



Perceptions of Cell Phone Animations as an Educational Tool: A Case Study in Southeastern Nigeria

Julia Bello-Bravo¹, Rachel Nwakwasi², Tolulope A. Agunbiade¹, Barry R. Pittendrigh¹

¹University of Illinois at Urbana-Champaign, Illinois, USA,

²Federal University of Technology, Owerri, Imo State, Nigeria

ABSTRACT

This study was based on the use of scientific educational animations as a learning tool in three southeastern Nigerian villages. This study was conducted to understand the reception of some specific educational animations that can be watched on cell phones. We conducted a short survey regarding people's perceptions of these animations, clarity of the animations' messages, lessons learned based on remembering key elements from the animations and information usage. We also focused on other questions related to cell phones as a way of transmitting and deploying information. Our study revealed that all of the participants liked the animations and the vast majority of participants indicated that they could understand the basic content of the animations. Another aspect of the survey was the use of cell phones as a mode of communication and transmission of educational materials. The majority of the respondents recognized that cell phones can be used as a logical technology for transmitting the animations but they also suggested, in terms of social pathways, that the animations could be deployed through farmer field schools, women associations, churches and youths. In the population surveyed, this study indicates that although cell phones are communication devices, there was a positive perception regarding their use as an educational tool, in transmitting and sharing educational materials.

Keywords: *Educational Animations, cell phones, education, southeastern Nigeria*

1. INTRODUCTION

Education can be considered a basic human right and an indispensable means by which individuals and groups of people can realize other sets of human rights [1]. Educational opportunities are also a collective set of mechanisms by which socially and economically marginalized children, youths and adults can lift themselves out of poverty. An increased level of education also provides knowledge that ultimately allows individuals a means to participate more fully in and to build their communities [2]. Access to information and knowledge has always been, and continues to be, a significant challenge for low literate (and illiterate) learners in developing nations. Pedagogical approaches for educating low literate learners have lagged behind that of literate learners, a problem exacerbated by the fact that many low literate learners also live in remote and rural areas that are difficult to reach.

For approximately one billion low literate learners on the planet, the technological revolution based on access to Internet and cell phones have brought new opportunities for the development of new educational pedagogies. It is expected that technology should lead the way to improve teaching and learning, as well as educational opportunities that will help level the playing field in all types of education – particularly across racial, gender and geographic divides [3]. Such approaches have a potential to play a positive impact on agricultural systems [4]. There is evidence that cell phones are becoming easily available for users in developing nations. They offer new ways of teaching and also have the potential to enhance learning and the development of new knowledge in many exciting ways by providing access to a vast array of information, through entertaining audio-visuals, and provide connections to other people or groups for feedback and inspiration [3]. Our program, called Scientific Animations

Without Borders (SAWBO), creates and deploys educational animations that can be watched on cell phones and also on other video capable electronic devices [5-11].

In the following study, we tested the effectiveness of animations as an approach to access, transmit and share useful information in developing countries. Our approach is based on using educational materials in the form of animations to deliver information and knowledge in local languages about better techniques and practices that can help to prevent a disease or reduce pre- and post-harvest losses. The idea behind this approach is to create and deliver educational materials that are easy to understand in the language of the user in a cost effective manner. The animations can be viewed through different electronic devices, shared and transmitted between Bluetooth® and video capable cell phones. This approach intends to bridge the gap that exists between low literate learners living in rural areas and access to information that can be useful for their daily lives by bringing information and communication technology (ICT) to the different social networks: extension agents, farmer field schools (FFSs), women cooperatives, NGOs, entrepreneurs and others [12].

In many rural areas in developing countries in Africa, the radio has classically been an important mass media mechanism for accessing information, with the emerging use of videos to inform decision makers as a complimentary or even a competing technological approach [13]. The cell phone industry is growing rapidly and in Nigeria, cell phone telecommunications currently covers approximately 60% of the national territory [14]. Creating educational videos of relevance in local languages has the potential to strengthen the livelihoods of people living in rural areas by giving them greater access to ideas that can be incorporated into their lives and local environment. However, video mediated learning, as

well as the transmission of the videos through cell phone technology, is not a guarantee that it will work in terms of people retaining information from the message contained in the video itself. Cell phones are easy to use and can easily be transported from one area to another. The impact of cell phones on the economic activities of nations, businesses and small entrepreneurs is phenomenal [15].

Even though the cell phone industry is reshaping and revolutionizing communication globally, there are some cultural as well as institutional barriers that need to be addressed in order to determine if these devices can play at least a partial or complimentary role in breaking down educational barriers for low literate learners. However, communications technologies are rapidly changing and the greater question is, can we create educational content for low-literate learners that can be used with these evolving technological opportunities for deployment? Before we begin to address the many critical questions of the various networks by which this content can be deployed and what are the direct impacts (in terms of changing behavior), we must first ask simpler questions that include (1) are people receptive to this educational content and (2) are they open to the use of novel deployment tools? Additionally, as we live in the age of hyper-collaborations and crowdsourcing, such studies can be the basis for novel ideas of how to deploy such content in a cost effective manner.

The Federal Republic of Nigeria is the most populous African country with an estimated 165.5 million citizens [16]. Nigeria is located in West Africa and it is a federation of 36 states, which are divided into six geopolitical zones [17]. According to statistics by the Nigerian Communication Commission (NCC), Nigeria has approximately 100 million cell phone lines, making it Africa's largest telecoms market [18] and an extremely important country in which to test the potential usefulness of cell phones as an educational tool. Thus, this study was conducted in the southeastern part of Nigeria and was based on a small survey about the effectiveness of the content of three animations: (1) treatment of water to prevent cholera, (2) neem extract as a natural insecticide and (3) prevention of malaria. Multiple target audiences were tested: farmers, women's associations, cell-phone dealers, entrepreneurs, etc.

The objectives of this study were to determine (1) the perception of usefulness of the content of the selected animations and (2) the perception of the easiness of cell phone technology as a mode of transmission of information and knowledge in southeastern Nigeria. We addressed the following issues: how appealing the target audience found the videos, the perceived clarity of the message, the perceived lessons learned based on key elements that viewers remembered after watching the videos, and how the viewers thought the videos could be deployed.

1.1. Descriptions of the Study

SAWBO, a University of Illinois at Urbana Champaign initiative, is focused on the creation and dissemination of relevant information and knowledge around the world in the

form of animations, showing specific techniques in local languages and dialects that can serve to improve people's lives. These videos can be downloaded from the Internet (<http://sawbo.illinois.edu> and <http://susdeviki.illinois.edu>) directly onto cell phones from the Internet or onto computers and then transferred to cell phones. They are available in several Nigerian languages including Hausa, Igbo, and Yoruba and also Nigerian Pidgin English, which are spoken by a significant amount of the Nigerian population. For the purpose of this pilot study, the following three animations were selected.

1.1.1. Cholera

Cholera is an intestinal infection caused by a bacterium known as *Vibrio cholerae*. The main symptoms of this disease are diarrhea and vomiting. Transmission of cholera primarily occurs through the consumption of contaminated food or drinking water. In the video, which is less than three minutes in duration and can be watched on cell phones, we describe several techniques that can be used to help prevent cholera, including methods of treating water, washing of hands, and seeking medical advice if/when one has the symptoms of cholera (Figure 1). To avoid cholera, it is necessary to treat non-potable water and this animation offers different ways to accomplish this aforementioned task. To address this problem, our SAWBO program has created an animation in 3D explaining different techniques that can be used to prevent cholera. Following the different steps visually suggested, the animation offers not only methods to prevent cholera but provide important information that viewers should know about cholera disease.



Figure 1: Screen shot from the cholera prevention animation.

1.1.2. Natural Insecticide from Neem Seeds

Naturally occurring insecticidal compounds can be extracted from neem seeds and sprayed onto crops to prevent pest insect damage. This animation, in which is less than three minutes, explains how to sort and process neem fruits before grinding them into a powdered form that is mixed with water (Figure 2). The mixture is then filtered before being used as an insecticide spray on crops to control insect pests to reduce losses due to pest attack.



Figure 2: Screen shot from the natural insecticide from neem seeds animation.

1.1.3. Malaria Prevention

Malaria is a disease caused by a parasite that is transmitted to people through the bite of the female *Anopheles* mosquito. The video explains that the disease is transmitted by mosquitoes, the symptoms of malaria and practices that can be used to reduce the transmission of malaria (Figure 3).



Figure 3: Screen shot from the malaria prevention animation

2. METHODOLOGY

2.1. Study Area

This study was conducted in Abia, Ebonyi and Imo states in the southeastern part of Nigeria (Figure 4). These states share essentially similar characteristics. Igbo is the language spoken but with slight variations in dialect as one moves from one state to the other. The farmers grow similar crops with mostly similar cropping systems. The common staples grown are root tuber crops (yam, cocoyam and cassava), sweet potato, plantain, banana and leafy vegetables. The Nigerian nation lies wholly within the tropical zone; however, there are wide climatic variations from the southern to northern regions of the country. Temperatures rarely exceed 32°C (90°F), but

humidity is very high and nights are sometimes hot. As one moves inland in Nigeria, there are two distinct seasons: (1) the wet season that occurs from March to late October and (2) a dry season that occurs from November to February. As is typical in many West African countries, Nigeria's climate is influenced by strong latitudinal zones, which become progressively drier as one moves in a northward direction from the coast. Rainfall is the major climatic variable in Nigeria, with altering wet and dry seasons in most areas. Inter-annual and sub-seasonal climate variability dramatically impacts the productivity of these aforementioned crops [17]. There is an emerging consensus regarding a link between increased climatic variability (e.g., incidence of droughts) and a greater incidence of diseases and pests in cropping systems [19]. Additionally, cholera and malaria both represent diseases that occur in Nigeria and require educational programs in order to help avert or reduce the problems of these ailments in the population. It is important to also note that access to clean drinking water is a challenge for approximately 72 million Nigerians [20].

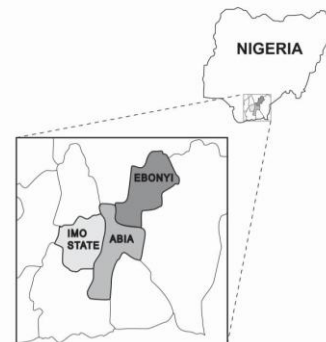


Figure 4: The regions in southeastern Nigeria where this survey study had been conducted

For this study, three local government areas (LGA), in three states in southeast Nigeria, were selected. These were Ikwo LGA in Ebonyi central zone, Ebonyi state; Owerri West LGA in Owerri zone, Imo state, and Ikwuano LGA in Umuahia zone in Abia state. These three aforementioned LGAs are peri-urban areas, with secondary and tertiary educational institutions. Ikwo is the largest LGA in Ebonyi State. It has a population of 214,604. The people of this area are mainly rice farmers. Others are civil servants or engage in petty trading, fishing and palm wine tapping. Owerri West LGA covers an area of 295 km and has a population of 250,000 people. The people in this area are mainly farmers and civil servants while Ikwuano LGA covers an area of 281 square km and has a population of 137,993. The people are mainly farmers and civil servants. The major modes of communication in this region include radio, print media, television and the use of cell phones.

2.2. Sampling Procedure and Sample Size

The Federal University of Technology Owerri (FUTO) in Nigeria performed the study on the deployment of the three animations, in villages in the southeastern part of Nigeria. Students from FUTO conducted a survey consisting of ten questions. This provided us with information using animated

videos to deploy educational materials in rural areas where access to information and knowledge is limited. The participants included farmers, women belonging to associations, cell phone dealers, entrepreneurs and post graduate students working as teachers in primary, secondary or tertiary institutions. The participants were asked questions dealing with (1) their age, (2) cell phone ownership, (3) effectiveness of using cell phones for communicating educational content, (4) why they thought cell phones might be useful for transmitting information, (5) their educational levels, (6) did they like the animations they saw, (7) did they find the messages in the animations clear, (8) lessons learnt, and (9) suggestions on how to deploy these videos.

Three FFSs were visited with the assistance of eight students from FUTO and Michael Okpara University of Agriculture, Umudike (MOUUAU). There was an initial assessment of reactions of people in the FFSs to SAWBO videos before beginning the process of exploring other strategies for the deployment of these animations. The students were trained to conduct the surveys. Several meetings were organized with the researcher, FFS leaders and the eight students to discuss the intricacies of the surveys and the videos. At these meetings, the student to be sent to different LGAs, distribute the assigned video and administer the questions of the survey to the different participants was decided. Students were trained in two groups prior to the survey. Training was mainly based on SAWBO packages, its intent, how to operate video and Bluetooth® phones and transfer images and videos from cell phone to cell phone, laptop to phone and vice versa, how to show the animations through cell phones and get the different packages transferred into their phones and several other phones that were compatible with SAWBO animated videos. They also received training on elements of informed consent, unanticipated problems and reporting requirements, privacy and confidentiality, assessing risk in social and behavioral sciences, ethical principles, coding, the use of Microsoft Word and Excel programs etc. The interviewers explained the motive of the survey, to each participant, but the videos were shown to the participants without prior explanation about the content except for very old participants who were given little explanation as required and this was done individually.

Multi-stage random sampling technique was employed in this study. In the first stage, three states were randomly selected out of the five states that make up southeast Nigeria which are Ebonyi, Imo and Abia States. In the second stage, one agricultural zone was randomly selected from each of the selected states to give three agricultural zones namely Owerri zone in Imo state, Umuahia zone in Abia State and Ebonyi central zone in Ebonyi State. This gave a total of three agricultural zones. The third stage of the sampling involved the random selection of one LGA from each of the zones giving a total of three LGAs as mentioned above. The fourth stage was the random selection of 20 respondents from each state used in this study.

2.3. Data Collection and Analysis

The study was conducted in November of 2012. This study consisted of assessment of the three animated videos in three different villages in the southeastern part of Nigeria.

Approximately 20 people from each village watched each of the aforementioned videos making a total of 60 people. The survey addressed research questions about how effective animations were in communicating the content of the message and responses by the participants as to what they thought they learnt about the given topic, which included the prevention of diseases such as cholera and malaria; and insect pest control using neem extract. Additionally, a question specifically about other important issues that people would like to see in an animated format was also included in the survey. Ultimately, the survey addressed questions about cell phones as a mode of information transmission and also other ways of distribution and deployment.

Students that spoke the local dialect in the different LGAs showed the animations to the participants and conducted the survey. The students were also trained to provide answers about the content of the survey and on the knowhow of transmitting the videos from cell phone to cell phone in the case that the user asked to have the video on his/her cell phone. Each student was assigned the same number of LGAs and animations. Each student provided information with the name of the LGA, district, province and approximately how many people live in the LGA. They also provided information on the dialect and the country. Three LGAs were randomly selected depending on the dialect of the student that conducted the survey and the dialect of the people in the LGA. The questions in the survey were the same for all the LGAs in southeast Nigeria.

3. RESULTS AND DISCUSSION

SAWBO has made available an increasing number of educational animated videos and language variants appropriate for Nigeria. Thus, this study was intended to determine the target population perception of the potential for the effectiveness of the use of cell phones as a tool for transmitting educational materials in southeastern Nigeria. The survey was administered to both men and women aged between 18 to 70 years (Table 1). The participants included farmers, teachers, women association, cell phone dealers and entrepreneurs. Some of the participants did not answer all of the questions.

Table 1: Age ranges of the respondents. One respondent did not answer

Age Group	Number
18-29	26
30-50	28
51-70	5

Farmers who are the beneficiaries of agricultural extension programs have embraced the concept that cell phone technology could be of use to them, but in some cases individuals have been hampered by the economic challenges of owning such a device. Fifty-seven of the participants owned a cell phone and only two did not own a cell phone (Table 2). When asked about the effectiveness of cell phones as a mode of communication and educational content,

participants however agreed that cell phones are potentially an effective mode of communication and educational content (Table 2).

The participants that mentioned that cell phones are an effective mode of transmission of information were also asked to give reasons why they think this is so; 20 mentioned that it is easy to use and understand as reasons for its effectiveness while 40 individuals mentioned that it is an effective mode of information transmission because it can be used to reach a wider audience (Table 3).

Table 2: Questions regarding cell phone ownership and perceived usefulness of cell phones as communication/educational tool. Several respondents did not answer the second question.

Question	Response	Numbers
Cell phone ownership	Yes	57
	No	2
Effectiveness of cell phone as a mode of communication and educational content	Effective	50
	Not Effective	1
	Not Sure	7

Table 3: Preferred answer as to why cell phones are a useful tool for communications and deployment of videos

Reason	Number
Easy to use and understand	20
Wider audience	40

The accessibility of smallholder farmers to useful educational content that can be accessed and used on cell phones has always being a challenge and even if educational materials were made available to these groups, literacy is a limitation for at least some of these target populations. The participants in this study were mostly literate with 39 out of the total 59 participants having tertiary education, 16 having high school education and about four having the most basic primary or elementary education (Table 4).

Table 4: The highest levels of education obtained by each of the participants. One participant did not respond

Education	Number
Elementary (primary) school	4
High school	16
Tertiary education (college of education, technical college, polytechnic and university)	39

Participants were also asked if they liked or did not like the videos and if they found the messages clear in the videos. One hundred percent of the participants said they liked the videos (Table 5) and all but one of the participants said they found the message of the videos clear (Table 6).

Table 5: Did the participant like the video or not?

Video	Like Video	Do Not Like Video
Cholera	20	0
Neem	20	0
Malaria	20	0

Table 6: Did the participant find the message in the video clear?

Video	Clear	Not Clear
Cholera	19	1
Neem	20	0
Malaria	20	0

The participants also learned key lessons from each of the three animations they watched. The objective of the SAWBO animations is to share and transmit information that will be useful to people in their daily lives. For the two disease prevention animations (cholera and malaria), the objective was for people to learn information on how they can prevent these diseases, the symptoms associated with the diseases and also health measures they should take in case they or another member of the family shows symptoms of the diseases. These objectives seem to have been met, as the participants gave the disease prevention (cholera and malaria animations), water purification (cholera), cause of disease and control measures (malaria) as lessons they learned from the disease prevention animations. For the animation describing the use of neem seed as a natural insecticide, participants mentioned pesticide production and the use of neem seed as an insecticide as lessons they learned from watching the animation (Table 7).

Table 7: Concepts the participants stated that they learned from the videos. Some respondents mentioned multiple concepts

Video*	Lessons Learned	Number
Cholera ^a	Cholera prevention	8
	Water purification	14
Neem ^b	Pesticide production	11
	Neem seed for pest control	9
Malaria ^c	Malaria prevention	15
	Cause of malaria	12
	Control measures through environmental sanitation	10

* Key elements are given below for each video

^a Boiling water, aqua tab pills and use of bleach

^b Neem trees, ripe neem seeds, sun drying of seeds, pounding of the seeds, mixing of the powder with water and spraying of the filtrate on plants to control insect pests

^cMosquitoes as vectors of disease, bed nets to prevent malaria, window nets, insecticide sprays and environmental hygiene

In terms of deployment, the cell phone technology, as the mode of transmission, is part of a rapidly growing industry in developing countries – one in which numerous people in developing nations are gaining better access to these devices. Besides the participants mentioning that cell phones were an effective technology for viewing and sharing of the animations, they also suggested that FFSs, churches, women associations, extension agents and youth groups might be logical social deployment pathways to disseminate these animations (Table 8).

Table 8: Potential deployment approaches for the animations, as suggested by the participants

Suggested medium of deployment	Number
Farmer field schools	28
Churches/religious venues	8
Women's associations	8
Extension agents	11
Youth	5

Some weakness in this approach, as mentioned by the participants, are: the current costs of cell phones, power failure, lack of video compatibility of some models of cell phones, lack of technological know-how for some users to operate on complicated phones and vision impairment for older people. These weak points were consistently raised during the assessments of the three animations. Finally, generally sporadic and insufficient supply of electric power in the urban and rural areas can hamper the usefulness of electronically-based access to information and knowledge (e.g., DVDs and TV). Cell phones can be used when the electric grid is down or by mechanisms off the main electrical grid (e.g., solar panels).

4. CONCLUSION

It is possible that cell phones can conveniently serve as an effective educational tool for transferring educational packages on health, agriculture and other economic activities. They were used as suitable means of transferring SAWBO packages – about cholera, and for using natural insecticide such as the neem seed and for malaria prevention to farmers, in this study, in southeastern Nigeria. However, illiteracy and power failure are presently being faced by Nigeria, and most developing nations. This is currently being addressed and did not to a great extent deter participants from having some of these packages transferred into their mobile phones. Many stated that they were considering practicing the packages as demonstrated since it stands to promote the use of locally sourced materials such as neem trees and seeds which can be found all over the country. Despite the fact that cell phones are unaffordable to some, many older respondents used their children and ward's phones, which were models that were

compatible with animation transmission technology, to access SAWBO packages.

Recently, in Nigeria, the Honorable Minister of Agriculture Mr. Akinwunmi Adesina in his Agricultural Transformation Agenda (ATA) announced plans of the Federal Government to distribute 10 million free cell phones to farmers in 2013 to boost food production in the country [21]. The fact that the Federal Government of Nigeria, through the Honorable Minister of Agriculture, has already put plans in place to distribute cell phones to farmers will reduce the burden associated with high cost of cell phones for farmers. The use of animations with voice overlays in central Igbo language, which is understood by almost all Igbo speaking states notwithstanding the unique dialect spoken by each state, has significant potential as a generalizable learning tool. Additionally, SAWBO's approach to voice overlay has been used in the past to produce multiple dialects of the same language, such that animations can be deployed into local areas with local dialects; such a strategy that could be repeated with any language.

There is certainly the potential for Government, Non Governmental Organizations (NGOs), media houses, radio stations, entrepreneurs, concerned private bodies, on the importance and effectiveness of the use of cell phones as an educational tool (in addition to other educational tools such as the print media, radio and television houses) and transfer of useful knowledge such as those transmitted by SAWBO in areas of health, economic activities, education, agriculture, etc. However, it is noteworthy that in Nigeria, and other developing countries, especially among farmers, some individuals successfully make use of traditional (indigenous) methods of malaria treatment and prevention using herbs that are locally sourced (an area which needs to be explored and tested in future studies) which has always been the trend before the era of orthodox medicine. Finally, if the Federal Government of Nigeria improves on electric power supply, as is planned, then the deployment of animations through this mechanism may become easier.

To this end, SAWBO is making available more videos, and language variants (in collaboration with FUTO), that are appropriate for use in the Nigerian context. Such videos include, but are not limited to approaches to prevent postharvest losses, other aspects of malaria prevention and tuberculosis prevention and treatment. These videos can be easily downloaded from the Internet for government agencies, extension agents, NGOs, schools, private citizens, and anyone else with Internet access. These represent tangible materials that these aforementioned and individual organizations can use immediately upon downloading from the SAWBO system and the supporting Sustainable Development Virtual Knowledge Interface (SusDe ViKI) [5]. However, achieving impact through strategy will need to involve coordinated interactions between FUTO and other in-country institutions and organizations [22].

Acknowledgement

We thank the sixth substantive Vice Chancellor of Federal

University of Technology Owerri (FUTO), Prof C.C. Asiabaka; DVD Academics, Prof B.N. Onwuagba; Prof Ike Nwachukwu of MOUAU; Dean of SAAT, Prof M.C. Ofoh. We also thank Dr. F.N. Nnadi, Prof. Mrs E. C. Matthews Njoku, Dr. O. M. Adesope and the following students who assisted in performing the survey: Ihuomah Deborah, Njoku Perpetua, Anuforo Amarachi, Emezuru Gloria, Ihekwaaba Ifeanyi, Nwoso Ogochukwu, Jane Awah and Okoro George. We also thank Susan Balfe for the creation of Figure 1. SAWBO has been made possible through support provided to the Dry Grains Pulses CRSP by the Office of Agriculture Research and Technology, Bureau of Food Security, in the United States Agency for International Development, under the terms of grant no. EDH-A-00-07-00005 (to BP and JBB). The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development or the U.S. government. Support for SAWBO has also come from the ADM Institute for the Prevention of Postharvest Loss at the University of Illinois Champaign Urbana (to JBB and BP) and C.W. Kearns, C.L. Metcalf and W.P. Flint Endowment Funds (to BRP).

REFERENCES

- [1] UNESCO (United Nations Educational, Scientific and Cultural Organization). (2003). General comment 13 on the right to education. *UNESCO Economic & Social Council*. Retrieved May 18, 2007 from http://portal.unesco.org/education/en/file_download.php/c144c1a8d6a75ae8dc55ac385f58102erightededuc.pdf
- [2] Umekachukelu, F. C. (2011). Education as a tool of social reconstruction. Bulletin Version 4.2.0. Retrieved June 10, 2012 from <http://www.nigeriavillagesquare.com/guest-articles/education-as-a-tool-of-social-reconstruction.html>
- [3] Noeth, R. J. and Volkov, B. B. (2004). Evaluating the effectiveness of technology in our schools, ACT Policy Report. ACT Information for Life Transmission. Retrieved August 9, 2012 from http://www.act.org/research/policymakers/pdf/school_tech.pdf
- [4] Ihimhekpen, O. (2012). Agriculture not a big player in equity markets, but has potential to be — Minister. *Compass News Paper Nigeria*. Published 28th December 2012. Retrieved, December 29, 2012 from <http://www.compassnewspaper.org/index.php/special-desk/business-news/11145-agriculture-not-a-big-player-in-equity-markets-but-has-potential-to-be-minister>
- [5] Bello-Bravo, J., Diaz, R., Venugopal, S., Viswanathan, M., and Pittendrigh, B. R. (2010). Expanding the impact of practical scientific concepts for low-literate learners through an inclusive and participatory virtual knowledge ecosystem. *Journal of the World Universities Forum* 3(4): 147-164.
- [6] Bello-Bravo, J., Seufferheld, F., Steele, L. D., Agunbiade, T., Guillot, D., Cutz, G., and Pittendrigh, B. R. (2011). Scientific Animations Without Borders: An international online approach for building applicable scientific educational materials for use on cell phones and the Internet in developing nations. *The International Journal of Science in Society* 2(4): 49-62.
- [7] Bello-Bravo, J., and Baoua, I. (2012). Animated videos as a learning tool in developing nations: A pilot study of three animations in Maradi and surrounding areas in Niger. *The Electronic Journal of Information Systems in Developing Countries* 55(6): 1-12.
- [8] Bello-Bravo, J., and Pittendrigh, B.R. (2012). Scientific Animations Without Borders: A new approach to capture, preserve and share indigenous knowledge. *The Journal of World Universities Forum*. 5(2): 11-20.
- [9] Bello-Bravo, J., Agunbiade, T., Dannon, E., Tamo, M., and Pittendrigh, B.R. (2013). The prospect of animated videos in agriculture and health: A case study in Benin. *International Journal of Education and Development using ICT* 9(3): In Press.
- [10] Bello-Bravo, J., Olana, G.W., Enyadne, L. G. and Pittendrigh, B.R. (2013). Scientific Animations Without Borders and communities of practice: promotion and pilot deployment of educational materials for low-literate learners around Adama (Ethiopia) by Adama Science and Technology University. *The Electronic Journal of Information Systems in Developing Countries* 56(4): 1-11.
- [11] Bello-Bravo, J., Seufferheld, F., Steele, L. D., Agunbiade, T., Guillot, D., Cutz, G., and Pittendrigh, B. R. (2013). Scientific Animations without Borders: an international collaborative approach for building applicable scientific educational materials for use on cell phones, and the Internet in developing nations. In: Boukar, O., Coulibaly, O., Fatokun, C., Lopez, K., Tamò M. (eds.). *Enhancing cowpea value chains through research advances. Proceedings of the 5th World Cowpea Research Conference, 26 September – 1 October 2010 Saly, Senegal*, pp. 369-380.
- [12] Arokoyo, T. (2003). ICTs in the Transformation of Agricultural Extension: The Case of Nigeria. Retrieved October 15, 2012 from http://Internships.Cta.Int/Observatory2003/Case_Studies/Case_Study_Nigeria.Pdf



<http://www.esjournals.org>

- [13] Ramirez, R. and Quarry, W. (2004). *Communication for Development: A Medium for Innovation in Natural Resource Management*. IDRC, Ottawa.
- [14] Agyeman, O. T. (2007). ICT (Information Communication Technology) for Education in Nigeria, infoDev's Survey of ICT and Education in Africa: Nigeria Country Report. 2(53): 1-12. Retrieved October 12, 2012 from <http://www.infodiv.org/en/Publication.422.html>
- [15] Ogbomo, M. O. and Ogbomo, E. F. (2008). Importance of Information and Communication Technologies (ICTs) in Making a Healthy Information Society: A Case Study of Ethiopia East Local Government Area of Delta State, Nigeria. *Library Philosophy and practice* ISSN 1522-0222.
- [16] Sabin Vaccine Institute. (2012). Nigeria. Health System and Expanded Program on Immunization (EPI) Program. Washington, DC. Retrieved January 17, 2013 from <http://www.sabin.org/programs/sif/nigeria>
- [17] Awotoye, O. O. and Olaniran, J. M. (2010). Effects of temporal changes in climate variables on crop production in tropical sub-humid South-western Nigeria. *African Journal of Environmental Science and Technology* 4(8): 500-505.
- [18] Ogunlesi, T. and Busari, S. (2012). Seven ways mobile phones have changed lives in Africa. CNN. Retrieved December 1, 2012 from <http://edition.cnn.com/2012/09/13/world/africa/mobile-phones-change-africa/index.html>
19. Nzeh, E.C., Eboh, R.O., Eboh, E. Nweze, N., Nzeh, C., Orebiyi, J. and Lemchi, J. (2012). Climate Change Adaptation in Nigeria and its Challenges in Agricultural Sector: Empirical Information. Academia.edu. Retrieved December 31, 2012 from http://www.academia.edu/1200946/CLIMATE_CHANGE_ADAPTATION_IN_NIGERIA_AND_ITS_CHALLENGES_IN Retrieved 30th December 2012.
20. Winjobi, D. T., Salami, D. Olugbohunmi, E. and Adedeji, M. (2008). Implementation of the Millennium Development Goals in Nigeria. Make Our Money Work for Us Campaign. Global Call to Action against Poverty/MDGs Nigeria. Retrieved December 30, 2012 from <http://www.cafsofrag4development.org/pdf/SHADOW%20REPORT%20GENERAL%20AAA.pdf>.
21. Channels Television Nigeria. (2012). FG plans technologically powered agricultural sector. Published Tue August 14th 2012. Retrieved January 2, 2013 from <http://www.channelstv.com/home/2012/08/14/fg-plans-technologically-powered-agricultural-sector>
22. Hall, A., Bockett, G., Taylor, S., Sivamohan, M. V. K. and Clark, N. (2001). Why research partnerships really matter: Innovation theory, institutional arrangements and implications for developing new technology for the poor. *World Development* 29(5): 783-797.