Journal of Agricultural Education,
57(1), 137-149. doi: 10.5032/jae.2016.01137

Adoption of Information and Communication Technologies (ICTs) by Agricultural Science and Extension Teachers in Abuja, Nigeria

Olugbenga Omotayo Alabi[1]

Abstract

This study examined adoption of Information and Communication Technologies (ICTs) by agricultural science and extension teachers in Abuja, Nigeria. Specifically, the objectives are to: identify the background and demographic characteristics of agricultural science and extension teachers in the study area; examine the factors influencing adoption of ICTs by respondents and determine the challenges or constraints militating against adoption of ICTs by respondents in the study area. Data were collected from 60 purposively selected agricultural science and extension teachers in the study area. Data were analyzed using descriptive statistics SPSS 19.0, Likert scale, t-test and Logit model. Ages, teachers' experience, access to ICTs were significant factors influencing adoption of ICTs by respondents at 1% probability level. Teachers' attitude, teachers' awareness significantly influences adoption of ICTs by respondents at 5% probability level. Word processors are perceived useful in setting tests and examination question papers, while, photocopy machine was perceived ease to use to make copies of teaching materials. Access to appropriate ICTs equipment and lack of infrastructure such as irregular electricity supply are the major challenges. The study recommends easy access, awareness and use of ICTs by instructors and regular supply of electricity to improve and stimulates adoption of ICTs by respondents.

Keywords: - ICTs, Agricultural Science and Extension Teachers, Abuja Nigeria.

Introduction

Information and Communication Technology (ICTs) covers any product that will store, retrieve, manipulate, transmit or receive information in a digital form. Available data suggest that the majority of developing countries, such as sub-Saharan Africa, are lagging behind in the information revolution (Zhao & Frank, 2003). There is little doubt that sub-Saharan Africa's populations (agriculture science and extension teachers included) are missing out on the booms of ICTs in educational management (Bigum, 2000). As the region is lagging behind in adoption, use and innovation in the ICTs sectors. The people of sub Saharan Africa are missing out on a better education and well managed educational systems and facilities (Kipsoi, Chang'ach & Sang, 2012). In Sub-Sahara Africa, the social barrier to ICTs diffusion and adoption include access issues, the appropriateness of ICTs to African culture, Africa's lack of communication channels, and lack of ICTs education and training (Totolo, 2007). Some of the economic barriers have to do with Africa's underdevelopment, civil wars, corruption in the government. Statistics abound on the low density of telephone lines, the lack of clean water and electricity to mention but a few (Akpan, 2000; Jesen, 2002; Oladele, 2001; Onyango, 2000; Totolo, 2007). According to Totolo (2007), Africa is the second largest continent and the least computerized. Most of Africa is characterized by a dearth of national information policies and this has contributed immensely to the failure of information technology adoption (Berman & Tettey, 2001; Korac-Kakabadse et al, 2000; Totolo 2007; United

[1]Olugbenga Omotayo Alabi is an Associate Professor in the Department of Agricultural Economics and Extension, Faculty of Agriculture, University of Abuja, P.M.B 117 Gwagwalada-Abuja, Abuja, Nigeria, omotayoalabi@yahoo.com

Nations Economic Commission for Africa, 2001; Wilson & Wong, 2003). According to United Nations Economic Commission for Africa (2001), the process for setting up ICTs policies and strategies is a work in progress, but it is rather slow because it requires concentrated effort from all parties, including the national governments, for effective leadership and direction. The Economic Commission for Africa (2001) goes on to say that the few national information policies that have been formulated have been marked by their lack of comprehensiveness in terms of content and coverage. Africa does not have the infrastructure or the skilled manpower to accelerate ICTs adoption. Onyango (2000) summed up the magnitude of the political problems saying that the policies have tended to fail in Africa because there has been no thread of continuity or review process in all policy matters. Murphrey, Arnold, Foster and Degenhart (2012) stated that research is needed to determine how technology can be used to improve learning and the learning environment, especially from the learner's perspective. Roades, Irani, Telg and Myers (2008) reported a majority of college of agriculture students own computer and are users of audio/video technology, which indicate these types of technology could be a viable teaching tool. There is enough evidence from existing literatures that "teachers are slow to recognize the benefits of new technologies" (Zahari, 2005, p 1). Cassim and Eyono Obono (2011) stated that the "learning opportunities provided by the increasing use of technology in classrooms are not being exploited in schools generally" (p.1). ICTs have contributed greatly to educational management in schools worldwide (Kipsoi, Chang'ach & Sang, 2012).

Conceptual Framework

UNESCO (2002) posited that the existing cognitive structure of the learner determine how new information is perceived and processed. If the new information makes sense to the existing structure of the learner then the new information item is incorporated into the structure (i.e., assimilation). If the data are very different from the existing mental structure of the learner, they are either rejected or transformed in ways so that it fits into the structure (i.e., accommodation). Learning occurs through adaption to interactions with the environments. ICTs can be used to support the learning environment by providing tools for discourse, discussions, collaborative writing, problem-solving, and by providing online support systems to scaffold students' evolving understanding and cognitive growth. The design of effective ICT-based learning environments should take into account how the human mind works and what are its cognitive limitations (Kalyuga, 2009). Most educational cognitive process occurs consciously and involves information from the learner's knowledge base. These attributes (consciousness and knowledge base) are associated with two major components of our cognitive structures: working memory (a conscious information processor) and long-term memory (a store of knowledge). In order to be efficient, ICTs-based learning formats and methods need to be tailored to cognitive characteristics of learner (Kalyuga, 2009).

The adoption and use of ICTs in education have a positive impact on teaching, learning, and research. ICTs can affect the delivery of education and enable wider access to the same. In addition; ICTs increase flexibility as learners can access the education regardless of time and geographical barriers. It can also influence the way students are taught and how they learn (Noon-Ul-Amin, 2009). Results from the survey of 360 teachers from a ICTs training project in Cambodia indicate that most teachers make use of acquired ICTs skills in some ways after training and some teachers actually re-invent the way to use their acquired skills. However, according to the results of the same study, the integration of ICTs in teaching is still difficult for some teachers as they require some training and practice (Richardson, 2009). A 2010 study by Van Mele, Wanwoeka and Zossou found that 78% of development organizations, including universities, research institute and non-government organizations (NGOs) use video to train farmer (Cai & Abbott, 2013). Until recently, however, video training in rural areas required generators, DVD players, projectors and other audio-visual equipment. Videos can be very persuasive (Cai & Abott, 2013). Agricultural

concepts and technologies can be hard to describe in words. Concepts are easily understood when demonstrated visually (Gandhi et al., 2007). Long agricultural processes can be compressed into short video segments, thus enhancing training efficiency (Cai & Abbott, 2013). There are both benefits and challenges to teaching ICTs and research must be conducted to determine which communication technologies are perceived as entertainment tools versus information tools (Rhoades, Friedel & Irani, 2008).

According to Kumar et al., (2008) "there is need to examine the factors affecting teachers' computer use and its implication to teachers' professional development" (p.1127). According to Cassim and Eyono Obono (2011), user acceptance of a given technology is affected by their perceptions on the usefulness and ease of use of the technology. Murphrey et al. (2012) stated that men and women were nearly diametrically opposite in the perception, acceptance of technology, illustrating how gender can play a role in perception, acceptance and use of technology. Vankatesh and Morris (2000) stated "men consider perceived usefulness to a greater extent than women , perceived ease of use was more salient to women compared with men and men perceived technology as easier to use as time went on, compared to women perceiving it as harder to use with the passage of time"(p. 128). Cai and Abbot (2013) reported that video training can bridge the knowledge and information gaps between men and women.

Purpose and Objectives

The purpose of this study was to document the level and role of ICTs as they relate to agricultural science and extension teachers in Abuja, Nigeria. In order to address this purpose, the objectives that guided the study were: (a) identify the background and demographic characteristics of agricultural science and extension teachers in the study area; (b) examine the factors influencing adoption of Information and Communication Technology (ICTs) by agricultural science and extension teachers in the study area; and (c) determine the challenges or constraints militating against adoption of ICTs by participants in the study area.

Method and Procedures

Population and Sample

The target population was agricultural science and extension teachers in higher institutions in Abuja, Nigeria. A reconnaissance survey was conducted to identify and obtained comprehensive list of all the agricultural science and extension teachers in all higher institutions in Abuja, Nigeria. The accessible population and the sample for this study consisted of 60 agricultural science and extension teachers. Purposive sampling design was used to sample and identified teachers for the study.

Instrument

A questionnaire was used. The instrument contained questions with specific focus on (a) background and demographic characteristics of agricultural science and extension teachers; (b) factors influencing adoption of ICTs by respondents; (c) type of ICTs used; (d) teachers' attitude; (e) perceived usefulness of ICTs; (f) perceived ease of use of ICTs by respondents; and (g) challenges or constraints faced by the agricultural science and extension teachers. Previous literatures were consulted (Cassim & Eyono Obono, 2011) to derive the questions and to get the apriori expectations of relevant variables included in the model. The instrument contained closed and open ended questions. A total of 70 questionnaires were administered to agricultural science and extension teachers with 60 questionnaires recovered and used for the analysis for a response rate of 87%.

Validity and Reliability of the Instrument

Content validity was established by using a panel of expert in the extension education field. The panel of expert was given a copy of the instrument and asked to comment on its contents. Experts' comments and suggestions were incorporated into the final instrument. The drafts of the questionnaires were purposively given to Agricultural Science and Extension Teachers for validation. Items were validated using test-re-test reliability. In test-re-test reliability the same measuring instrument was used to take two separate measurements on the same population at different times. The reliability coefficient was 0.86.

Procedures and Analysis

Questionnaires were administered using purposive sampling design in January 2014. Respondents included agricultural science and extension teachers in higher institutions of learning in Abuja, Nigeria. Data were analyzed using SPSS 19.0 according to Gall, Gall, and Borg (2003). Descriptive statistics were used to describe the following: the background and demographic characteristics of respondents; types of ICTs used; teachers' attitude; perceived usefulness of ICTs; perceived ease of use of ICTs; and challenges and constraints faced by respondents in adopting ICTs. Likert scale questions were constructed using a four-point scale. An independent sample t-test was used to determine if a significant difference existed between variables included in the Logit Model and adoption of ICTs by agricultural science and extension teachers. The Logit model is based on cumulative probability function and the transformation is such that a cumulative distribution is estimated, thereby eliminating the (0, 1) problem associated with linear probability model (Pindyck & Rubinfeld, 1981). The Logit model was empirically estimated as:

$$Z_i = L_n\left(\frac{Pi}{1-Pi}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \cup_i$$

Where, Zi = is the choice index of teachers (1, Adopt ICTs. 0; Otherwise)
X_1 = Age (Years)
X_2 = Teaching Experience (Years)
X_3= Access to ICTs (1, Access; 0, Otherwise)
X_4= Teaching Attitude (Units)
X_5= Teacher Awareness (1, Aware; 0, Otherwise)
$\cup_i$= Error Term

Results and Findings

Objective 1: Description of Background and Demographic Characteristics of Agricultural Science and Extension Teachers in Abuja Nigeria

The study revealed that 83% of the participants were male and nearly 67% were between ages of 31-50 years. Fifty-seven percent of participants reported being employed in their current professional position less than 20 years ago. Sixty-six percent of the subjects categorized themselves as having Ph.D qualifications. Table 1 shares detailed background and demographic information of agricultural science and extension teachers in the study area. This study also alleviates the fears gender can play with respect to perception, acceptance and use of technology as observed by Murphey et al. (2012).

Table 1
Background and Demographic Characteristics of Agricultural Science and Extension Teachers in Abuja, Nigeria.

Background and Demographic Characteristics	Frequency	Percentage
Gender		
Male	50	83.33
Female	10	16.67
Age (Years)		
31 – 40	10	16.67
41 - 50	30	50.00
51 - 60	18	30.00
> 60	02	03.33
Teaching Experience (Years)		
0 – 10	9	15.00
11 – 20	25	41.67
21 – 30	16	26.67
31 – 40	10	16.66
Highest Qualification Obtained		
Ph.D	40	66.67
M.Sc	19	31.67
B.Sc	01	1.66
Total	**60**	**100.00**

Objective 2: Factors influencing Adoption of Information and Communication Technologies (ICTs) by Agricultural Science and Extension Teachers in Abuja, Nigeria.

Ages, teaching experience and access to ICTs were significant factors influencing adoption of ICTs by agricultural science and extension teachers in the study area at 1% probability level respectively. The coefficients of age, teaching experience and access to ICTs were positive (see Table 3). These findings are in consonance with a priori expectations as stated in Table 2, for example, age could positively influence adoption of ICTs. As the teachers becomes older in age, could maintain technologies they are accustomed to many years ago thereby negatively influencing this adoption of ICTs. Teaching attitude and teachers' awareness are also significant factors influencing adoption of ICTs by agricultural science and extension teachers in the study area at 5% probability levels respectively (see Table 3). The coefficient of teaching attitude is negative and this implies that teachers' attitude could negatively influence adoption of ICTs by the teachers, which agrees with a priori sign as stated in Table 2. Eighty-eight percent of maximum likelihood estimates are correctly predicted.

Table 2
A Priori Expectations of Explanatory Variables included in the Logit Model

Explanatory Variables	A priori Signs
Age	±
Teaching Experience	+
Access to ICTs	+
Teaching Attitude	±
Teaching Awareness	±

Table 3
Maximum Likehood Estimates of the Logit Model Result of Adoption of ICTs Agricultural Science and Extension Teachers in Abuja, Nigeria.

Variable	Coefficient	t-value
Age (X_1)	0.189	2.727***
Teaching Experience (X_2)	0.315	2.819***
Access to ICTs(X_3)	0.157	2.921***
Teaching Attitude (X_4)	-0.671	2.67**
Teachers Awareness (X_5)	0.812	2.615**
Size of Log-Likelihood	-81.45	
Likelihood Ratio Test	71.75***	
% Correction Prediction	88.2	
Goodness of Fit	39.41***	

***- Significant at 1% probability level; **- Significant 5% probability level

Participants were asked whether the teaching attitudes presented in Table 4 had influenced them to adopt ICTs in the area. Nineteen percent of the subjects prefer to get other people to do ICTs related task for them rather than do it themselves. Participants believed that ICTs are scaring and frustrating and a luxury for most of their learners. According to Sang et al., (2009) and Zhao and Cziko (2001), teachers' educational beliefs could impact on their use of ICTs.

Table 4
Agricultural Science and Extension Teachers' Attitude to ICTs in Abuja, Nigeria.

Teaching Attitude	F	%
Computer cannot cater for most of the emotional aspect of teaching and learning	78	10.03
Teaching is normally about books, pen, pencils, chalk and the blackboard	110	14.14
ICTs are quite scary and frustrating and are a luxury for most of my learners	131	16.84
I prefer to get other people to do ICTs related task for me than do it my self	151	19.41
Most of my learners spend too much time playing computer games	76	09.77
Most of my learners get their eyesight damaged by computer screens	41	05.27
ICTs usually makes my learner lose interest in reading and writing with a negative affection on their spelling, speech and handwringing	120	15.42
Computer and ICTs usually provide my learners with opportunity to cheat	71	09.13
Total	**778***	**100.00**

* Multiple Responses

A comparison between agricultural science and extension teachers on the type of ICTs adopted revealed that extension teachers use public address system (21%) and video (12%) respectively (see Table 5). Training that combines video and traditional methods such as lectures and farmer-to-farmer extension has proven to be more effective than traditional training methods alone (Grandhi et al., 2007; Zossou, Van Mele, Vodouhe & Wanvoke, 2009b,). In many projects, video has replaced traditional training and serves as a stand-alone knowledge and innovation

dissemination approach. Video-mediated training has a strong potential to overcome information inequality (Bery 2003; Lie & Mandler 2009; Zossou et al., 2010) again this alleviate the fears as shown by Murphrey et al. (2012). Agricultural science teachers use photocopying machine (16%) and public address system (17%) mostly to reach their students.

Table 5
Types of ICTs used by Agricultural Science and Extension Teachers in Abuja, Nigeria.

Types of ICTs	**Agricultural Science**		**Extension**	
	F	**%**	**F**	**%**
Computer (Microsoft Excel, Spreadsheet Applications, Word Processor, Microsoft Word etc.)	110	8.59	81	8.14
Video	34	2.65	121	12.16
Twitter™	31	2.42	21	02.11
Overhead Projector	181	14.13	51	05.13
Internet Facilities	161	12.57	121	12.16
E-mail	171	13.35	101	10.15
Photocopying Machine	213	16.63	121	12.16
Public Address System	219	17.10	210	21.11
Video Covering Machine	161	12.57	168	16.88

*Multiple Responses

Tables 6 and 7 revealed that 16% of participants prefer word processors to help set tests and exams questions. They also use phocopying machines to make copies of teaching material respectively. Other factors found by existing research as affecting the adoption of ICTs for the teaching include: teachers' perception on how subject should be taught (Crisan, 2004); teachers perception on the value of historical education practices (Crisan, 2004); a lack of time for ICTs adoption (Jones, 2004; Keong et al., 2005); teachers age (Jones 2004); and teachers perceptions on the effectiveness and usefulness of ICTs (Chrysostomou & Moulides, 2009).

Table 6
Perceived Usefulness of ICTs by Agricultural Science and Extension Teachers in Abuja, Nigeria.

Perceived Usefulness	**F**	**%**
The general use of ICTs for teaching usually reduces learners boredom as it makes my lessons more interesting	76	8.49
The general use of ICTs for teaching usually improves my learners performances	78	8.72
Power point, projectors and Animations are usually visual aids for learners	121	13.52
Word processors usually helpful to me for the analysis of learners performance	148	16.54
Spreadsheet are usually helpful to me for the analysis of learner performance	50	5.59
The world wide web usually offers me a wider range of interesting teaching, games quizzes and puzzles)	55	6.15
SMSs, Emailing, blogs, and forums, etc. usually allow me to interact with other teacher after working hours (e.g the sharing of spontaneous teaching ideas)	51	5.69
Photocopy machine usually save me effort in the production of class note for my learners.	145	16.20
E-learning websites such as web-city usually allow me to introduce my learners to new learning strategies	50	5.59
Data bases usually allow me to keep a proper such as marks, registries and other information's.	121	16.20
Total	**895***	**100.00**

*Multiple Responses

Table 7
Perceived Ease of Use of ICTs by Agricultural Science and Extension Teachers in Abuja, Nigeria

Perceived Ease of Use	F	%
Sending emails and SMSs to share teaching ideas and teaching resources with other teachers	70	7.66
Using Google to search for textbooks, lesson notes, and work sheets to download	60	6.56
Using a photo copying machine chandler the keypad, paper-jams paper-feed and other error with the machine to make copies of teaching material	150	16.41
Using a spreadsheet application (e.g. Microsoft Excel, Open office) to create register and mark sheet.	78	8.53
Using a word processor application (e.g. Microsoft Word, Open office writer) for tests, exams and lesson notes)	148	16.19
	60	6.56
Creating formulas to analyze learner marks from databases	140	15.32
Delivering power point lesson presentation to a class	78	8.53
Interacting with E-Learning system such as web city	70	7.66
Uploading files to email	60	6.56
Setting up an internet connection for instant internet access from a cellphone.		
Total	**914***	**100.00**

*Multiple Responses

Objective 3: Challenges or Constraints Militating against Adoption of ICTs by Agricultural Science and Extension Teachers in the Study Area

Participants were asked about the various challenges or constraints encountered in adopting ICTs. 19% of the respondents indicated a lack of infrastructure such as electricity as an issue. Many developing countries like Nigeria have a very low base from which to implement ICTs interventions in education management in schools. Infrastructure is crucial. It is estimated that less than 1% of people in Africa uses or have access to the internet (Bigium, 2000). In order to increase and improve the use of ICTs in the schools, a range of obstacle (as presented in Table 8) that prevent teachers to using ICTs effectively need to be overcome. The key barriers to using ICTs include: lack of access to appropriate ICTs equipment's (20%) and lack of time for training, exploration and preparation (11%).

Table 8
Challenges and Constraints Faced by Agricultural Science and Extension Teachers in Adopting ICTs in Abuja, Nigeria.

Perceived Ease of Use	F	%
Lack of Access to Appropriate ICTs Equipment	141	20.83
Lack of time for Training, Exploration and Preparation	81	11.96
Negative attitude towards ICTs in Education	101	14.91
Lack of Infrastructure e.g Irregular Electricity	132	19.50
ICTs Fear and Anxiety	103	15.21
ICTs Technical, Administrative and Institutional Support	78	11.52
Obsolete Software and Hardware	41	06.06
Total	**677***	**100.00**

*Multiple Responses

Conclusions

Based on the findings, there are many conclusions that can be drawn related to the background and demographic characteristics of participants, factors influencing adoption of ICTs and challenges or constraints faced by the participants against adoption of ICTs.

Objective 1: Background and Demographic Characteristic of Participants

Based on the background and demographics collected from respondents, it can be concluded that agricultural science and extension teachers are identified as generally male regardless of position as agricultural science or extension teacher. 40 respondents were less than 50 years of age. The majority of teachers had been in their profession for more than 10 years. Another interesting finding related to the qualification of teachers in higher institution was that the majority had obtained their Ph.D and are qualified teachers.

Objective 2: Factors influencing Adoption of ICTs by the Respondents

Based on the findings, it was not surprising that age, teaching experience, access to ICTs, teaching attitude and teachers' awareness toward ICTs significantly influenced adoption of ICTs by respondents. Their negative attitudes, low level of awareness and their perception on the usefulness and ease-of-use of ICTs contributed to low level of ICTs adoption for the teaching. The results of this research on the low level of ICTs adoption for the teaching also complement existing literatures which indicated low levels of ICTs adoption for teaching in general (Cassim & Eyono Obono, 2011; Richardson, 2009; Sang et al., 2008; Zahari, 2005; Zhao & Cziko, 2001). Furthermore, teachers' attitude and perception on the usefulness and ease-of-use of ICTs affected the adoption of ICTs for the teaching. This can be seen as confirmation of similar existing results on the adoption of ICTs for teaching in general (Cassim & Eyono Obono 2011; Chrysostomou & Mousoulides, 2009; Crisan, 2004; Kumar et al., 2008). This study also adds value to the body of knowledge by presenting evidence on teachers' ICTs awareness as a factor which affected the adoption of ICTs for the teaching in the area.

Objective 3: Challenges or Constraints Faced by Participants against Adoption of ICTs

Based on the finding where most technology infrastructure like electricity is government controlled.Also, in term of access to appropriate ICTs where teacher in schools that have computers learns basic computer skills such as word processing. The integration of computers and other ICTs

across learning areas remains a pressing issue. Poor conditions of the infrastructure make access to information costly, which in turn makes the use of ICTs low.

Implications and Recommendations

Based on the conclusion, ICTs instruction targeted for users or learners must be modified while still maintaining the learning integrity and contents. Educators must continue to incorporate visual ICTs and written communication instruction to help reach all types and backgrounds of students. Attention to this factor could improve the overall quality of instruction and ensure learners that are satisfied. Thus, it is recommended that ICTs, instructors consider the use of the technology; literatures suggest that the more systematic the changes, the more effective ICTs will be in education, it is also recommended that at this 21st century, principals, teachers, students in Africa should have access and consider using ICTs in schools as it is in developed countries of the world. Government of African countries should as a matter of policy action incorporate ICTs to school curriculum and make sure up-to-date ICTs facilities are made available in our school system. Teaching attitude and teacher's awareness on ICTs needs to be improved. Training of staff personnel on use of ICTs should be a routine exercise in all schools. The mis-use of ICTs in schools by students should be guided and monitored by schools principals and administrators. The most important in the systematic approach includes the uses of ICTs in administration and management and in broader management of the education system. Teachers' access and awareness to ICTs could stimulate more use of ICTs in educational management. Infrastructure friendly environment needs to be created hence a holistic approach should be adopted.

References

Akpan, P. (2000). Africa in the age of a global network society. *African Studies Quarterly, 4*(2), Retrieved November 20, 2005 from http://web.africa.ufl.edu/asq/v4/v4i2al.htm.

Berman, B.J. & Tetley, W.J. (2001). African States, bureaucratics, culture and computer fixes. *Public Administration and Development 21, 1-13.*

Bery, R. (2003).Participatory video that empowers in: S.A White (Ed.). *Participatory Video Image That Transform And Empower* (pp. 102-121), New Delhi, India; Sage

Bigun, C. (2000).Solutions in search of educational problems; speaking for computer in school. [Electronic Version] *Educational Policy 12(5): 596.*

Cai, T. & Abbott, E. (2013). Using video as a replacement or complement for the traditional lecture/demonstration method in agricultural training in rural Uganda. *Journal of Applied Communication 97*(4)*-61.*

Cassim, K. M. & Eyono Obono, S.D. (2011).On the factors affecting the adoption of ICT for the teaching of world problems. *Proceedings of the World Congress on Engineering and Computer Science WCECS*, October 19-21, 2011, San Francisco, USA

Chrysostomou, M. & Mousoulides, N. (2009). Teacher's belief about the adoption of new technologies in the mathematics curriculum. *Proceedings of CERME*, 6, pp. 1270-1279.

Crisan, C. (2004, June). Mathematics teachers' learning about and incorporation of ICT into classroom practices. In *Proceedings of the day conference* held on (Vol. 12, pp. 15-20).

Gall, M.D., Gall, J.P., & Borg, W.R. (2003) *Educational research: An introduction* (7th ed). Boston MA Allyn and Bacon.

Gandhi, R., Veeraraghavan, R., Toyama, K., & Ramprasad, V. (2007, December). Digital green: Participatory video for agricultural extension. In *Information and Communication*

Technologies and Development, 2007. ICTD 2007. International Conference on (pp. 1-10). IEEE.

Hennessy, S; Ruthven, K. & Brindley, S. (2005).Teacher perspective on integrating ICT into subject teaching. Commitment, Constraints, caution and change. *Journal of Curriculum Studies 37*(2) *155-192.*

Jensen, M. (2002). Information and communication technologies (ICTs) in Africa-A status report. Presented to the third task force meeting, United Nations Headquarters: September 2002–October 2002. Retrieved February 6, 2005. *Online: http://www. unicttaskforce. org/thirdmeeting/documents/jensen% 20v6. doc Retrieved on Novemner*, *11*, 2002.

Jones, A. (2004). A review of the research literature on barriers to the uptake of ICT by teachers.

Kalyuga, S. (2009). Managing Cognitive Load in Adaptive ICT-Based Learning. *Systemics, Cybernetics and Informatics, 7*(5)*,16-21.*

Keong, C. C., Horani, S., & Daniel, J. (2005). A study on the use of ICT in mathematics teaching. *Malaysian Online Journal of Instructional Technology*,*2*(3), 43-51.

Kipsoi, E.J., Changach, J.K., & Sang C.H. (2012). Challenges facing adoption of information communication technology (ICT) in educational management in schools in Kenya. *Journal of Sociological Research 3*(1)*,* 18-28.

Korac-Kakabadse, N., Kouzmin, A & Korac-Kakabadse, A. (2000). Information technology and development: Creating "IT harems" fostering new colonialism or solving "wicked" policy problems? *Public Administration and Development 20*(3), 171-184

Kumar, N., Rose, R.C., & D'Sliva J. L. (2008). Predictors of technology deployment among Malaysian teachers, *American Journal of Applied Science 5*(9), 1127-1134

Lie, R., & Mandler, A. (2009). *Video in development: Filming for rural change*(pp. VI-60). CTA [etc.].

Murphrey, T.P., Arnold, S., Foster, B., & Degenhart, S. H. (2012). Verbal immediacy and audio/video technology use in online course delivery: What do university agricultural education students think. *Journal of Agricultural Education 53*(3):14-27.

Noor-Ul-Amin, S. (2013). An effective use of ICT for education and learning by drawing on worldwide knowledge, research, and experience: ICT as a change agent for education. *Scholarly Journal of Education*, *2*(4), 38-45.

Oladele, B. A. (2001). The Imperatives of Challenges for Africa in the Knowledge Age: Status and Role of National Information Policy.

Onyango, R.A.O. (2000). Global information and Africa: On the crest of a mirage? *Library Management 21*(4), 197-204.

Pindyck, R. S., & Rubinfield, D. L. (1998). *Adoption of econometric models and economic forecast.* McGraw-Hill International Edition UK.

Rhoades, E., Friedel, C., & Irani, T. (2008). Classroom 2.0: Student feeling on new technology in the classroom. *NACTA Journal 52*(4): 32-38.

Richardson, J. W. (2009). Providing ICT Skills to teachers' trainers in Cambodia: Summary of project outputs and achievement. *Journal of Education for International Development 4*(2): 1-12.

Sang, G., Valcke, M., Van Braak, J., & Tondeur, J. (2009). Factors support or prevent teachers from integrating ICT into classroom teaching: A Chinese perspective. In *Proceedings of the 17th International Conference on Computers in Education [CDROM](808-815), Hong Kong: Asia-Pacific Society for Computers in Education. http://www. icce2009. ied. edu. hk/pdf/c6/proceedings808-815. pd f.*

Totolo, A. (2007). *Information technology adoption by principals in Botswana secondary schools*. Florida State University.

UNESCO (2002). *Infrastructure and communication technologies in teacher education: A planning guide*. UNESCO Paris.

United Nations Economic Commission for Africa (2001). *African information society initiative: An action framework to build Africa's information and communication infrastructure*. Retrieved November19, 2005 from http://www.uneca.org.

Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS quarterly*, 115-139. *doi 10.2307/3250981*

Wilson, E. J., & Wong, K. (2003). African information revolution: A balance sheet. *Telecommunications Policy 27,*155-177.

Zahari, Z. (2005). Enhancing Remedial Learners Reading through eLearning. In *Proceedings of the Second International Conference* (pp. 201-207).

Zhao, Y., & Cziko, G. A. (2001).Teachers adoption of technology a perceptual control theory perspective, *Journal of Technology and Teacher Education 9*(1):5-30.

Zhoa, Y., & Frank, K. A. (2003). Factors affecting technology uses in schools: ecological perspective [electronic version] *American Educational Research Journal 40*(4): 807-840.

Zossou, E., Vanmele, P., Vododouhe S. D., & Wanvoeke, J. (2009b). Comparing farmer-to-farmer video with workshops to train rural women in improved rice parboiling in Central Benin *Journal of Agricultural Education and Extensions 15*(4): 329-339.

Zossou, E., Van Mele, O., Vodouhe, S. D., & Wanvoeke, J. (2010). Women groups formed in response to public video screenings on rice processing in Benin. *International Journal of Agricultural Sustainability 8*(4), 270-277.