INFORMATION AND COMMUNICATION TECHNOLOGY INTEGRATION: A PARADIGM SHIFT FOR EFFECTIVE TEACHING OF BIOLOGY IN SENIOR SECONDARY SCHOOLS IN KATSINA STATE, NIGERIA

[1]NURADDEEN YUSUF GALADANCHI, [2]MUSTAPHA MUHAMMED & [3]MUJITTABA BATURE
[1]Department of Early Childhood Care Education
[2]Department of Primary Education, [3]Department of Computer Science
Yusuf Bala Usman College of Education and Legal Studies Daura, Katsina State
ygaladanchi2015@gmail.com

Abstract

This study investigated the importance of Integrating Information and Communication Technology (ICT) in improving the teaching of Senior Secondary Schools Biology in Katsina State, Nigeria. However, the use of this contemporary paradigm was found to be not effective due to different factors. Descriptive survey research design was used for the study. Population of three hundred and forty-eight (348) were used in this study, in which a sample of one hundred and sixty-nine (169) participants including Biology teachers, Head teachers, and Biology students were participated in the study. Questionnaire was used as an instrument for data collection. Descriptive and inferential statistics applied for data analysis. Pearson Product Moment Coefficient (PPMC) was employed to test the hypothesis at 0.05 level of significance. The results showed that ICT was never used in teaching Biology. The study concluded that, in Katsina State Senior Secondary School, ICT was not used in biology class This was associated with the lack or shortage of ICT related infrastructure. Therefore, it was recommended that more investment in providing ICT related infrastructure is needed for successful integration of ICT in teaching Biology among others.

Keywords: Biology, ICT, ICT Infrastructure, teaching

Introduction

In the present education system, teachers are encouraged to use innovative strategies allowing learners in acquiring competencies required for the 21st century to adapt in this changing world. The use of Information and Communication Technology (ICT) in teaching and learning process is one of the innovative strategies which is being adopted in different countries around the world (Bhasin, 2012)
Information Communication Technology (ICT) refers to the totality of methods and tools that are used in gathering, storing, processing and communicating information. ICT has found application in virtually all the available professions in the world (Olutola & Olatoye, 2015). Based on the 2030 United Nations (UN) Agenda for sustainable development, each United Nation member country has to use ICT in different domains for promoting national development (UN, 2016). This has been also stipulated under the 17th goal of UN international framework where ICT has been recognised to be an important tool for national development. In line with this UN agenda, African Union summit of 2015, emphasized on ICT infrastructure development as top priority for achieving the vision 2063. The policy could be achieved only if all African countries provide a reliable and affordable ICT related services such as increasing broadband connectivity, accessibility of ICT at all school levels, and investing in ICT related project (African Union Commission, 2015).

According to Kelentric Marijana (2013) integration of ICT into an educational system is a special type of educational change. As such it is influenced by various factors that emerge inside educational stakeholders. Such factors are either internal or external depending on thei rsource. External factors

are those that are not under direct influence of the individual and exist outside of the individual's mind, for example equipment, financial resources or technical support. On the other hand, internal factors stem from the individual's mind and individual have control over them to some extent. These can be feelings, attitudes, perceptions or knowledge about ICT. Some of these factors also present obstacles to integration of ICT while others enable it. External factors are also referred to as non-manipulative or exogenous factors (Drentand Meelissen 2008), infrastructure (Pelgrum2001), practical factors (Tearle, 2004) and facilitating conditions, (Teo, 2010).

The integration of ICT in teaching and learning process was found to help in creating a conductive learning environment in which students participate actively and constructively (Volman & Van, 2001). It is therefore used in developing the abilities of students in terms of communication, problem solving, cooperation and lifelong learning (Plomp, Brummelhis&Rapmund, 1996). The innovative use of ICT in teaching and learning, enhances learner-centered method which is an important approach for effective teaching and learning process (Drent & Meelissen, 2008). Therefore, the adoption of this technology is necessary for enhancing the students learning in every subject (Mwanda; Mwanda; Midigo& Maundu, 2017). This will engage students in developing decision making, critical thinking and problem solvingbehaviors (Grabe & Grabe, 2001). In teaching biology, ICT (especially when using visuals and animations) makes the learning environment more enjoyable, motivating and attractive by increasing learners' attention to the subject content thus promoting the effective teaching and learning process (Tomljenović & Zovko, 2016).

Generally, ICT is used in different activities across different subjects. The common generic ICT applications include; word processing for text development, power point for content presentation, excel for calculations and internet for exploring different web sites in terms of getting the required content from different sources (Enu; Nkum; Ninsin; Adoma &Korsah, 2018). These generic ICT skills help students to acquire relevant competences in terms of doing and presenting their home works and sharing content with other communities. On the other side, specific ICT tools and applications (software) were developed for teaching and learning Biology as well as other science subjects. Among this software we may include the SimBio software for DNA replication (The SimBio Consortium, 2001), the NeuroBytes for improving the teaching and learning of nerve transmission across the synapses (Isabel, Vignesh & Rogers 2018) that was difficult to be grasped through the traditional didactic methods (Šorgo, Verčkovnik, & Kocijančič, 2010). On the other side, the virtual laboratories were also found to play a great role in teaching and learning Biology. Through this scenario, students are guided to understand the analogies of natural phenomena through visual representation and realistic simulations based on real phenomena (Sommer & Sommer, 2003). The virtual labs use the power of computerized models and simulations and a variety of other instructional technologies to replace face-to-face lab activities (Scheckler, 2003). This kind of learning process enhance students to get access to the hands on activities that are not available in their physical laboratories (Muhamad, Zaman, & Ahmad, 2012).

Integrating ICT in teaching and learning biology, provides teachers with opportunities to bring nature into classroom activities (Demkanin et al., 2008). The Edmodo platform, which is an e-learning model has been found to be successful in teaching Biology (Végh & Elbert, 2017). It has been recognized that ICT increases students' motivation through facilitating the exchange of information between groups of students (Senthilkumar, Sivapragasam, &Senthamaraikannan, 2014). Kareem (2018), described how multimedia strategies are the best methods to be adopted for making teaching Biology meaningful. However, different factors were found to influence the successful use of ICT in teaching and learning process. Some of these factors include: teachers' skills and competence, teachers'

perception, teachers' trainings and availability of ICT related infrastructures (Ndayambaje&Ngendahayo, 2014).

In terms of effectively use of ICT in teaching and learning Biology, adequate trainings on using different ICT tools and software in teaching Biology are needed. The effective trainings should focus on providing teachers with a structured formation in technology-based activities and environments so that they can leave traditional methods of teaching to explore and design modern learning environments (Yamith, 2012). It is assumed that adequate trainings and facilities increase ownership in teachers for using ICT in classroom activities (Abuhmaid, 2011). The teachers with inadequate trainings on using ICT tools have been accused of showing low confidence and competence in using ICT in education. Additionally, the lack of ICT related trainings and technical support may affect teachers' willingness in the adoption and use of ICT in education (Goktas, Yildirim & Yildirim, 2008). The successful use of ICT depends on the degree at which teachers are trained and supported (UNESCO, 2003).

On the other hand, the ICT related infrastructures plays a great role in successful use of ICT in teaching and learning. In this regards, most of African countries are increasing computers and other ICT facilities in different schools but the gap in ICT infrastructure still to be a big challenge (Hennessy, Harrison & Wamakote, 2010). The shortage of ICT infrastructure such as: computers, scanners, mobiles phones, printers, projectors, radio, camera recorders, TV sets and software such as: data logging, simulations, virtual experiments tools, electricity and internet connection was found to be a serious obstacle in using ICT for teaching and learning process (Šorgo et al., 2010). Mumtaz (2006) stated that, the shortage of hardware and software is one of the reasons that prevent the effective use of ICT in classrooms. Mulwa & Kyalo (2011), Njoroge; Margaret & Joab, (2017) stated that, the decisions of teachers on using computers in classrooms tend to be influenced by the accessibility and availability of relevant infrastructures. Connectivity to electricity and internet facilities are also highly needed during integration of ICT in teaching and learning process. Nevertheless, electricity and internet connectivity are still a big challenge in many developing countries mostly in Africa (Mathevula&Uwizeyimana, 2014). This was also confirmed by the findings from the of Eze & Adu (2015) that revealed that the lack of internet connectivity and electricity was a barrier to the effective use of ICT in many African schools.

The challenges in the use of ICTs for teaching Biology include acquisition of necessary skills, access to computers and networks, epileptic power supply, and inadequate funds. The need for capacity building as effective strategy for developing competencies of Biology teachers on use of ICTs in teaching is considered paramount in order to achieve effective teaching of senior secondary schools' biology.

Statement of the Problem

Based on the importance of using ICT in teaching Biology, it was imperative to investigate how integration of ICT is effective for improving teaching biology subject in selected public secondary schools in Katsina metropolis of Katsina State. It has found some distributed computers in Katsina State Senior Secondary Schools stored and unused due to lack of electricity, internet connectivity, lack of proper utilization, teachers especially for biology subject were not trained in basic ICT skills. However, no available reports on the teachers' trainings towards the use of specific ICT software in teaching biology and other science subjects, therefore the practical use of ICT in teaching and learning process is questionable.

Regarding the importance of using ICT in teaching biology subject, it is important to investigate how

integration of ICT is effective for promoting teaching of biology in selected public senior secondary schools in Katsina State.

Objectives of the Study

The study was guided by the following objectives:

1. To investigate the extent to which biology teachers are using ICT in teaching biology in public secondary schools of Katsina metropolis, Katsina State.
2. To investigate the influence of ICT training and availability of ICT infrastructure on the effective use of ICT in teaching biology in public secondary schools of Katsina metropolis, Katsina State.

Research Questions

The following questions guided the study.

Research Question One. To what extent are biology teachers using ICT in teaching Biology?

Hypothesis

HO1: There is no significant relationship between availability of ICT infrastructure and the teaching of biology using ICT in public secondary schools in Katsina State.

Methodology

A descriptive survey research design was used in this study. The target population of the study was three hundred and forty-eight (348). The sampled size which drawn from the total population was one hundred and sixty-nine (169) biology teachers. Questionnaire as an instrument was used for data collection. The research participants used three-points rating scale (1=Never, 2=sometimes and 3=Frequently) for choosing in 6 statements related to the use of ICT in different activities related to the teaching and learning Biology in the questionnaire. In the average of rating, the mean value less than 1.5 express the non-use of ICT (Never), the mean value ranging from 1.5 to 2.5 indicated a moderate use of ICT (sometimes), while the mean value from 2.5 to 3 expressed the excellent use of ICT (frequently). The reliability coefficient of the instrument was obtained at 0.82. Descriptive statistic was used to answer the research questions and Pearson Product Moment Coefficient was used to test the hypothesis at 0.05 level of confidence.

Results and Discussion

The findings obtained from the questionnaire distributed to the participants were presented below.

RQ. Table 1: Extent at which senior secondary school teachers using ICT in teaching Biology N = 169

S/N	Statements	N	Mean	SD	Remark
1	The use of ICT in Biology lesson preparation	169	1.20	0.67	Never
2	The use of ICT in explaining Biological concepts	169	1.40	0.72	Never
3	The use of ICT to conduct practical in Biology	169	1.09	0.49	Never
4	The use of ICT in carrying out virtual presentation.	169	1.10	0.69	Never
5	The use of ICT to collect images and videos of organisms in lesson presentation.	169	1.30	0.58	Never

From the above table 1 based on the three-points rating scale used by the respondents (1=Never,

2=sometimes and 3=Frequently) for choosing in 5 statements related to the use of ICT in different activities of teaching and learning Biology. The average of ratings was calculated against each statement. In these averages of rating, the mean value less than 1.5 express the non-use of ICT (Never), the mean value ranging from 1.5 to 2.5 indicated a moderate use of ICT (sometimes), while the mean value from 2.5 to 3 expressed the excellent use of ICT (frequently).

Based on the findings presented in the above table 1, it has been found that ICT was never used in any of the activities related to the teaching and learning Biology (in secondary schools of Katsina state) like virtual presentation, explaining different biological concepts and collection of digital images to be presented in Biology classroom.

Table 2: There is no significant relationship between availability of ICT infrastructure and the level of using ICT in teaching biology in public secondary schools in Katsina State. N=169

Variable		t-cal	Sig.
Level Of Using ICT In Teaching And Learning Biology	Pearson	.845***	
	Sign. (2-tailed)		.000
	N	169	

** Correlation is significant at 0.05 level of significance (2 tailed)

From the table 2, a significant relationship is shown between availability of ICT infrastructure and the level of using ICT in teaching and learning Biology as the obtained Pearson's correlation coefficient (r=.845) is greater than p-value of .000. The above findings are similar with the findings of Ghavifekr et al., (2006) stating that the use of ICT is influenced by teachers' extrinsic factors including the lack of resources, time, access and technical support. On the other hand, Mwendwa (2017) has found that the availability of adequate ICT resources determines its effective integration in teaching and learning process. Technologies such as interactive whiteboards, e-conferences, educative software and education portals among others, have been proved as an essential boost to classroom activity, learning motivation and general inquisitiveness (Gulbahar, 2007).

Conclusion

Based on the findings from the research, it was noted that most of Biology teachers involved in this research were not completely used ICT in teaching and learning Biology. This is because ICT was generally found to be not used in facilitating teaching like Biology. The inadequate use of ICT was identified to be associated with insufficient of adequate ICT infrastructure in secondary schools of Katsina State.

Recommendations

ICT integration was described as important paradigm in teaching and learning; therefore, all educational agents have to invest in providing the adequate trainings related to the use of ICT in teaching different science subjects. These trainings should be tailored in line with the needs of teachers who are requested to use the specific ICT tools and software in teaching and learning process. Additionally, more investment is needed in terms of equipping schools with adequate ICT infrastructure as it has been found that they play a great role in this aspect.

References

African Union Commission. (2015). The Africa we want. https://doi.org/10.18356/8cdc8224-en

Abuhmaid, A. (2011). ICT training courses for teacher professional development in Jordan. The Turkish Online Journal of Education Technology, 10(4), 195–210.

Bhasin, B. (2012). Integration of Information and Communication Technologies in Enhancing Teaching and Learning. Contemporary Educational Technology, 3(2), 130–140.

Drent, M., &Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? Computers & Education, 51(1), 187–199.

Demkanin, P., Kibble, B., Lavonen, J., Guitart, M. J., & Turli, J. (2008). Effective use of ICT in Science Education. In Bob Kibble, School of Education, University of Edinburgh.

Enu, J., &Nkum, D; Ninsin,E; Adoma, D.C&Korsah, D. . (2018). Teachers ' ICT Skills and ICT Usage in the Classroom : The Case of Basic School Teachers in Ghana Teachers ' ICT Skills and Ict Usage in the Classroom : The Case of Basic School Teachers in Ghana. Journal of Education and Practice, 9(20).

Eze, I., & Adu, E. O. (2015). The Utilization of ICT in Education for Sustainable Development . The utilization of ICT in education for sustainable development. ResearchGate,

Ghavifekr, S., Kunjappan, T., Ramasamy, L., Anthony, A., & My, E. (2006). Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions. Malaysian Online Journal of Educational Technology, 4(2), 38–57. Retrieved from www.mojet.net

Grabe, M., & Grabe, C. (2001). Integrating Technology for Meaningful Learning. Houghton Muffin Company.

Goktas, Y., Yildirim, Z., & Yildirim, S. (2008). A review of ICT related courses in pre-service teacher education programs. Asia Pacific Education Review, 9(2), 168–179.

Hennessy, S; Harrison, D. J &Wamakote, L. (2010). Teacher Factors Influencing Classroom Use of ICT in Sub Saharan Africa. Itupale Online Journal of African Studies, 2, 39–54.

Gulbahar, Y. (2007). Technology planning: A roadmap to successful technology integration in Schools. Computers & Education, 49(4), 943-956.

Isabel, M,G; Vignesh, S &Rogers ,J, J. (2018). NeuroBytes:Development of an Integrative Educational Module Accross Neurophysiology and Engineering (Evaluation). 2018 ASEE annual conference & exposition. Amercan Society for Enginering Education.

Kareem, A. A. (2018). The Use of Multimedia in Teaching Biology and Its Impact on Students ' Learning Outcomes. The Eurasia Proceedings of Educational & Social Sciences, 9(1), 157–165. Retrieved from https://dergipark.org.tr/download/article-file/531778

Muhamad, M., Zaman, H. B., & Ahmad, A. (2012). Virtual Biology Laboratory (VLab-Bio): Scenario-based Learning Approach. - Social and https://doi.org/10.1016/j.sbspro.2012.11.395 Behavioral Sciences, 69(January 2011), 162–168.

Mathevula, M. D., &Uwizeyimana, D. E. (2014). The challenges facing the integration of ICT in teaching and learning activities in South African Rural Secondary Schools. Mediterranean Journal of Social Sciences, 5(20), 1087 1097. https://doi.org/10.5901/mjss.2014.v5n20p1087

Mumtaz, S. (2006). Factors affecting teachers ' use of information and communications technology : a review of the literature. Journal of Information Technology for Teachers, 9(3). https://doi.org/10.1080/14759390000200096

Mulwa, A & Kyalo, D. (2011). The influence of Ict infrastructure on readiness to adopt elearning in secondary schools in Kitui district, Kenya.

Mwendwa, N. K. (2017). Availability of Resource Materials and Facilities for ICT Integration in the Public Primary School Curriculum in Kitui County , Kenya. Saudi Journal of Humanities and Social Sciences Scholars, 2(5), 362–368. https://doi.org/10.21276/sjhss

Njoroge, N. F., Margaret, N & Joab, K. (2017). Influence of selected factors on the implementation of information and communication technology policy in public secondary schools in Naivasha Sub-country, Kenya. International Journal of Education and Development Using Information and Communication Technology (IJEDICT), 13(2), 70–86.

Olutola, A.T. and Olatoye, O.O. (2015). Challenges of E-learning Technologies in Nigerian University Education. *Journal of Educational and Social Research*, 5(1), .301-305.

Plomp, Tj., ten Brummelhis, A.C.A., &Rapmund, R. (1996). Teaching and Learning for the Future. Report of the Committee on MultiMedia in Teacher Training (COMMITT). Den Haag:

Šorgo, A., Verčkovnik, T., & Kocijančič, S. (2010). Information and communication technologies (ICT) in biology teaching in Slovenian secondary schools. Eurasia Journal of Mathematics, Science and Technology Education, 6(1), 39–46. https://doi.org/10.12973/ejmste/75225

Sommer, B. A., & Sommer, R. (2003). A Virtual Lab in Reserach Methods. Journal Of Teaching Psychology, 30, 171 173).

Scheckler, R. K. (2003). Virtual labs : a substitute for traditional labs ? ResearchGate, 47, 231–236.

Tomljenović, K., & Zovko, V. (2016). The Use of ICT in Teaching Mathematics - A Comparative Analysis of the Success of 7th Grade Primary School Students. Croatian Journal of Education, 18(Special Issue edition2), 215–221. https://doi.org/10.15516/cje.v18i0.2177

Senthilkumar, R., Sivapragasam, C., &Senthamaraikannan, B. (2014). Role of ICT in Teaching Biology. (9), 780–788.

UN. (2016). Incgeon Declaration and Framework for Action for implementation of Sustainable Development Goal 4. Journal of American History, 94(1), 232–233. https://doi.org/10.2307/25094797

UNESCO. (2003). Report of the Experts' Meeting on Documenting Experiences in the use of ICT in Education and Schoolnet Operations. Bangkok., Bangkok.

Volman, M. & Van Eck, E. (2001). Gender equity and information technology in education: The second decade. Review of Educational Research,. ResearchGate, 71.

Végh, V., & Elbert, G. (2017). The effects of using Edmodo in Biology education on students' attitudes towards Biology and ICT. Problem of Education in the 21st Century, 75(5), 484.