

## **AIDS: An ICT model for integrating teaching, learning and research in Technical University Education in Ghana**

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### **ABSTRACT**

Information and Communication Technologies (ICT) has changed the way we communicate and carry out certain daily activities. Globally, ICT has become an essential means for disseminating information. Using Accra Technical University in Ghana as a case study, this paper proposes an ICT model called Awareness Incentives Demand and Support (AIDS). Our proposed AIDS model depicts how different ICTs can be integrated in tertiary education for effective teaching, learning and research. Currently, Accra Technical University does not have a resilient means of providing ICT in education. In this study, relevant data was obtained through a quantitative research method involving questionnaires. The questionnaire was developed using the main components of the proposed AIDS model. In all, ninety (90) students and twelve (12) lecturers were considered from a maximum of three (3) schools in Accra Technical University. Samples of lecturers and students from all the three (3) schools were surveyed. Based on the responses received from the participants, the AIDS model was proposed. Successful implementation of the AIDS model practically increased the use of ICT for education by both teachers and students in Accra Technical University.

**Keywords:** *Awareness; Incentives; Demand; Support; Accra Technical University, Teaching, Research; Education, ICT.*

### **INTRODUCTION**

Globally, the basic operations of tertiary institutions lies in the provision of appropriate and reliable academic education consisting of teaching, research and service (Beebe, 2004; Boulton and Lucas, 2011; Cloete and Maasen, 2015). Through Information and Communication Technology (ICT), the provision of access to knowledge anywhere and anytime as well as opportunities for networking and communications for knowledge sharing, participation, and lifelong education is guaranteed (Buabeng-Andoh, 2012; Asabere, 2013). Developed nations in the world have made significant applications of ICT in their daily activities. This is however relatively slow in developing nations such as Ghana. In developed nations, these new technologies and approaches are having a positive impact on education.

Though the application of ICT may be slow, measures are placed to guarantee that proliferation of ICT integration in education is made possible. An example of this is the National Research and Education Networks (NREN). The role of NREN is to operate as the national backbone that connects a country's tertiary institutions with each other as well as providing Internet services for research purposes (Mkandawire, 2013). In addition, Ghana is also enforcing the integration of ICT in various areas such as governance, education and research (Yidana, 2007). Through connection of tertiary institutions, NREN has provided a means of carrying out research through the increase of Internet bandwidth, enabling researchers to collaborate with each other by providing ICT resources (Mkandawire, 2013).

According to the Ghanaian Academic and Research Network (GARNET, 2014), the advancement of West and Central African Research and Education (WACREN) has led to the development of AfricaConnect2 which is involved in developing a high-speed Research and Educational network to connect the entire African continent to the European GEANT network thereby allowing students, researchers and academics in Africa and beyond to collaborate. The objectives of GARNET are as follows:

1. To ensure that there is inter-institutional human networking, research collaboration, and academic collaboration between Ghanaian tertiary institutions and other tertiary institutions worldwide.
2. To build, develop and share high-speed networks by creating economies of scale.
3. To encourage associations between academic and research communities, industry, government and other international research and educational networks.

In order to address the educational challenges of the Ghanaian population, the Ghana ICT4AD Policy (2003) states that in various tertiary institutions in Ghana, the major role of ICT is vital. As a consequence, Higher Educational Institutions (HEIs) in Ghana have to support this policy by aligning with its specific objective in terms of education i.e. to support an enhanced educational system whereby ICTs are extensively positioned to expedite the provision of educational services at all stages (Ghana ICT4AD Policy, 2003). The Ghana ICT4AD Policy (2003), further states that there exists high illiteracy rate in Ghana, and this constitutes about 40% of the population. Only 3% of the population have attained tertiary level of education, which results in serious repercussions regarding national development. Therefore, Technical Universities and other HEIs in Ghana have to enhance social education services to ensure quality and locational equity.

In order to stay current and acquire help in upholding the financial viability and operation involving ICT-based education programmes, tertiary institutions are entering into partnerships with the private sector (Beebe, 2004). In Ghana, as of November 2015 there are about five (5) million Internet users of which most of them are the youth. They mainly use the Internet for chatting on social media, watching or downloading entertainment videos and listening to music (Internet World Stats, 2015). A tertiary institution such as Accra Technical University can take advantage of the Internet as a means of teaching, learning and carrying out research. This paper involves detailed information on how to encourage students and lecturers in Accra Technical University to sensitize themselves towards the use of ICT in education.

More importantly, ICT usage has become the baseline internationally (Nawaz and Kundi, 2010). This is because more computers are being linked to the global network (Internet) as a means of exchanging of information. It is necessary for Accra Technical University to be part of this network, in order to benefit from the information it provides, to increase our knowledge or share our knowledge with others. The integration of ICT into research is essential for information needed by both students and lecturers to conduct their research. Since integration of ICT has become the baseline in all aspect of education, information needed are now mostly found on the Internet and an organization's local network.

This paper presents an ICT model called Awareness, Incentives, Demand, Support (AIDS). AIDS is a model/framework that seeks to sensitize lecturers and students in Accra Technical University, in order to motivate them to use ICT in education. The proposed AIDS involves some components and mechanisms that HEIs can apply to inspire lecturers and students to use ICT in education. The rest of the paper is chronologically structured as follows. The Problem Statement is elaborated and discussed in the next section followed by Literature Review, Proposed AIDS Model, Materials and Methods, Research Discussion and finally Concluding Remarks and Future Work.

## **PROBLEM STATEMENT**

Organizations such as GARNET provide Internet access and other resources that can be used by institutions such as Accra Technical University but not much has been done to implement it. Currently, Accra Technical University faces a challenge in conducting teaching and providing research through ICT. There are cases whereby students wish to obtain lecture notes which were previously facilitated by a lecturer but due to the unavailability of access to such resources, students are forced to consult their class mates who may not have all the information being requested. Furthermore, students need certain relevant software such as AutoCAD and Bentley for their courses but due to inadequate ICT facilities, not all the students benefit from the ICT resources made available on campus. In addition, lecturers are required to spend more time in reteaching the same topics. This occurs due to the need of dividing a large class size into groups so as to enable lecturers to manage the classes easily. There are challenges in providing the documents to students especially when they are many in one class. The process of providing lecture notes or research documents to students or other lecturers, could introduce and generate a high chance of computer virus spreading through flash drive or any portable storage unit. This will affect both students and the lecturers' storage devices. In addition, it would be tedious to send an assignment to a large population of students (for e.g. students in accountancy department) at the same time or one at a time. As a consequence, an improved procedure of facilitating lectures and delivering lecture notes etc. through ICTs is required for effective education in Accra Technical University. This paper therefore seeks to solve this problem by answering the research questions below.

## **Research Questions**

Based on the problem statement enumerated above, the research questions involved in this study include:

1. Which barriers confront lecturers and students when they want to try to integrate ICTs in education?
2. Which tools or resources influence lecturers to encourage lecturers and students to use ICTs in education?
3. What method(s) can be used to integrate ICT in education?
4. How will such methods provide effective teaching, learning and research through ICT?

## **LITERATURE REVIEW**

This section presents some studies that have been carried out on how ICT supports teaching, learning and research, the advantage of using ICT in education, and some barriers encountered in integrating ICT in education. Many tertiary institutions are welcoming ICT usage in more proficient and competitive processes for both administrative processes and delivery of services (Suryawanshia and Narkhedeb, 2015). Nowadays, a wide range of technologies such as virtual reality, videoconferencing, handheld computers, digital cameras, World Wide Web (WWW) and digital libraries are incorporated in ICT for education (Mathevula and Uwizeyimana, 2014). As part of this technological advancement, networking of computer devices has provided a method of sharing knowledge locally and internationally. An example of this is the Electronic Learning (E-Learning).

E-learning can be defined as a learning process that is enabled or supported by the use of digital tools, the internet (web-based) and digital learning content. It typically involves some form of interactivity, which may include online interaction between the learner and their teacher or peers (Asabere and Enguah, 2012; Mikre, 2011; Asabere and Mends-Brew, 2012). E-Learning activities

are usually undertaken via the internet and expedited by different categories ICTs which offer new opportunities for education (Asabere and Enguah, 2012).

Existing literature has shown that factors such as quality of software and hardware, incentives to change, background in formal computer training, ease of technology use, commitment to professional learning, school as well as national policies influence teachers' decisions to use ICT in the classroom (Mumtaz, 2000; Buabeng-Andoh, 2012; Asabere and Ahmed, 2012). Additionally, the positive effects of using ICT on pupils' learning is evident in various research findings over the past twenty (20) years. Although such ICT in education projects have proliferated, affecting several training programmes and investments by schools, there has been an insufficiently slow uptake of ICT in education in various schools (Cox, Preston and Cox, 1999; Passey and Samways, 1997, Asabere, 2012).

During recent past years, many researchers have been analysing and providing suggestions on how ICT should be used. For instance, in the 1980s, the use of ICT was mainly divided into two areas, which were technological and pedagogical use (Lavonen, 2008). Governments of all EU countries provided software for the purpose of training a specific skill. Another proposal under the above pedagogy was the use of ICT for learning assistant or as an application tool (Lavonen, 2008). Some of these software tools include: Power Point presentation, word processing and spreadsheets.

### **How ICT Supports Education?**

#### ***Enabling Collaboration***

Individuals and groups of people can collaborate locally or geographically at a far distance through ICT in both temporary and long-term situations. Collaboration through ICT usually involves students with peers in other schools or the same school and teachers with other teachers in the same school or different schools (Bingimlas, 2009). An example of such collaboration is the Computer Supported Intentional Learning Environments (CSILE). Developed by Ontario Institute of Studies in Education, CSILE is a network system which provides an avenue for collaborative learning by promoting interaction through referencing and sharing ideas (Jung, 2005).

Under this collaboration process, online resources for teachers are provided through websites which helps them to cooperate in order to develop themselves professionally. The Internet provides linkages for larger teaching communities which enables interaction among expert groups. For example, the website relating to "Virtual Teacher Centre" in the UK provides educational resources for career development to support the professional development of teachers (Jung, 2005).

#### ***Online Experts***

Another use of ICT is to seek for advice from experts. Lecturers assist students on a specific problem in their area of study. Online teaching, learning and research is popular for all categories of students and lecturers because its nature is usually asynchronous. Asynchronous methods provide students to cooperate in a larger scale of courses when it is suitable for them, i.e. communication can take place between students and other participants at any time. Furthermore, it provides instructional contents for students which serve as a guide during the teaching process (Stone and Perumean-chaney, 2011).

### ***Provision of Constant Teaching, Learning and Research***

ICT serves as a suitable tool for providing constant education through teaching, learning and research. It enables students and lecturers to access resources from any place thereby saving time as well as cost, and also enables teachers to communicate among themselves and students without boundaries through a communication medium. This will enable/promote independent and group learning, as well as reading of each other's idea and views (Hubackova and Klimova, 2014; Yilmaz, 2015). Moreover, it will further improve the relationship among lecturers and educational participants. ICT also provides a means of constructing powerful learning experiences; it is pedagogically neutral. This corroborates the fact that, ICT can be used in supporting traditional methods of teaching large groups and students note taking (Majumdar, 2007).

The implementation of ICT enables lecture notes or handouts to be easily accessible by both lecturers and students. The process of improving teaching can be fostered by an expanded availability of combining best practices and course materials in education, which can be shared by means of ICT. Disadvantaged groups can also be reached through ICT (Asabere and Enguah, 2012; Buabeng-Andoh, 2012). Teachers also have the opportunity to teach at any time. Mobile technologies continue to support constant teaching and learning (Noor-UI-Amin, 2013). Some ICT tools that are incorporated into research are: decision support systems, mapping systems, database management systems, Geographic Information System (GIS), recommendation models to assist decision-making and Internet/networks on the web for sharing best practices, (Chaiyama, 2015).

Having accessible softcopy of information enables lecturers to update and review the course content which are immediately available to the learning audience (Gary, 2002). Furthermore, the amount of educational activities being done by ICT changes the nature of education, which is proliferating more into web-based systems (Vajargah, Jahani and Azadmanesh, 2010). There is more expectation from society for easier access, quality information, more flexible approaches and greater online opportunities in education which in turn affects teaching and learning. Consequently, worldwide demand for higher education is influencing teaching, learning and research.

### **Review of Existing ICT Adoption Models in Education**

This section elaborates on existing ICT adoption models in education which will substantiate the reasons for presenting our proposed AIDS model. We present some existing models in literature below.

Using "Activity Theory", Nyvang (2006) proposed a theoretical model for the implementation of ICT in higher education using a Danish university as a case study. The model advocates that implementation in itself is an activity system. The implementation activity in Nyvang (2006) is made up of three processes: Selection of ICT; adaptation of ICT and change of practice with ICT.

Mishra and Koehler (2006) proposed an ICT model for teachers to integrate technology in knowledge teaching through pedagogical content. The proposed ICT model in Mishra and Koehler (2006) referred to as TPACK builds on Shulman's (1987) constructs of pedagogical content knowledge (PCK) to include technology knowledge. The development of TPACK by teachers is critical for effective teaching with technology. Mishra and Koehler (2006) elaborated on the nature of technologies and the importance of their inclusion in their proposed ICT model. Through the above utilized constructs, the TPACK ICT model successfully enabled the integration of technology use in teaching.

Wang (2008) proposed a generic ICT model which involved three fundamental elements: technology, social interaction, and pedagogy. Wang (2008) elaborated that the design of these

components should help teachers to incorporate ICT into their curricula in effective ways. The theoretical foundations for the construction of the proposed ICT model provides the design of interactivity, constructivist learning theories and the notion of usefulness. The proposed generic model in Wang (2008) can be applied in the design of learning environments, facilitation of online discussions and comparison of ICT tools.

Engida (2011) proposed the ICT-enhanced teacher development model (ICTeTD), which is technology use in teaching. The ICTeTD model is conceptual in the sense that it provides a visual representation of the concepts/knowledge bases from which teachers draw during their teaching. In the ICTeTD model, teaching is understood to be broader and involves all the activities of a teacher relating to a specific subject such as lesson planning, classroom instruction, assessment/evaluation, curriculum review and development.

Wang and Woo (2007) proposed a systematic model for designing ICT-integration plans. Their proposed ICT model is systematic because it follows a logical flow and has modules organized in a rather linear manner. The development of each module in their ICT model depends very much on the completion of its previous modules. Additionally, their ICT model essentially provides an easy-to-follow structure, where designers move to the next module only after they have completed the current module. The key components of their ICT model include: problem statement, learning objectives, technology required, rationale, strategies, assessment and reflection.

A review of literature shows that most existing ICT models in education are more teacher-oriented i.e. they focus more on implementation of ICT into pedagogical methods without considering enhanced active roles of students in the model. As the teachers learn and implement ICT in pedagogy, it is necessary for the students to understand and gain the skills required to apply ICT in their various field of study. The proposed AIDS model in this paper provide a means for students to enquire and give opinions on whether they are satisfied and conversant with the available ICT infrastructure and technology required for their education.

### **Advantages of Using ICT in Education**

ICT usage has increased the flexible process of delivering education to ensure easy access of knowledge by students and lecturers ubiquitously. ICT in education has had an impact on teaching activities of teachers and the learning activities of students, due to the fact that currently the processes are learner driven. The presence of ICT in education prepares the students/learners for lifelong learning and improves the quality and delivery of education (Noor-UI-Amin, 2003). Integration of ICT in education has brought about flexible time-spacing in teaching and student learning processes thereby increasing the interaction and reception of information. Through provision of lecture notes or videos, students who are fast learners gain the opportunity to study ahead (Nessipbayeva 2013; Yilmaz, 2015). Such possibilities suggest that students can improve their academic performance and teachers or lecturers can provide current learning and research materials (Noor-UI-Amin, 2003). ICT in education usually offers an educational platform for training students. This is typically accessible through a web browser and software such as Microsoft Windows, MAC, UNIX, etc. (Gary, 2002).

### **Barriers of Integrating ICT in Education**

In developing countries such as Ghana, there isn't adequate investments in equipment, infrastructures and resources. To sustain ICT integration in education, large budgets and financial investments are prerequisites. In addition to purchasing new equipment and software, Investments also include developing infrastructures pertaining to schools. For instance, some buildings have not been constructed for installing Wi-Fi devices (Rabah, 2015). According to Gary

(2002) robust multimedia courses are challenging to design and develop. This is due to limitations in bandwidth to access resources in the network. In addition, the development and retention of human resource involved in ICT is still a key challenge especially in African tertiary institutions. The main reason for this human resource challenge is low salaries and poor conditions of service. The term brain drain usually occurs as a result of this challenge (Khan *et al.*, 2012).

Finally, there is inadequate knowledge in the use of ICT by lecturers. Current research has shown that some lecturers in developing nations such as Ghana are still learning how to adopt ICT to teach students. Due to the constant advancement of technology, some lecturers do not have adequate skills necessary to operate new technology (Bingimlas, 2009). In addition, there is a problem of implementing ICT in teaching since some teachers are accustomed to teaching without the use of ICT. This may be due to majority of teachers not having enough ICT training or facing challenges in accessing ICT facilities. There wouldn't be change in the outcome of teaching if teaching is not re-aligned in relation to technology use (Kirkwood, 2013).

### PROPOSED AIDS MODEL

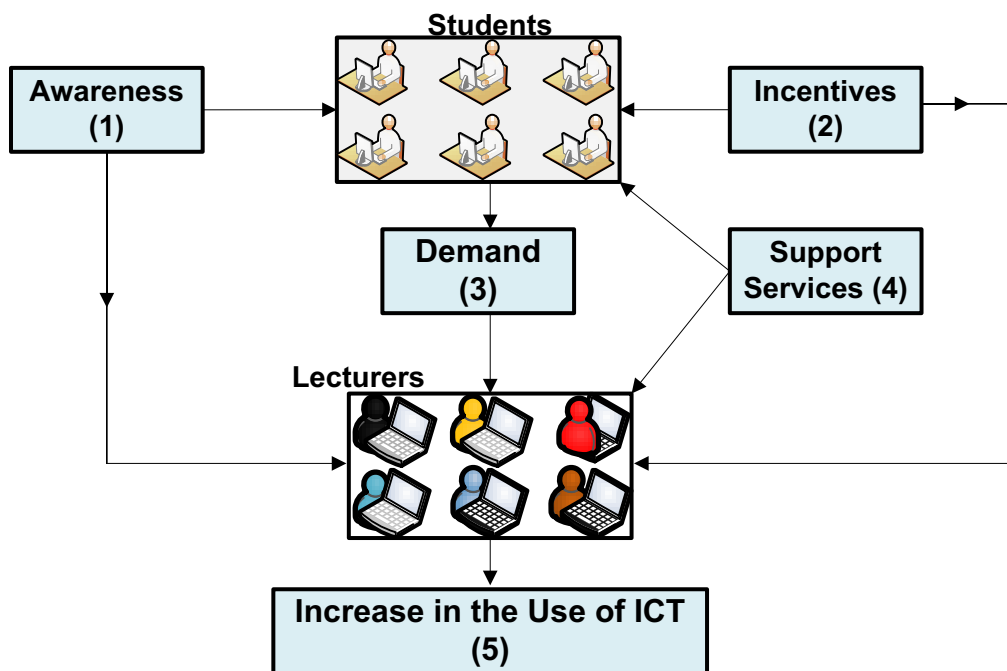


Figure 1: AIDS Model

AIDS is an ICT model that is aimed at increasing the use of ICT in education through major stakeholders consisting of teachers and students. The AIDS model is made up of four (4) major components which relate to lecturers and students. As shown in Figure 1, the initial process of the model begins with **Awareness (1)** of the ICT usage in education by both lecturers and students. Once the advantages and use of ICT are made known to both students and teachers in their various field of learning, teaching and research, **Incentives (2)** have to be provided to both students and lecturers based on the sort of motivation that will encourage the use of ICT. Through the provision of incentives such as providing computer laboratory and increase in internet bandwidth, students increase their **Demand (3)** for lecturers to integrate ICT into teaching and research so as to utilize the available ICT facilities. This leads to the need for **Support**

**Services (4)** to aid or provide help to students and lecturers on how to integrate ICT in their various fields of research or teaching. At the end of the process, there is increase in the use of ICT in the institution. In order for the proposed model to work effectively, the right ICT infrastructure (which is likely to be quite expensive) should be made available by the tertiary institution that wants implement the model.

## **MATERIALS AND METHODS**

The research methodology implemented for this study was a quantitative approach. Quantitative research is primarily about collecting data for statistical studies which is represented in a numerical form to explain a specific concept (Borrego, Douglas, Amelink, 2009). The questions that were used in the questionnaire were made up of closed ended and open ended questions. The study was guided by ethical issues. As a consequence, the questionnaires did not ask the participants to answer any personal questions.

Validity and reliability are two imperative factors to consider when developing and testing any instrument (e.g. questionnaire and content assessment test) for use in a study. Due to the fact that the proposed AIDS model consists of four (4) different components and involves a large population (students and lecturers), we utilized questionnaires as a research instrument for gathering enough data that is required to ensure the validity and reliability. Specifically, in the case of validity we considered content validity and construct validity. In relation to content validity, we verified and validated the extent to which items in our questionnaire represent the content we wish to measure (Litwin and Fink, 1995; Liu, 2010; Lamar, 2012). Furthermore, in relation to construct validity, we verified and validated the extent to which our questionnaire accurately represents a construct such students and lecturers' belief or attitude in relation to teaching, research and learning using the proposed AIDS Model (Litwin and Fink, 1995; Liu, 2010; Lamar, 2012). In terms of reliability, we considered internal consistency reliability and test-retest. In relation to internal consistency reliability, we corroborated and authenticated the consistency of the score of individual items with scores of a set of items in our questionnaire. Additionally, in relation to test-retest, we substantiated and validated the correlation of scores from one administration of our questionnaire to another (Litwin and Fink, 1995; Liu, 2010; Lamar, 2012).

The participants considered in the study were taken from Accra Technical University which is a tertiary institution that offers part-time (evening school) and full-time (regular school) Higher National Diploma (HND) and Degree (Bachelor of Technology) programmes. Accra Technical University is divided into three (3) main schools/faculties namely School of Applied Sciences and Arts, School of Engineering, and School of Business and Management Studies. There is a combination of eighteen (18) departments under the administration of these three (3) schools. The population that was considered were lecturers and full-time students. The full-time students were considered because they stay longer on campus and they form the majority of the population size that uses the university's resources.

Samples of students and lecturers from all the three (3) schools were surveyed. We divided the population under consideration based on the faculty and departments that the participant belongs to. Therefore, thirty students (30) and four (4) lecturers were taken from each school from which fifteen students and two lecturers were selected from each Academic Department per school. In all, ninety (90) students and twelve (12) lecturers were considered for the study. Statistical Package for Social Sciences (SPSS) was utilized to analyse the quantitative data received. Results of the study are presented in descriptive statistics, frequency, percentage and charts below.



### **Instruments for Data Collection**

The quantitative method involving the administration of questionnaires was selected due to the advantage of reaching out and obtaining more information from a large number of people who are not situated at one place. The questionnaire targeted both students and lecturers in order to identify challenges faced by Accra Technical University in integrating ICT in education and the suggestions proposed by the respondents. One hundred (100) questionnaires were administered to students and seventeen (17) questionnaires were administered to lecturers. We received ninety (90) questionnaires from the students representing 90% response rate and twelve (12) questionnaires from lecturers representing 70.5% response rate. These response rates showed that we received enough questionnaires for data analysis.

The questions were distributed by means of printed paper material (hard copy) to both lecturers and students. Each questionnaire for lecturers and students consisted of eleven (11) main questions with subdivisions. Questions 1-5 for both students and lecturers are made up Likert Scale (strongly disagree = 1, disagree = 2, neither agree nor disagree = 3, agree = 4 strongly agree = 5) questions focused on our proposed AIDS model. The remaining questions in the questionnaire for both lecturers and students consisted of different questions related to the encouragement, barriers, methods and ICT resources/facilities pertaining to effective ICT integration in education in Accra Technical University. The questions were categorized according to the groups that the questionnaire is directed towards (i.e. the students and lecturers). More specifically, using the component of our proposed AIDS model, the category of questions includes the following:

1. Barriers of integrating ICTs in learning and research (students)
2. Barriers of integrating ICTs in teaching and research (lecturers)
3. **Awareness**
  - a. Awareness and training of lecturers in use of ICTs in education.
  - b. Awareness and training of students in use of ICTs in education.
4. **Incentives**
  - a. Incentives for lecturers to integrate ICTs in teaching and research.
5. **Support**
  - a. Support services that can influence lecturers to integrate ICT in teaching and research.
  - b. Support services that can influence students to demand lecturers to integrate ICTs in teaching and research.
6. Factors that depict the integration of ICT in education.

In order for the AIDS model to be successful, the information below provides important aspects of the questionnaire developed for the study.

### **Awareness of the Advantage of Integrating ICT in Education**

Based on awareness under the AIDS model, the developed questionnaire includes questions relating to the organization of more workshops and seminars for lecturers and students which will serve as an advantage of integrating ICT into education. For instance, the Administration or an Academic Department of Accra Technical University can provide training based on current ICT infrastructures used in the various fields of study. Furthermore, workshops and seminars about online journals and electronic library can improve students and lecturers research abilities. Through the training provided at such workshops and seminars, both students and lecturers will be conversant in the use of ICT for research and education.

### Incentives for Integrating ICT in Education

The training on ICT usage in education in addition to providing computer laboratories and access to online journals and e-libraries will increase ICT usage in education. Moreover, the knowledge acquired from workshops together with the demanded incentives will enable lecturers and students to better understand how to implement ICT in their various fields of study, research and in their occupation. Finally, in order to provide fast access to online journals and e-libraries, there is the need to increase the internet bandwidth so as to cater for the increase in internet usage by the students and lecturers who are made aware of the benefits of using ICT in education.

### Demands for the Integration of ICT in Education

In order to relate to the questions regarding incentives for both lecturers and students, the questionnaire also included ICT demands such as the provision of peripheral devices e.g. printers and projectors. Once the demand for computer laboratories with the necessary devices are met, wireless access points can be made available in order to enable students and lecturers easily access online journals and e-library as mentioned under the incentives.

### Support Services That Will Help in the Integration of ICT in Education

Once the awareness, incentives and demands has been met, there is a need for support services. These support services will help both students and lecturers to further understand and implement ICT in education. As a consequence, questions relating to ICT support services were included in the questionnaire. For instance, the opinion of lecturers and students in relation to the availability of ICT support for academic purposes, ICT tools training, provision of online journals and E-library.

## RESULTS

### Background Characteristics of Participants

The data in Table 1 shows that male participants involved in the study are more than female participants in both categories (lecturers and students). This is due to the fact that majority of the population are males. In relation to Lecturers (Male = 83% and Female = 17%). Similarly, in relation to students (Male = 83% and Female = 17%).

*Table 1: Gender of participants*

Category	Number	Percentage
Lecturers (Male)	10	83
Lecturers (Female)	2	17
Students (Male)	71	79
Students (Female)	19	21

### Responses Gathered from Participants (Lecturers and Students)

Tables 2-9 and Figures 2 and 3 below illustrate responses gathered from both lecturers and students. The results were divided into two main categories namely responses obtained from the Likert Scale questions as well as objective questions relating to the proposed AIDS model. In Table 2-9, TN = Total Number, M = Mean, SE = Standard Error, SD = Standard Deviation and V = Variance. In our data analysis, a high M value represents the most selected category by the participants. Additionally, a low SE corresponds to a high M. As a consequence, if the SE for a

particular category is high, then its corresponding M is not valid. Furthermore, SD refers to how dispersed the received data is and the V represents the differences that exist in the mean of the Likert scale of a particular category.

**Table 2: Barriers of integrating ICT in learning and research (students)**

	<b>TN</b>	<b>M</b>	<b>SE</b>	<b>SD</b>	<b>V</b>
<b>Inadequate internet bandwidth</b>	90	4.02	0.13	1.26	1.60
<b>Inadequate appropriate ICT infrastructure</b>	90	3.92	0.13	1.26	1.58
<b>Inadequate ICT ready classrooms</b>	90	3.81	0.13	1.28	1.64
<b>Poor access to software for lecturers and students</b>	90	3.68	0.14	1.34	1.79
<b>Inadequate technical support</b>	90	3.63	0.14	1.34	1.81
<b>Insufficient number of computers for lecturers and students</b>	90	3.89	0.13	1.27	1.61
<b>Inadequate appropriate administrative support</b>	90	3.41	0.12	1.16	1.35
<b>Inadequate knowledge/skills for ICT integration in learning and research.</b>	90	3.64	0.13	1.26	1.58
<b>Inadequate in-service and re-training in ICTs</b>	90	3.62	0.13	1.25	1.56
<b>Challenges faced in accessing course content and instructional programs</b>	90	3.66	0.13	1.23	1.51
<b>Insufficient time to use ICT.</b>	90	3.78	0.14	1.33	1.77

As shown in Table 2, in relation to the responses from students, inadequate Internet bandwidth (which has the highest M value) was the major reason for the difficulty of integrating ICT in learning and research (M = 4.02, SE = 0.13, SD = 1.26 and V = 1.60). This analysis is followed by students agreeing to the fact that, there isn't enough ICT infrastructures that will enable the integration of ICT (M = 3.92, SE = 0.13, SD = 1.26 and V = 1.58).

Furthermore, the results in Table 2 show that the number of computers that are made available to students and lecturers are insufficient (M = 3.89, SE = 0.13, SD = 1.27 and V = 1.61). This is followed by poor access to software needed by the respondents (M = 3.68, SE = 0.14, SD = 1.34 and V = 1.79). Based on the responses gathered from students, insufficient number of computers has created a challenge in accessing course contents and instructional programmes (M = 3.66, SE = 0.13, SD = 1.23 and V = 1.51). The results also show that there isn't enough knowledge for ICT integration in teaching and research (M = 3.64, SE = 0.13, SD = 1.26 and V = 1.58). This is due to inadequate ICT facilities available in Accra Technical University. It is also revealed in Table 2 that, other categories that correspond to a high M value include: inadequate ICT ready classrooms (M = 3.81, SE = 0.13, SD = 1.28 and V = 1.64), and insufficient time to use ICT (M = 3.78, SE = 0.14, SD = 1.33 and V = 1.77).

**Table 3: Barriers of integrating ICT in teaching and research (lecturers)**

	<b>TN</b>	<b>M</b>	<b>SE</b>	<b>SD</b>	<b>V</b>
<b>Inadequate internet bandwidth</b>	12	4.25	0.39	1.36	1.84
<b>Inadequate appropriate ICT infrastructure</b>	12	4.75	0.13	0.45	0.20
<b>Inadequate ICT ready classrooms</b>	12	4.67	0.14	0.49	0.24
<b>Inadequate software for lecturers and students</b>	12	4.42	0.34	1.16	1.36
<b>Inadequate administrative support</b>	12	3.92	0.29	1.00	0.99
<b>Inadequate knowledge/skills for ICT integration in teaching, and research.</b>	12	3.33	0.43	1.50	2.24
<b>Inadequate in-service and re-training in ICTs</b>	12	4.08	0.38	1.31	1.72
<b>Challenges faced in accessing course contents and instructional programmes</b>	12	3.75	0.37	1.29	1.66
<b>Insufficient time to use ICT.</b>	12	3.58	0.42	1.44	2.08

According to Table 3, although the population size of lecturers sampled compared to the students is relatively smaller, the results obtained illustrate that there isn't enough ICT infrastructures, which leads to an obstacle or a barrier of integrating ICT in teaching and research as shown with a high M value of 4.75 (M = 4.75, SE = 0.13, SD = 0.45 and V = 0.20). According to the responses gathered from lecturers, there aren't enough classrooms to provide the infrastructures that are needed for teaching, learning and research (M = 4.67, SE = 0.14, SD = 0.49 and V = 0.24). Furthermore, software needed by both lecturers and students are not enough (M = 4.42, SE = 0.34, SD = 1.16 and V = 1.36). Table 3 also illustrates that, other categories that correspond to a high M value include: inadequate administrative support (M = 3.92, SE = 0.29, SD = 1.00 and V = 0.99), and challenges faced in accessing course contents and instructional programmes (M = 3.75, SE = 0.37, SD = 1.29 and V = 1.66).

Results in Table 4 reveal that providing training on the use of electronic journals, e-library, Google scholar and Internet search will influence the students in terms of ICT usage for their studies and research. This is illustrated through the results in the third row of Table 3 (M = 3.98, SE = 0.13, SD = 1.28 and V = 1.64) which is followed closely by training students on the use of a learning management system (M = 3.97, SE = 0.12, SD = 1.11 and V = 1.22). Results in Table 4 also indicate that there is a need for training of students in the use of ICTs (M = 3.97, SE = 0.12, SD = 1.11 and V = 1.22), and facilitating workshops for students on the advantages of ICTs (M = 3.70, SE = 0.15, SD = 1.45 and V = 2.10). This means that, in order to introduce and influence the integration of ICT in education, Accra Technical University should put more emphasis in providing learning management systems, electronic journals and an e-library.

**Table 4:** Factors that can cause the awareness and training of students in use of ICTs in learning and research

	<b>TN</b>	<b>M</b>	<b>SE</b>	<b>SD</b>	<b>V</b>
<b>Awareness of workshops for students on advantages of ICTs.</b>	90	3.70	0.15	1.45	2.10
<b>Training students on the use of learning management system (e.g. Moodle).</b>	90	3.97	0.12	1.11	1.22
<b>Training students on the use of electronic journals, e-library, Google scholar, and internet search.</b>	90	3.98	0.13	1.28	1.64
<b>Compulsory training of students on the use of ICTs.</b>	90	3.96	0.13	1.24	1.55

Table 5 depicts that having more workshops that explains how to integrate ICT in teaching and research and its benefits will help reduce the barriers of integrating ICT in teaching and research. This is depicted in the first row of Table 5, which has the highest M value ( $M = 4.58$ ,  $SE = 0.19$ ,  $SD = 0.67$  and  $V = 0.45$ ). This analysis is followed by training lecturers on the use of ICTs e.g. email, PowerPoint presentations, electronic boards ( $M = 4.42$ ,  $SE = 0.23$ ,  $SD = 0.79$  and  $V = 0.63$ ). The next highest M value involved increase in the number of research materials and publications ( $M = 4.33$ ,  $SE = 0.36$ ,  $SD = 1.23$  and  $V = 1.52$ ).

**Table 5:** Awareness and training of lecturers in the use of ICTs in teaching and research

	<b>TN</b>	<b>M</b>	<b>SE</b>	<b>SD</b>	<b>V</b>
<b>Awareness of workshops for lecturers on advantages of integrating ICT in teaching and research.</b>	12	4.58	0.19	0.67	0.45
<b>Training lecturers on the use of ICTs e.g. email, PowerPoint presentations, electronic boards.</b>	12	4.42	0.23	0.79	0.63
<b>Training lecturers on the use of electronic learning management system for e.g. Moodle</b>	12	4.25	0.22	0.75	0.57
<b>Training lecturers on the use of electronic journals, e-library, and internet search.</b>	12	4.08	0.31	1.08	1.17
<b>Increase in the number of research materials and publications.</b>	12	4.33	0.36	1.23	1.52

Results in Table 6 shows that, having adequate computer laboratory is deemed the most important incentive necessary for demanding the integration of ICT in teaching and research. This

is represented in the third row of Table 6 ( $M = 4.21$ ,  $SE = 0.12$ ,  $SD = 1.12$  and  $V = 1.25$ ). The category with the next highest  $M$  value involves requirement of resources such as availability of wireless access on campus and hostels ( $M = 4.02$ ,  $SE = 0.13$ ,  $SD = 1.25$  and  $V = 1.57$ ). The third highest  $M$  value involved the availability of ICT equipment in lecture rooms ( $M = 4.01$ ,  $SE = 0.13$ ,  $SD = 1.23$  and  $V = 1.52$ ) which is followed by the access to online journals, Internet bandwidth and lastly provision of learning management systems. The results in Table 6 show that the provision of necessary facilities relating to ICT will introduce the implementation of other resources for the integration of ICT in teaching and research.

**Table 6:** Incentives for students to demand for lecturers to integrate ICTs in teaching and research

	TN	M	SE	SD	V
<b>Availability of wireless access point around campus and hostels is an important incentive to motivate students to demand lecturers to integrate ICTs in teaching and research.</b>	90	4.02	0.13	1.25	1.57
<b>Availability of ICT equipment in lecture rooms</b>	90	4.01	0.13	1.23	1.52
<b>Availability of adequate computer laboratory for students.</b>	90	4.21	0.12	1.12	1.25
<b>Availability of electronic learning management systems</b>	90	3.94	0.12	1.18	1.40
<b>Availability and free access to online journals</b>	90	4.01	0.13	1.24	1.54
<b>Increasing Internet bandwidth for students.</b>	90	4.00	0.14	1.30	1.69

Results in Table 7 reveal that, student respondents mostly agree that providing online help (help desk) will cause them to demand for lecturers to integrate ICT in teaching and research ( $M = 3.88$ ,  $SE = 0.12$ ,  $SD = 1.15$  and  $V = 1.32$ ). This is followed by providing help through email ( $M = 3.82$ ,  $SE = 0.13$ ,  $SD = 1.20$  and  $V = 1.45$ ) and mobile phone ( $M = 3.56$ ,  $SE = 0.14$ ,  $SD = 1.33$  and  $V = 1.78$ ). According to the results in Table 8, most lecturers agreed that provision of online help desk will support the integration of ICT in education better ( $M = 3.58$ ,  $SE = 0.40$ ,  $SD = 1.38$  and  $V = 1.90$ ). Setting up help desk for lecturers with mobile phone was the least selected option ( $M = 2.67$ ,  $SE = 0.48$ ,  $SD = 1.67$  and  $V = 2.79$ ). Results in Tables 7 and 8 indicate that both the students and lecturers agree in principle that the use of online help desk will support the integration of ICT.

**Table 7:** Support services that can influence students to demand lecturers to integrate ICTs in learning and research

	<b>TN</b>	<b>M</b>	<b>SE</b>	<b>SD</b>	<b>V</b>
<b>Setting up help desk for students with online (web site) access.</b>	90	3.88	0.12	1.15	1.32
<b>Setting up help desk for students with email.</b>	90	3.82	0.13	1.20	1.45
<b>Setting up help desk for students with mobile phone.</b>	90	3.56	0.14	1.33	1.78

**Table 8:** Support services that can influence lecturers to integrate ICT in teaching and research

	<b>TN</b>	<b>M</b>	<b>SE</b>	<b>SD</b>	<b>V</b>
<b>Setting up help desk for lecturers with mobile phone.</b>	12	2.67	0.48	1.67	2.79
<b>Setting up help desk for lecturers with email.</b>	12	3.08	0.47	1.62	2.63
<b>Setting up help desk for lecturers with online (web site) access.</b>	12	3.58	0.40	1.38	1.90

According to the results in Table 9 which relates to ICT incentives, most lecturers selected availability and free access to online journals, e-library and databases ( $M = 4.58$ ,  $SE = 0.26$ ,  $SD = 0.90$  and  $V = 0.81$ ), followed by Availability of ICT equipment in lecture rooms e.g. PowerPoint projectors, electronic boards ( $M = 4.50$ ,  $SE = 0.26$ ,  $SD = 0.90$  and  $V = 0.82$ ) and increasing Internet bandwidth ( $M = 4.42$ ,  $SE = 0.34$ ,  $SD = 1.16$  and  $V = 1.36$ ). The least incentive that was selected involved the provision of financial remuneration to lecturers who integrate ICTs in teaching and research ( $M = 3.75$ ,  $SE = 0.35$ ,  $SD = 1.22$  and  $V = 1.48$ ). Results in Table 9 indicate that if the above incentives are provided to lecturers in Accra Technical University, integrating ICT in teaching and research can be achieved.

Figure 3 illustrates that, lecturers mostly use word processing software (34%) compared to all the other software provided in the question. This may be due to the need of the software to prepare lecture materials for students and publication of their research. The above result is followed by browsing software (rate of 21%) which is mostly used to search for research materials. Figure 2 below shows that, 54% of the students mostly use Browser software compared to the other software provided in the options. Browser software is mostly used on the student's computers and mobile phones that support wireless network or Internet services.

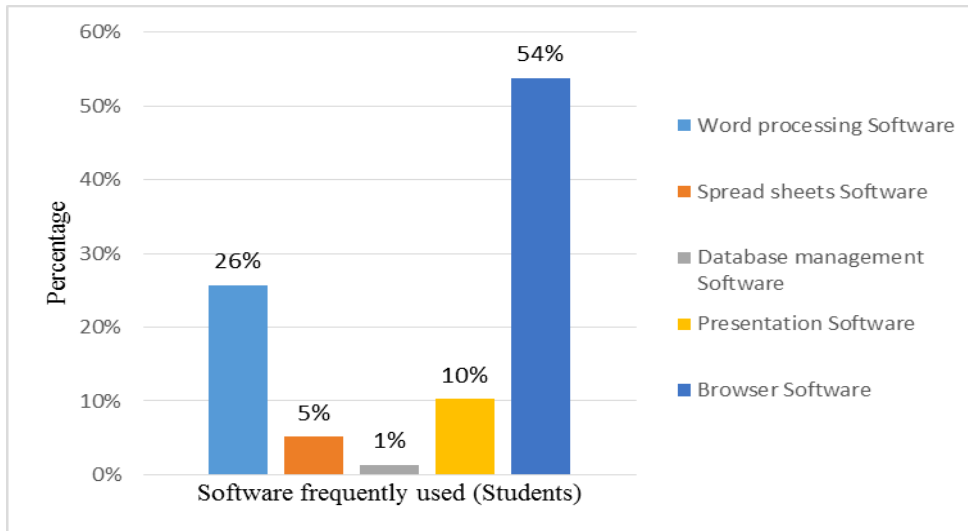
**Table 9:** Incentives for lecturers to integrate ICTs in teaching and research

	<b>TN</b>	<b>M</b>	<b>SE</b>	<b>SD</b>	<b>V</b>
<b>Availability of ICT equipment in lecture rooms (e.g. PowerPoint projectors, electronic boards)</b>	12	4.50	0.26	0.90	0.82
<b>Availability and free access to online journals, e-library and databases.</b>	12	4.58	0.26	0.90	0.81
<b>Providing financial remuneration to lecturers who integrate ICTs in teaching and research</b>	12	3.75	0.35	1.22	1.48
<b>Providing free laptop computers and software to lecturers.</b>	12	4.00	0.43	1.48	2.18
<b>Availability of electronic learning management systems e.g. Moodle.</b>	12	4.17	0.39	1.34	1.79
<b>Increasing Internet bandwidth.</b>	12	4.42	0.34	1.16	1.36

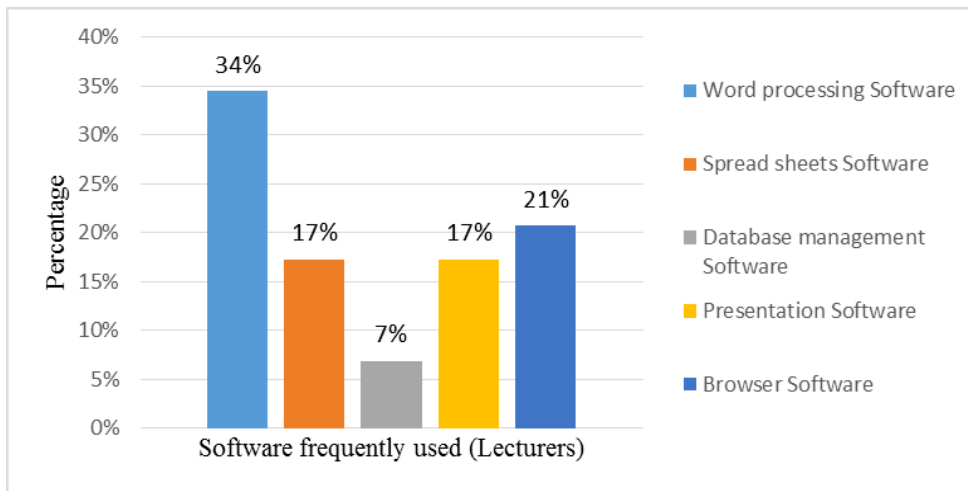
## DISCUSSION AND EVALUATION OF THE AIDS MODEL

The rapid proliferation of ICTs has paved way for technological advancements in education. Globally, many Higher Educational Institutions (HEIs) are implementing different forms of ICTs in education using different modes such as electronic learning (e-learning) and mobile social learning (Asabere and Enguah, 2012; Xia et al., 2013, Asabere, 2013). Higher education is one of the most important sectors for developing the human capital of various countries worldwide. Through effective development of human capital, higher education enables various countries to support innovation and find new solutions for sustainable and justifiable growth (Muianga et al., 2013).





**Figure 2:** Software frequently used (students)



**Figure 3:** Software frequently used (lecturers)

Pedagogic methods of education through ICT has to be adopted by teachers, researchers and learners respectively. Initially, teachers have to sensitize themselves with ICT methods of teaching to improve their pedagogy. This concept can then be transformed to students. The ICT competency and skills of both teachers, students and staff should be upgraded (Asabere, 2013; Buabeng-Andoh, 2012). There is a recognition that for Ghana to make any considerable progress in its socio-economic development efforts, sustainable resources are needed to reduce the percentage of the population without educational achievement. This will widen the access to tertiary/higher education by the enormous majority of the population and hence increase the percentage of population with tertiary level education (Asabere and Enguah, 2012; Asabere, 2013; Buabeng-Andoh, 2012).

In order to successfully develop and implement the AIDS model in this paper, it was very necessary to review our research questions and ascertain the barriers and obstacles lecturers and students in Accra Technical University face in integrating ICT in education and also to consider important variables or needed resources that influence both teachers and students to encourage them to use ICTs for education.

Based on the research conducted, the findings revealed that integrating ICT in education in Accra Technical University is quite difficult due to: inadequate ICT infrastructure equipped in lecture rooms and laboratories, poor wireless access connectivity on campus and not enough Internet bandwidth for students and lecturers to access necessary resources for their education and research. Due to inadequacy of ICT infrastructures, there isn't enough means of accessing online journals and an e-library. Furthermore, the software that are needed by both the lectures and students are not provided or are difficult to access thereby hindering the attainment of knowledge or skills of the ICT usage in education.

Referring to the analysis carried out, the favorable method of integrating ICT in education is to provide the ICT infrastructures and resources. Furthermore, the provision of a website as a means for lecturers to offer and access the necessary ICT resources and support services is very necessary. Additionally, there should be a platform for students to access documents and other information in their areas of study or research.

Lastly, most respondents stated in the questionnaire that there is a need for training on the use of current software which are used internationally in their various fields of study or research. In addition, there is the need for an intranet in Accra Technical University which will provide resources such as lecture notes and research materials which can be made available by a lecturer without totally depending on the Internet. This is because the Internet may attract more traffic on the network or may take longer to resolve issues if problems were to arise leading to the inefficiency of the network.

In order to implement the AIDS model, a web portal was created to provide both students and teachers in Accra Technical University with the necessary materials for teaching and/or research. The number of lecturers and students used for evaluating the AIDS model were thirty (30) and one hundred (100) respectively. Multimedia sources for explaining a practical method or concept for various courses were also made accessible to the selected students and teachers. In the use of the web portal, both students and teachers agreed that more ICT infrastructure was necessary to realize the advantages of ICT in education. The model allowed the opinions of both students and teachers to be taken into consideration for effective implementation of ICT in education. In the AIDS model effective support services were provided based on the type of demands made by both teachers and students. This proves that AIDS model increases the use of ICT by both lecturers and students in tertiary institutions.

## **CONCLUDING REMARKS AND FUTURE WORK**

The introduction and proliferation of ICT in education has provided teaching, learning and research opportunities for tertiary institutions in Africa. However, some tertiary institutions in Africa have not realized the benefits of these opportunities as a result of barriers of ICT in education. These barriers include: inappropriate physical environment and ICT infrastructure, unsuitable course content and instructional programs, unsatisfactory number of computers to be used by lecturers and students, inadequate hardware/software, the unavailability of technical and appropriate administrative support and absence of fundamental knowledge/skills for ICT as well as knowledge/skills for ICT integration in education.

In order to promote and inspire students and lecturers to integrate ICT in teaching, learning and research, this paper through a quantitative research methodology (questionnaire) proposed and ICT in education model called AIDS. The questionnaire for this research was developed using components of the AIDS model and administered to ninety (90) students and twelve (12) lecturers in Accra Technical University. The AIDS model inspires and sensitizes lecturers and students so that they will be aware of ICT in education; promotes the delivery of incentives for lecturers and students; and creates the required demand for integration of ICTs in education through students as catalyst for change and delivery of support services. Results of the study revealed that the proposed AIDS model is appropriate for integrating ICT in education in Accra Technical University.

A limitation of this research study is the population size in relation to the number of tertiary institutions in Ghana. In order to further substantiate the proposed AIDS model in this paper, further research, evaluation and implementation in many other tertiary institutions in Ghana is very necessary, vital and relevant. Since this research work is limited to Accra Technical University, future work will focus on increasing the population size through the promotion of further research design, elaboration and development of a workbook for the proposed AIDS model so that many other tertiary institutions (traditional and technical universities) in Ghana can use it to encourage and motivate their lecturers and students to integrate ICT in education.

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