]. ICT helps in the expansion of the pool of students. In the past, education has been a privilege and an opportunity that had often been unavailable to many students whose situation did not fit the mainstream. Through the flexibilities provided by technology, many students who previously were unable to participate in educational activities now find opportunities to do so. The pool of students is changing and will continue to change as more and more people who have a need for education and training are able to take advantage of the increased opportunities [18]. Interesting opportunities are now being observed among, for example, students studying university courses to overcome limitations in their school programmes and infrastructure as workers undertaking courses from their desktops.

ICT has also had an impact on the cost of education. Traditional thinking has always been that technology-facilitated learning would provide economies and efficiencies that would see significant reductions in the costs associated with the delivery of educational programmes. The costs would come from the ability to create courses with fixed establishment costs, for example, technology-based courses and for which there would be savings in delivery through large scale uptake. The costs associated with the development of high quality technology-facilitated learning materials are quite high. It has been found to be more than a matter of repackaging existing materials and large scale reengineering has been found to be necessary with large scale costs. Likewise, costs associated with delivery have not been found to diminish as expected. The main reason for this has been the need to maintain a relatively stable student-to-staff ratio and the expectation of students that they will have access to teachers in their courses and programmes. Compared to traditional forms of off-campus learning, technology-facilitated learning has proven to be quite expensive in all areas of consideration, infrastructure, course development and course delivery [26]. People therefore brace themselves for the advantages and affordability, which improves the quality of education in the near future to also increase components of the cost.

1.4. ICT and Students' Performance

The direct link between ICT use and students' performance has been the focus of extensive literature during the last two decades. Several studies have tried to explain the role of technology in education and the added value of these technologies in classrooms and on students' performance. However, the assessment of the effect of ICT on students' performance of various authors has been

mixed. [27] surveyed students in a matched pair of online and face-to-face principles of an economics course taught by the same teacher. They reported that examination scores, after taking into account differences in student characteristics, were approximately six percent higher for the on-campus format than for the online format. They attribute the relatively better performance in the on-campus classes to the benefit of in-person teacher-student interactions, and attribute the relatively poorer performance of the students in the online class to the lack of self-discipline necessary for successful independent learning in the online environment.

[28] surveyed 240 students in a programme offering courses in the three formats of online, on-campus and hybrid. Using a standard regression model where the final exam score is the dependent variable and student characteristics are the independent variables, they report that predicted exam scores for students in the online courses were significantly less than those of students in the on-campus and in the hybrid formats. However, the comparison of examination scores between students in the hybrid and students in the on-campus classes registered no significant difference. [29] surveyed three matched pairs of face-to-face and online principles of economics courses taught at three different institutions. The students' score in the Test of Understanding College Level Economics (TUCE) given at the end of the term was used as the measure of learning outcomes. After taking into account selection bias and differences , student characteristics, they reported that the average TUCE scores are almost 15% higher for the face-to-face format than for the online format. The authors therefore found that ICT does not play any significant role in students' achievements. [30] also surveyed two matched pairs of on-campus and online courses, one in statistics and the other in managerial economics. They reported that after taking into account student characteristics and selection bias, students in the online format of the statistics class examination scored 14.1% less than in the traditional format, whereas, for the managerial economics class, the test scores within both formats were not significantly different. [31] concluded that there is no evidence for a relationship between increased educational use of ICT and students' performance. They found a consistently negative and marginally significant relationship between ICT use and some student achievement measures.

On the other hand, [32] present the results of a randomised policy evaluation carried out in two Indian States to improve the quality of education in urban slums. The authors found out that a computer assisted programme, designed to reinforce mathematical skills, had a large and positive impact on mathematics scores. However, the programme did not produce positive spill-overs to other subjects. [33] also evaluated whether changes in ICT investment had any causal impact on changes in educational outcomes in English schools over the period from 1999 to 2003. Using an Instrumental Variable (IV) approach to control for endogeneity of ICT use, the authors found evidence for a positive causal impact of ICT investment on educational performance in primary schools.

[34] constructed a database of 67 sections of introductory economics, enrolling 3,986 students taught by 30 instructors in 15 institutions in the United States of America during the spring and autumn semesters of 2002. They found significant, but low, positive impact on student performance due to ICT use. However, they showed that some ICTs seem to be positively correlated to performance, while others are not. The analysis of the effects of these methodological and technological innovations on the students' attitude towards the learning process and on students' performance seems to be evolving towards a consensus, according to which an appropriate use of digital technologies in higher education can have significant positive effects both on students' attitude and their achievement.

1.5. Challenges Associated with the Integration of ICT in Education

Notwithstanding the benefits associated with the integration of ICT in education, there are some challenges attached to the use of ICT. The first challenge associated with the use of ICT in schools is teacher qualifications and expertise. [19] points out that most IT teachers employed in English secondary schools lack qualifications and training in IT or computing, while very few have been specifically trained to teach IT. In spite of the general requirement that all teachers should have basic IT literacy, [19] reports that staff development in IT is far too limited and most teachers have to teach themselves how to use IT in general.

Another problem, which is at the conceptual level, shows that even the teachers who have basic knowledge in ICT do not learn new concepts and softwares on ICT. Teachers of IT must regularly learn new concepts and re-learn old skills in new contexts, as the technology changes. [19] explains that the recent availability of Internet access in schools has required IT teachers to learn about email and web browsers to re-focus their programming skills so that they can build websites using HTML and be aware of new web-related features in familiar software, such as word processors. This has challenged the capacity of many teachers. A related problem to the above-stated problem is the fear or low confidence teachers have in teaching or using ICT facilities in teaching students. This is especially the case when they find out that their IT skills are out of date in comparison with those of their students. Teachers usually use older equipment at school, whereas students may have access to more modern computer equipment at home. A research by [36] concluded that it is not surprising that "Teachers' command of IT subject was weak and appeared to weaken in comparison with previous year" (p. 11).

There are also problems with teaching styles. As [19] explained, there is confusion over the appropriateness of styles of teaching. There are concerns about the use of ICT in teaching and learning and the way IT resources and the curriculum are organised. These circumstances affect students who are training to be IT teachers when they are on teaching placement in secondary schools. They may find that the curriculum model used in one teaching placement school is very different from that used in another; contact with students may be too brief, causing difficulties with teacher-pupil relationships; different approaches to teaching and learning may be encountered; there may be difficulties with continuity and progression

in the IT curriculum; and expected standards may not be consistent. Student teachers may be better qualified, and have more practical experience of IT systems and resources than their subject mentors in schools.

In terms of resources, it has been argued by [19] that the use of ICT involves using more expensive resources more frequently than in other curricular activities. However, there is insufficient hardware in many schools for pupils to have access whenever they need it, and students may have to share computers even in IT subject studies [36]. [37], in a worldwide survey of schools from 26 countries, found that the most frequently mentioned problem in integrating ICT in education has been the insufficient number of computers. [38] cited limited availability of ICT resources as a major obstacle to classroom management and organisation of resources. In terms of availability of ICT hardware and software, [19] identified another problem. Crawford found that the hardware and software available in schools is not consistent between and often within schools. Using examples from South Africa, Crawford explained that different hardware platforms were available and each school has a variety of different software in use. [7] have also identified the problem of availability stating that the problem of access constitutes a major obstacle to the use of computers in Ghana.

The outcome of the above problem leads to another problem of curriculum under standardisation to a large degree. The problem is that schools must be equipped regularly because technology changes rapidly and often unpredictably, with the result that schools must re-equip more frequently than in other subjects and forward planning is more difficult. Many schools re-equip in sporadic bursts due to bid-based funding and government initiatives. ICT can also distract learning. This may be particularly salient at home, where Internet access could be a source of distraction because of chat rooms or online games, reducing the time spent in doing homework or learning. [39] observed that pupils tended to lose concentration when groups working on a computer are too big. Thus, the impact of the availability of ICT on student learning will strongly depend on their specific uses. ICT-based instruction could again restrict the creativity of the learner. ICT tends to allow acting only in a predefined way with limited interactive possibilities. This might reduce the students' abilities in terms of problem solving and creative thinking in predetermined schemes, but not their ability to come up with independent creative solutions on their own.

2. Methodology

The mixed method approach that combines both qualitative and quantitative approaches was used for driving the entire study [40]. A concurrent triangulation design of the mixed method approach was adopted for the study. In this approach, both the qualitative and quantitative data were collected concurrently in one phase, though the analysis for each set of data is carried out separately [41]. Finally, the interpretations from both sets of data are integrated.
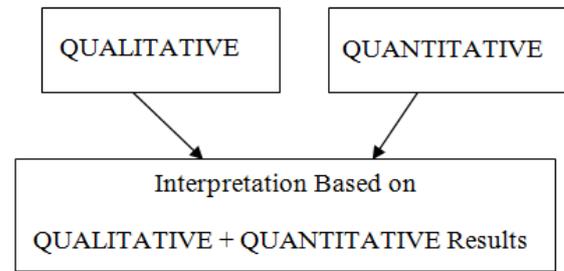

Figure 1. Concurrent Triangulation Design (Source: Creswell, 2009)

The researchers adopted this design to cross-validate the findings of the study to give a deeper comprehension on the extent of the integration of I.C.T. in the lesson delivery of lecturers as well as the academic performances of students [40]. This was seen to be imperative because both qualitative and quantitative data were required to rigorously assess the impacts of I.C.T. integration into the teaching and learning processes in tertiary institutions in Ghana. A one-sided approach would not have been very efficient in yielding the best paradigm of assessment.

A descriptive research design was adopted for the study. [42] has observed that the purpose of descriptive research is to observe, describe and document an aspect of phenomena as it naturally occurs. It is concerned with the conditions of relationship that exist, such as determining the nature of prevailing conditions, practices and attitude, opinions that are held, processes that are going on or trends that are developed. The choice of descriptive design of the study was due to the fact that the design finds answers to questions through the analysis of relationship between or among variables, herein being I.C.T. integration and lesson delivery of lecturers and students' performance. The descriptive study approach aided the researchers in giving a picturesque account of the areas in the teaching and learning process where the services of I.C.T. were required and/or utilized by both lecturers and students as well as in the administrative work of the administrators. Moreover, the descriptive approach assisted in the assessment of the impacts of I.C.T. in teaching thus, via the use of computer software or computer technology as well as in research works and learning processes of tertiary students.

Questionnaire was the main data collecting instrument used for collecting quantitative data which was analysed using the SPSS software to generate statistical tables and percentages to support and validate the findings of the study. The questionnaire as a data collection instrument was very important because it aided the researchers in obtaining the views of a large number of some of the respondents in the tertiary institutions on the impact of I.C.T. integration in lesson delivery and the performances of students who because of difficult schedules could not offer the researchers a face to face interview.

On the other hand, interviews and direct observations were used for soliciting for the qualitative data which was analysed using thematic analysis. Both instruments assisted the researchers in interacting with the key respondents, thus, lecturers, students and administrators in the tertiary institutions to know at first hand, how I.C.T. influenced their duties. For instance, the researchers personally observed how the use of I.C.T. or otherwise,

impacted the lesson preparation and lesson delivery of lecturers while soliciting for their views on the challenges that are associated with such integration and ways of remedying them. Again, while interacting with students in their hostels and halls of residences as well as in their lecture rooms, the researchers observed at first hand, how I.C.T. impacted on their studying and learning habits and the challenges that confronted many of the students who did not use the computer technological devices. During the interview sessions with the respondents, their responses were tape-recorded and transcribed thoroughly. The completed data collection instruments were cleaned to check whether respondents followed instructions uniformly and whether all research items were answered. The responses were edited in terms of spelling, inconsistencies and other mistakes. Each data collection instrument was given an identification number to avoid any data loss and double entries. This made the data analysis very rigorous.

The data from the direct observations of classroom teaching methods assisted the researchers in assessing how I.C.T. was utilized for both teaching and learning activities in the selected tertiary institutions. The reliability of the data collecting instruments were established using the Chronbach Co-efficient Alpha, a measure of internal consistency. A Chronbach Alpha Co-efficient of 0.80 implied that the instruments explained 80% of the issues of the study. With regard to the face validity of the instrument for the study, the items were submitted to course mates, supervisors and other lecturers with expert knowledge in validation of the research instrument and ICT.

The study was carried out in three tertiary institutions in Ghana, thus, Ho Polytechnic, Evangelical Presbyterian University College in Ho, Ghana Commercial Bank Training College at Nungua, and Standard Chartered Banking College in Accra all in Ghana.

A total of 496 respondents were sampled for the study. This comprised 348 students (87 per institution), 100 lecturers (25 per institution) and 48 administrators (12 per institution). Stratified random sampling was used in selecting the sample for the study. The study categorised the study population into four – along the four institutions. Equal proportionate sampling was used to sample respondents from the various institutions. Thus, 125 respondents were sampled from each institution. This was to have fair representation of the institutions. On the other hand, the administrative staff was sampled using the simple random sampling technique. Finally, thorough analysis via the rich data accrued from the data collecting instruments was carried out and a consistent, narrative essay of the findings was made.

3. Results and Discussions

3.1. Background Information of Respondents

This section highlights the demographic characteristics of respondents from all the selected tertiary institutions in the country. In a study of this nature, it is important to know the gender distribution of respondents. Data was therefore gathered on the sex of respondents. The sex of the respondents is indicated in Table 2.

The information presented in Table 1 indicates that out of the 496 respondents interviewed in the research, 248 were males and the remaining half were females, making up 50% each. Pryor and Ampiah (2003) have indicated that, today, the use of computers in Ghanaian schools cannot be over-emphasised because the accelerating pace of technology change is a worldwide phenomenon. The ICT4D document has stated that there will be a serious crisis if the integration of ICT as well as the use of the Internet is not encouraged in schools. In Ghana, there is no obvious policy to show preference for a particular sex in the use of ICT in the tertiary institutions. Hence, the respondents were sampled equally, as indicated in Table 1. Data was also collected in respect of the age range of the respondents. The analysis in this regard is portrayed in Table 2.

The research conducted revealed that none (0%) of the lecturers and the course administrators interviewed was below 26 years. Fifty-one (14.6%) students were below the age of 20 and 72 (20.7%) were within 21 – 25 years. Additionally, 102 (29.3%) of the students were within 26 – 30 years. In addition, six percent and 8.3% of the lecturers and course administrators respectively were within the age group of 26 – 30. Furthermore, 57 (16.4%) of the students, 20 (20%) of lecturers and seven (14.6%) of the course administrators were aged between 31 – 35 years. Additionally, 34 (34%) of the lecturers and 19 (39.6%) of course administrators fell within the ages of 36 – 40 years. The study also sought for responses based on departmental basis. The respondents were asked to indicate the various departments to which they belong. The breakdown is represented in Table 4.

It can be seen from Table 4 that 140 (40.2%) students were in the Business Department, while eight (16.7%) of the course administrators were from the Computer Science Department. It can also be seen from the Table that 10 (10%) 13 (13%) and 15 (15%) of the Lecturers were from the Home Economics, Engineering and Mathematics Departments. Similarly, 35 (10.1%) of the students and six (12.5%) of the course administrators were from the English Language Department. A minority, made up of 10 (2.9%) of the students, could also be found in other subject areas such as Religion and Statistics. This is in agreement with a report published by [24] which indicates that teachers now perceive ICT as a tool to meet the curricular goals. Hence, there is ICT integration in the school curriculum and assessment.

Table 1. Diagrammatic Representation of the Sampling Design and Sizes

Total Number of Respondents= 496			
Selected Tertiary Institutions in Ghana	Lecturers	Students	Administrators
Ho Polytechnic	25	87	12
Evangelical Presbyterian University College, Ho	25	87	12
Ghana Commercial Bank Training College, Nungua	25	87	12
Standard Chartered Banking College, Accra	25	87	12
TOTAL	100	348	48

(Source: Designed by the researchers).

Table 2. Sex of Respondents

Categories	Students		Lecturers		Course Administrators	
	Frequency	%	Frequency	%	Frequency	%
Male	174	50	50	50	24	50
Female	174	50	50	50	24	50
TOTAL	**348**	**100**	**100**	**100**	**48**	**100**

Source: Sample Survey, 2016.

Table 3. Ages of Respondents

Age	Students		Lecturers		Course administrators	
	Frequency	%	Frequency	%	Frequency	%
Below 20	51	14.6	0	0	0	0
21 – 25	72	20.7	0	0	0	0
26 – 30	102	29.3	6	6	4	8.3
31 – 35	57	16.4	20	20	7	14.6
36 – 40	39	11.2	34	34	19	39.6
Above 40	27	7.8	40	40	18	37.5
Total	**348**	**100**	**100**	**100**	**50**	**100**

Source: Sample Survey, 2016.

Table 4. Department of Respondents

Department	Students		Lecturers		Course administrators	
	Frequency	%	Frequency	%	Frequency	%
Business	140	40.2	32	32	10	20.8
Home Economics	45	12.9	10	10	7	14.6
Mathematics	25	7.2	15	15	5	10.4
Engineering	30	8.6	13	13	7	14.6
Computer Science	63	18.1	18	18	8	16.7
English Language	35	10.1	9	9	6	12.5
Others	10	2.9	3	3	5	10.4
Total	**348**	**100**	**100**	**100**	**48**	**100**

Source: Sample Survey, 2016.

3.2. Ways ICT Contribute to the Advancement of Educational Laurels in Ghana

[43] provides a philosophy where he describes the need for children to 'absorb the computer culture' to become familiar with these tools. As a result, items 13 to 22 in the research questionnaire were devoted to finding out if ICT tools are being used for lecturing or in the administration of education in the various institutions. The idea is to ascertain the ways ICT contributes to the advancement of educational laurels in Ghana. The responses gathered in this regard are presented in Table 5.

As can be seen from Table 5, close to 82.8% (288) of the students interviewed in the research indicated that they do not use ICT to do their assignments. Furthermore, 312 (89.6%) of them indicated they do not use ICT to prepare their personal study notes. In addition, 294 (84.5%) of the students admitted that no subject is taught with the computers in their schools. However, as Table 4 reveals, 114 (32.8%) out of the total of 348 students indicated that

their schools have enough software available to teach each subject. About 129 (37.1%) of the respondents only use the computers to play games. Respondents were also asked to indicate the number of hours they spend on their school computers per week. The result is analysed in Table 5.

Table 5. The Use of ICT by Students

Use of ICT by students	Yes	%	No	%
Use ICT to do assignments	60	17.2	288	82.8
Use ICT to prepare study notes	36	10.4	312	89.6
Teaching of subjects with computers	54	15.5	294	84.5
Availability of software for teaching	114	32.8	234	67.2
Playing games on your school computer	129	37.1	219	62.9
Sharing of skills	74	21.3	274	78.7
Sharing excitements and frustrations	120	34.5	228	65.5

Source: Sample Survey, 2016.

Table 6. Hours Students Spend on Computers per Week

Hours	Frequency	%
Do not have time	128	36.8
1 – 2 hrs	70	20.1
3 – 4 hrs	60	17.2
Above 4 hrs	90	25.9
Total	**348**	**100**

Source: Sample Survey, 2016.

The data shown in Table 6 indicates that 128 (36.8%) of the students do not have time with their ICT facilities in their schools, 70 (20.1%) and 60 (17.2%) spend between 1 – 2 hours and 3 – 4 hours, respectively, on ICT per week. Furthermore, 25.9 percent, which is 90 out of 350, spend more than four hours on ICT per week. These give credence to the words of [44] who asserted that just having the technology does not in itself give rise to collaborative learning. Learners need to have a context in which to understand the purpose of collaboration [44]. In other words, there is the need to integrate the curriculum, society and the available technology.

The extent to which lecturers and course administrators use ICT in their service delivery was also considered in this study. The data gathered in respect of this issue is presented in Table 7.

Table 7. Extent to which Lecturers and Course Administrators Use ICT

Use of ICT	Very High	High	Normal	Low	Very Low
Use of ICT to teach	0	0	27	51	22
Use of ICT to present assignments	0	0	11	70	19
Use of ICT to provide feedback to students	0	0	0	40	60
Use of ICT to conduct assessment	5	30	40	25	0
Use of ICT to collect information	0	8	20	70	2
Use of ICT to do research	40	38	22	0	0
Computer literacy skills to staff	0	15	20	50	15

Source: Sample Survey, 2016.

The analysis in Table 7 revealed that 51% and 22% of the respondents rated the extent to which they use ICT to teach as "Low" and "Very Low", respectively. Similarly, 70% each of the respondents rated the extent to which they use ICT to collect information and present assignments as "Low". Moreover, six (60%) out of every 10 respondents rated the extent to which they use ICT to provide feedback to students as "Very Low". The research conducted also revealed that about three out of every 10 (30%) of the lecturers and course administrators interviewed rated the extent to which they use ICT to conduct assessments as "High", as against a quarter (25%) of them who rated it "Low". In addition, 40% and 38% of the respondents rated the extent to which they use ICT to conduct research as "Very High" and "High", respectively. However, five percent, 30%, 40% and 25% rated the extent to which they use ICT to conduct assessments as "Very High", "High", "Normal", "Low" and "Very Low", respectively. This shows that the use of ICT enhances communication and dissemination of information from the lecturers to the students in terms of presenting assignments.

The results of the research showed that in a significant way, ICT is conceived to contribute greatly to the advancement of education in Ghana. This finding seems consistent with the findings of earlier researchers. It is believed that development in ICT creates access to learning opportunity, redresses inequalities, improves the quality of learning and teaching and delivers lifelong learning [24]. ICT can also accommodate differences in learning styles and remove barriers to learning by providing expanded opportunities and individualised learning experiences. Hence, ICT plays an important role in the transformation of education and training by enhancing educational approaches to teaching and learning.

However, [35] expressed the view that computer applications were not yielding the desired results even though the evolution of computers in education continued to enhance bandwidth, Internet and the World Wide Web. This opinion is asserted in the study when quite a large number of the respondents indicated that they did not have the appropriate software for learning the various courses of study in their institutions of study. This impression, however, is not the total norm in the delivery of education in tertiary institutions in Ghana because public universities in Ghana have a long history of the use of ICT for management purposes [45]. Some examples of these were the early payroll, admission and examination systems which were locally developed and maintained. These have faded out of use now. However, in 1997 with funding from the World Bank, the Ministry of Education acquired the Integrated Tertiary System (ITS) which was used to harmonise educational records and moderate workshops. Thus, from the foregoing, it can aptly be said that ICT has contributed significantly towards the achievement of educational laurels in Ghana.

3.3. Ways ICT Contribute to the Delivery of Education in Ghana

This section of the research sought to find out the ways ICT contributes to the delivery of education in Ghana.

Table 8 shows the results of the contribution of ICT to education delivery.

Table 8. Contribution of ICT to Education Delivery

Item	Yes		No	
	Frequency	%	Frequency	%
Access to the Internet	317	91.1	31	8.9
Use of the Internet	304	87.4	44	12.6
Benefits in terms of doing research	159	45.7	189	54.3
Internet in communications	317	91.1	31	8.9
Access to facilities in the Lab	144	41.4	204	58.6
Access to facilities after School	0	0	348	100
Use of computers for assessment	82	23.6	266	76.4

Source: Sample Survey, 2016.

Table 9. How often Students have benefitted from Computer Literacy in School

Item	Frequency	%
Once	193	55.5
Twice	95	27.3
Thrice and above	60	17.2
Total	**348**	**100**

Source: Sample Survey, 2016.

Items 23 to 30 were employed to ascertain the contribution of ICT to education delivery. The analysis represented in Table 7 shows that 98% and 93% of the respondents made up of 317 and 304 out of the 348 students, respectively, have access to the Internet and do make use of it as well. In addition, 159 (45.7%) respondents indicated that ICT facilitates their research work. Furthermore, 317 (91.1%) respondents indicated that ICT facilitates easy communication and dissemination of information within and across departments and educational institutions. This is supported by the report of the Asian Pacific Bureau of 2004 which indicates that students can access a wealth of educational resources outside the school and collaborate with other educational institutions through the use of the Internet. Data was also collected on the number of times respondents benefitted from computer literacy programmes in their schools. The outcome of this is reflected in Table 9.

The data gathered from the research and analysed in Table 8 showed that out of the 348 students, 193 (55.5%) of the students interviewed said that they have benefitted only once from a computer literacy programme in their school. Ninety-five (27.3%) said they have benefitted twice, and the remaining 60 (17.2%) indicated that they have benefitted more than twice. From Table 8, it can be said that significant gains can be made by students if they are able to have an improved access to the computer literacy programmes and the availability of the Internet. The main objective of this section is to find out ways in which ICT actually contributes to education delivery in Ghana. In 2004, Parliament passed into law Ghana's ICT for Accelerated Development (ICT4AD) policy which is currently at various stages of implementation. The results of the study indicate that there is an active relationship between education delivery and ICT.

The results further show that ICT should be seen as a vital tool that can enhance students' academic performance and education delivery in Ghana. This finding is supported by [18] when he indicated that ICT as a force has changed many aspects of the way we live. Furthermore, [12] reports that when technology is used to assist the human brain, new intellectual capabilities are created, thereby helping to change most aspects of a person's life. This is confirmed by studies conducted by [45] and [7]. They both mentioned in their separate works that there is an "increasing demand for educational services" such as ICT and that the "accelerating pace of technological change is a worldwide phenomenon" and educational delivery cannot be left out. Thus, we see from the analysis that ICT is perceived to be playing a very important role in the delivery of education in Ghana.

In addition, in relation to the managerial aspects of education delivery, indicated that the use of ICT-related technology is particularly helpful because administrators can construct virtual scenarios around different policy options to determine needs and analyse potential consequences [46]. [6] also agree that through an increase in motivation, by the use of multimedia and computer software, teacher training and subsequent delivery is greatly enhanced. This literature supports the analysis results that ICT is actively contributing to educational delivery in Ghana.

3.4. There is no Statistically Significant Difference in Student's Academic Performance Before and After the Use of ICT

This hypothesis was ascertained by running a paired sample t-test at five percent level of significance at 299 degree of freedom. The result of the test is indicated in Table 10.

Table 10. Result of the Paired Sample T-test

t-value	mean difference	Df	p<0.05
19.422	0.35	299	0.001

Source: Sample Survey, 2016.

The analysis in Table 10 shows that the value of the test statistics (t-value) is 19.422 and the p-value is 0.001. Since the p-value is less than the five percent level of significance, the null hypothesis is rejected at the five percent significance. The study, therefore, concludes that there is a significant difference in student's academic performance before and after the use of ICT. Further analysis was then carried to examine whether this significant change was positive or negative. There was a positive mean difference of 0.35, indicating a significant positive impact on the student's academic performance. From the above analysis, it can be observed that there is a very significant effect of ICT on student academic performance. This is buttressed by [5] who argues that if universities are to maximise the potential of e-Learning as a means of delivering higher education, they must be fully aware of the critical success factors. This is because of the significant effect of ICT on student academic performance. One other idea that typically supports the positive effect of ICT on education, as indicated in the study, is the fact that teachers who claim to follow the 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 traditional instructional approaches [33].

However, the total positive effect of ICT on education has not been realised because, according to [37], there are still factors that impede the total integration of ICT in institutions of learning. These factors, according to him, include lack of knowledge and skills of teachers as well as insufficient number of computers and ICT infrastructure in general. In a related study, [47] distinguished three factors which include dissatisfaction with the status quo, availability of resources and the pool of knowledge and skills available.

3.5. There is No Statistically Significant Difference in Service Delivery of Lecturers in Tertiary Education before and after the Use of ICT

This hypothesis was tested using a paired sample t-test at five percent significant level with 99 degrees of freedom. The analysis to that effect is presented in Table 11.

Table 11. Result of the Paired Sample T-test

t-value	mean difference	Df	p<0.05
9.782	0.61	99	0.001

Source: Sample Survey, 2016.

The result of the analysis tabulated in Table 11 shows that the value of the test statistics is 9.782, whilst the significant probability is 0.001. Since the P-value is less than the 0.05 level, the null hypothesis is rejected at the five percent level of significance. The result shows that there is a significant difference in service delivery of lecturers in tertiary education before and after the use of ICT. Thus, lecturers find it easier to do their work when ICT tools are available in their educational institutions than when they were not available. This observation is supported by the work of [6] which indicates that the Internet possesses the propensity not only to change the way society retains and accesses knowledge but also to transform and restructure traditional models of higher education, particularly the delivery and interaction in and with course materials and associated resources.

3.6. There is a Significant Difference in the Dissemination of Information in Educational Institutions before and after the Use of ICT

Table 12 shows the result of a paired sample t-test at five percent level of significance with 499 degrees of freedom.

Table 12. Result of the Paired Sample T-test

t-value	mean difference	Df	p<0.05
5.32	0.87	499	0.001

Source: Sample Survey, 2016.

The value of the test statistics (t-value) is 5.32, whilst the significant probability is 0.001. Since the significant probability (p-value) is less than the five percent level of significance, it implies the null hypothesis is rejected at the five percent significance. Based on this result, it is concluded that there is a significant difference in the dissemination of information in educational institutions before and after the use of ICT. Further analysis was then carried out to examine whether the difference was positive or negative and the result in Table 12 shows a positive mean difference of 0.87. This, therefore, shows that Information and Communication Technology (ICT) enhances information dissemination in educational institutions. Indeed, it has been confirmed through the study that information dissemination is enhanced greatly through the use of ICT. Accordingly, [35] argues that the fast expansion of the Internet and related technological advancements, in conjunction with limited budgets and social demands for improved access to higher education, has produced a substantial incentive for universities to introduce e-Learning courses. Crawford concurs that if universities do not embrace e-Learning technology that is readily available, they will be left behind in the pursuit of globalisation.

3.7. There is a Statistically Significant Difference in Accessing Information in Tertiary Education Before and After the Use of ICT

The result of the test is displayed in Table 13.

Table 13. Result of the Paired Sample T-test

t-value	mean difference	Df	p<0.05
11.82	0.47	499	0.001

Source: Sample Survey, 2016.

The fourth hypothesis was tested using a paired sample t-test as five percent significant level with 499 degrees of freedom. The result shows that the value of the test statistics is 11.82, whilst the significant probability is 0.001. Additionally, the null hypothesis is rejected at the five percent level of significance since the p-value is less than the 0.05 significance level. This, therefore, means that there is a significant difference in accessing information in tertiary education before and after the use of ICT. The positive mean difference of 0.47 also indicates that ICT has a positive relationship with access to information in tertiary educational institutions. It therefore means that getting academic information, remote learning resources and study materials where there are ICT tools is easier than in institutions where such facilities do not exist. To exert "attitudinal" changes in current "traditional" educational delivery practices by universities in order to fully utilise e-learning strategies for improved delivery of courses for its students, easy access to materials is pivotal. It is in line with this that [48] stated that ICT's have been identified as powerful tools for helping teachers with all the different aspects of their job, promoting the accessibility of information, enhancing instruction, simplifying administrative tasks, fostering professional growth and, in some cases, their own personal productivity. According to the authors, some teachers find that using various technologies allows them to teach in entirely different ways. In the information age which has led to a complex social and institutional structure in modern society, one has to be a global citizen to operate successfully.

4. Conclusions

The impact of ICT in the delivery of education in tertiary institutions cannot be underestimated. However, due to a myriad of challenges in the sector, such as lack of adequate skilled labour and lack of a functional ICT policy framework, the desired effects of ICT in education are not being felt. In conclusion, a lot of benefits have been demonstrated by the institutions that participated through the acquisition of both technology and academic skills. In addition, there is room for collaboration, global awareness and working on projects with students in both their schools and with those from other countries, even though the situation has shown some remarkable improvement with the inception of the use of ICT in the educational sector. However, with the following recommendations, it is believed that progress can be significantly made in the sector:

There is the urgent need for Government to work with the appropriate agencies to address the challenges facing the integration of ICT into the delivery of education in tertiary institutions. Modern computers should be procured for the institutions to facilitate enhanced delivery of education. In addition, educational policies, programmes and structures should be looked at consistently and changes made whenever the need arises in the interest of improving educational delivery towards the betterment of the kind of labour that we turn out of our institutions.

Secondly, graduates should be able to apply their acquired knowledge in the real world. This should be seen in the way they provide solutions to complex situations at their workplaces. This will be realised when adequate attention is given to the delivery of ICT in all tertiary institutions. In addition, a policy should be put in place to encourage students to draw their own technology learning goals. This should make it possible for them to evaluate their progress and the quality of their projects so as to refine what it is and what they have to know. Policy makers must also ensure that an opportunity is created to provide students with on-going room to apply their knowledge in complex, real world settings and to assess themselves with challenging standards for success.

There is also the need for an extensive professional development for teachers. This is needed to enhance their human capacity as teachers. This can be done with the use of ICT tools online or through face-to-face training workshops, among others. This, when done will be in line with the new pedagogical models required in the adoption of constructivist and constructionist learning outcomes.

Finally, there is the need for the provision of technical support to schools in line with the installation and maintenance of ICT infrastructure. The amount of effort needed in this regard towards large-scale installation, maintenance of hardware and software and networking equipment needed to have the maximum positive effect of ICT on education should not continue to be underestimated. A lot of trained technicians must be employed to offer technical support to the tertiary institutions, administrators and other educational workers.

5. Suggestion for Further Research

The researchers suggest a further study into the examination of the effect of lecturers' professional knowledge in ICT on teaching service delivery in tertiary education. This is also important because there is the need to evaluate and if possible, provide practical ways of improving their technical capabilities in I.C.T. to efficiently spearhead its integration into the teaching and learning activities in higher institutions of learning in Ghana.

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