International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2022, Vol. 18, Issue 3, pp. 110-121

Teachers' Perspectives of the Drivers and Constraints of ICT Integration into Mathematics Education: A Study of Private Secondary Schools in Five Cities in the Niger Delta

Areye Kiapene
University of Warwick, United Kingdom

ABSTRACT

This study reports on teachers' perspectives of the drivers and constraints of ICT integration into Mathematics Education in 50 private secondary schools in five cities in the Niger Delta region. The study employed a descriptive survey design to obtain the data. The sample or respondents for the study were two hundred mathematics teachers who were drawn through a random sampling technique. The sample represents four Mathematics teachers per school. The instrument for data collection was a structured questionnaire, which was administered and retrieved by research assistants. The instrument was validated for content and construct. The reliability coefficient was obtained using Cronbach's alpha. The study employed the use of descriptive statistics such as mean and standard deviation in analysing the data. From the results, it was discovered that the major drivers of computer integration into the teaching and learning of mathematics were changes in pedagogical practices, school, and national policy to meet global standards, ease of teachers' jobs and saved time due to students' enrolment and overcrowded classrooms, and the need to promote a student-centred approach to learning through the digital classroom. It was also revealed that mathematics teachers in private secondary schools used ICT, although superficially, in the teaching and learning of mathematics. It was also revealed that ICT contributed insignificantly to the teaching and learning of the subject due to the daunting impediments, primarily, lack of access, lack of support by management to access Internet services, lack of power supply, theft and vandalization, and inadequate training and skills of teachers to use ICT, which were all major constraints. Based on the findings, it was recommended that teachers be encouraged to use ICT by training them for ICT literacy and competency, and government should create an enabling environment that would reduce anti-social vices and the cost of access to Internet services.

Keywords*: Teachers' perspectives; drivers; constraints; ICT Integration; mathematics education*

INTRODUCTION

Nigeria is facing a challenge in education due to unprecedented growth in the school population. In 1999, the Federal Government of Nigeria launched the Universal Basic Education (UBE) programme. This programme stipulated that all children in the country were to have nine years of continuous compulsory education - six years in primary school and three years in Junior Secondary School (JSS) (Imam, 2012). Federal Ministry of Education (2014) reported that school enrolment in both primary and secondary levels of education increased remarkably, reaching about 22.6% and 96.3% increase in primary and secondary schools respectively. The challenge is exacerbated by the fact that school enrolment was not matched with an increase in resources. Therefore, secondary education was confronted with umpteen challenges such as: increased student-teacher ratio, use of unqualified teachers, unstable staff, inadequate classroom accommodations, poorly equipped libraries, laboratories, and subject rooms, scarcity and unaffordable textbooks, the politicization and poor maintenance of the culture of school infrastructures (Ike, 2017). A direct consequence, of the above problems, was a steady decline in the standard of education, which is mostly measured by the performance of the students at the Senior Secondary Certificate Examination conducted by the

West African Examinations Council (WAEC) and National Examinations Council (NECO), especially in sciences, technology, English language, and Mathematics (STEM) education. Abdullahi & Sirajo, (2020) blamed the poor performance on the fact that students are inadequately prepared for the examination.

To address these problems, one approach has been to harness and apply the potential of technology in teaching and learning in schools. In fact, Nigeria has embarked on several policies, remarkably the National Policy on Telecommunication (NPT) in 2005, Nigerian National Policy for Information Technology (NNPIT) in 2001, and a National Information Technology Development Agency (NITDA) was equally to ensure the implementation of NNPIT. NNPIT was replaced by the National Information and Communication Technology Policy (NICTP) in 2012. Both policies had admirable goals and objectives; however, they were unsuccessful and failed to give the integration of ICT into the educational sector the highest priority. Instead, the objectives related to education were submerged within human resource development because the policies were market-driven (Yusuf, 2005, The Ministerial Committee on ICT Policy Harmonisation, 2012).

One critical element to consider when integrating ICT into the educational system is the availability and standard of the telecommunication infrastructure such as Internet Service Providers (ISP), Internet penetration, computer penetration, and power supply (Reddy et al.; 2003). In observing the developments around the globe, the developed nations had no difficulties with the required telecommunication infrastructure (Clarke & Zagarell, 2012). This looks like an impossible challenge to third-world countries like Nigeria. Despite the implementation of NPT, it is disappointing to see Nigeria ranked the lowest among a selection of the third world and advanced nations in telecommunication infrastructure (CIA World Factbook, 2018).

Even though ICT has brought about the collapse of space, time, and borders, not everyone and every nation can participate in the global community (Reddy et al., 2003). Most regions in developed countries have continued to gather support for the incorporation of technology into their education and training sectors. They do this by striving to maximise the benefits of technology while minimising their weaknesses. The question is, would the Nigerian educational system follow the ray of light that comes with technology? Research has shown that students learn mathematics better and faster in a technology-enabled interactive environment than in their traditional classroom (Papadakis et. al, 2016). The awareness of the role of ICT in teaching and learning has encouraged Nigerian policymakers and researchers to pay attention to researching and incorporating ICT integration courses into teacher training programmes and Higher Education Institutions (Suleiman et. al, 2020), thereby empowering pre-service teachers and university lecturers to deploy ICT into mathematics education.

The inevitability of mathematics is embodied in the globalised application of computers in the industry and workplace. Computational competence is a major employability skill that is required of employees. This skill is expected to be acquired before graduation or one would face the bitter consequences of unemployment. Besides, there is the policy by the Joint Admission and Matriculation Board (JAMB) in Nigeria and other examining bodies that require that applicants take a computer-based aptitude test and pass to qualify for admission into higher institutions of learning. Unfortunately, to the best of my knowledge, no research has been done regarding the integration of ICT into mathematics education in secondary schools in the Niger Delta region.

Objectives of the study

The study aims at accomplishing the following objectives:

1. Identify the drivers for ICT integration into Mathematics education.
2. Determine the perceived benefits of integrating ICT use into mathematics education.

3. Identify the constraints that impede ICT integration into mathematics education.

RESEARCH QUESTIONS

The study was guided by the following research questions:

1. What are the drivers for ICT integration into Mathematics education?
2. What are the perceived benefits of integrating ICT into mathematics education?
3. What are the constraints that impede ICT integration into mathematics education?

RESEARCH METHOD

The study used a descriptive survey approach thereby, providing a more comprehensive understanding of ICT use in mathematics education in Nigeria. It is deemed appropriate because it is primary research in which the researcher collects first-hand information directly from participants (Hill & Helmers, 2014). This approach gives the opportunity to the researcher to randomly select participants or respondents. Field survey design helps the researcher to ensure that the research problem is effectively addressed. The study was conducted in the Niger Delta region of Nigeria between 2020 and 2022. The study was deliberately limited to private secondary schools in five major cities in the Niger Delta: Warri, Asaba, Benin City, Port-Harcourt, and Yenagoa, to accomplish more credible on-the-ground fieldwork, which would have been cumbersome with a broader study area.

The population for the survey was all private secondary school mathematics teachers in Warri, Asaba, Benin City, Yenagoa and Port-Harcourt. It started with the identification of schools that were willing to participate in the study. The exclusion of rural and public schools was because technology infrastructure was rarely available. Though Nigerian private secondary schools on the global stage are not resource-rich, they are better equipped than public schools since they charge fees and use part of the fees to provide infrastructure within their premises. The study was focused primarily on mathematics teachers without discrimination of gender, subject, and non-subject specialists. Fifty secondary schools in the study area, which had some form of ICT integration were purposively selected for the study. A sample of two hundred (200) mathematics teachers was drawn, using a random sampling technique. The sample consists of four teachers from each school.

The instrument for the study was a structured questionnaire. The questionnaire was developed through consultation with experienced mathematics teachers in Nigeria and past studies of the University of Warwick on ICT integration to determine the relevance of items and coverage of the study. The questionnaire was pilot tested with 12 mathematics teachers in three schools and an opportunity was given for them to criticize it extensively. The items that were deemed unnecessary were removed and after some alterations in the wording and length, it was deemed a clear and exhaustive instrument on ICT integration. The finalised questionnaire was made up of 3 subsections: the drivers for the use of ICT, the perceived benefits of ICT use, and constraints that impede ICT integration into mathematics in the study area. The instrument adopted a four-point Likert-like scale to weigh the opinion of the respondents. The weights were as follows: Very often (4), often (3), rarely (2), never (1). The questionnaire was subjected to a reliability test using a test re-test to confirm its construct and content validity. The Cronbach's alpha coefficient was 0.863 for the drivers, 0.805 for perceived benefits of ICT use and 0.953 for the constraints. The questionnaire generated Likert Scale data (interval measurement) and it was analysed using weighted mean

$\bar{x}_w = \frac{\sum_{i=1}^{n} x_i w_i}{\sum_{i=1}^{n} w_i}$ and standard deviation $Std. = \sqrt{\frac{\sum_{i=1}^{n} X_i^{\,2} - (\bar{x}_w)^2}{N-1}}$ to examine the spread or closeness of the responses. The weighted mean was used because of the difference in the intensity of the response options. A benchmark of 2.50 was set as a norm. A value above the benchmark was accepted, while below it was rejected.

RESULTS AND DISCUSSION

Table 1: *Results for the drivers of ICT integration into Mathematics education*

Item Description	N	Weighted mean	Std. Deviation	Remark
The school and national policy to meet global standards	200	4.04	0.718	Accepted
To ease teachers' jobs and save time due to students' enrolment and overcrowded classrooms	200	4.02	0.71	Accepted
The need to promote student-centred approach to learning through digital classroom	200	3.95	0.96	Accepted
Employers' requirements for employability	200	4.23	0.54	Accepted
Change in pedagogical practices	200	3.74	0.72	Accepted

The results presented in Table 1 above indicates that one of the most important drivers of ICT integration into mathematics education is the school and national policy to meet global standards. Mathematics is the foundation of science and technology. If a nation has to meet global standards, ICT must be integrated into the school curriculum and learning processes for technological breakthroughs. The government aims to establish and provide more Internet accessibility in the national schools to create a virtual learning environment and augment online best practices content starting with a video library of best teachers delivering lessons in critical subjects and maximize the use of ICT for distance learning and self-paced learning to expand the capacity of learning outcomes and allow for more customized learning requirement. Houston (2017) highlighted some technologies that are enabling profound changes in the workplace and organizations such as cloud and mobile computing, big data and machine learning, sensors and intelligent manufacturing, advanced robotics and drones, and clean-energy technologies, that have impacted seriously the foundations of global business and organizations. These technologies increase efficiency and effectiveness in the workplace.

It was discovered that one major reason for the interest in the integration of ICT is the need to ease teachers' jobs and save time due to students' enrolment and overcrowded classrooms. Overcrowded classes are a commonplace in schools in most cities in the study area. It was observed that teachers used ICT in planning, delivery of lessons, and in post-delivery, such as storage of data and retrieval with relative ease. This supports the finding by Rani (2018), that teachers retrieved relevant materials from the Internet for lesson planning. Similarly, Wanjala (2016), Yuan and Chun-Yi (2012), and Motamedi (2019) reported that ICT was a useful presentation tool. The need to promote a student-centred approach to learning through digital classrooms was also accepted as one of the reasons that promoted the integration of ICT in

schools. ICT creates a new learning landscape as it supports flexible, accessible, and personalized education. It is believed that learning independently increases creativity and builds self-confidence. This tends to confirm the findings of a study conducted by Jo (2013) who stated that ICT assists students in accessing digital information efficiently and effectively, supports student-centred and self-directed learning, produces a creative learning environment, promotes collaborative learning in a distance-learning environment, offers more opportunities to develop critical (higher-order) thinking skills, improve teaching and learning quality, and support teaching by facilitating access to course content.

It was discovered that employers' requirement for employability is one major driver for ICT integration in school. This confirms the statement of Soludo (2012), that Nigerian graduates are not employable, and they are misfits for today's workplace. This may be attributed to deficient exposure of recipients of education to employability skills to enable them to earn a living in a changing world. Numeracy skill is a major requirement in the workplace, and it is equally needed to pass and qualify for higher education. Bhat (2013) made it clear that we live in a global world where technology, especially information and communication technology, is changing the way businesses create value, strive, and determine how and where we work, as well as interpersonal communication in organizations. On this ground, it becomes expedient that ICT be integrated into mathematics education in secondary schools.

The results also revealed that change in pedagogical practices is one of the drivers for ICT integration in Mathematics education. The use of the Internet and computers is now commonplace in the study area despite the cost implication. Everyone wants to meet modern and current trends and be abreast with information. More so, ICT skills are requirements at the workplace to perform various tasks including computations. With the introduction of ICT into teaching and learning, Mishra and Koehler (2006b), and Ball et al., (2008) recognized Shulman's theory which linked pedagogy to technology. He described the framework for effective integration of ICT in teaching and learning as Technological Pedagogical Content Knowledge (TPCK). The result is an indication of the respondents knowing the benefits of ICT integration in the delivery of instructions, they were limited by insufficient training. The finding corroborates the report of Cassim (2010) on the correlations of ICT with teaching practice. It indicated that the majority of teachers did not know in which teaching and learning situations to use ICT, therefore they did not make use of ICT for extended projects, teacher lecturing, present information, demonstrations, or class instruction. Only the teachers who had some knowledge in which teaching and learning situations to use ICT, made use of ICT in the various teacher practice activities.

The results for the benefits of ICT use are shown in Table 2 below. It could be deduced that teachers perceived ICT as a beneficial tool in the teaching and learning of mathematics. This is because they recognised that ICT could improve students' achievement and performance. There are numerous ways in which ICT use in the teaching and learning of mathematics could improve the falling standard of mathematics education in Nigerian secondary schools. It was revealed that ICT stimulates students' interest, which supports the opinion of Ruthven & Lavicza (2011), Rani (2018), Turk & Akyuz (2015) and Lugalia (2015). This could unlock students' creativity and flexibility in approaching a challenging problem as opposed to believing that the teacher-demonstrated approach is the only mathematical door to finding a solution to a problem. Similarly, Wanjala (2016) stated that it is used as a presentation tool, (Yuan and Chun-Yi 2012; Motamedi 2019). ICT use keeps students focused during learning. It was also observed that ICT use reduced the level of abstraction because of seeing and building a relationship between items (Mwingirwa & Mihesco-O'Connor 2016), Clark-Wilson & Oldknow (2016). It was also discovered that ICT would be enhancing performance and grade. This is because the use of ICT deepened students' understanding. It helps to consolidate and brings alive some abstract aspects of the subject through spatial visualisation, as opposed to memorising or cramming of formulas that make little or no sense. This is in consonance with Aremu & Adebagbo (2016); and Gambari et al. (2014) and Turk

& Akyuz (2015) who confirmed that ICT improves performance grades. However, Sanders and George (2017) submitted a contradicting opinion that ICT reduces students' performance as it could distract them especially when its application is misused.

Table 2: *Benefits of ICT use*

Item Description	N	Weighted mean	Std. Deviation	Overall response
ICT helps teachers to represent mathematical concepts in different forms	200	4.04	0.718	Accepted
ICT is particularly useful in helping me to support the diverse learning needs of pupils.	200	4.02	0.71	Accepted
Pupils enjoy lessons more when they use ICT than when they don't.	200	3.95	0.96	Accepted
The use of ICT facilitates immediate feedback	200	3.94	0.79	Accepted
ICT promotes student-centred approach to learning	200	3.88	1.00	Accepted
The use of ICT helps to deepen students understanding of mathematics	200	3.88	0.95	Accepted
ICT encourages students to spot connectivity between mathematical concepts	200	3.86	0.87	Accepted
Use of ICT helps to uncover the underlying reasons for abstract mathematical concepts	200	3.80	0.85	Accepted
Use of ICT brings about the relevance of mathematics	200	3.74	0.95	Accepted
Using ICT in my teaching saves me time.	200	3.58	1.00	Accepted
ICT helps me to personalise the learning of each pupil.	200	3.47	1.07	Accepted
It is challenging to monitor pupils learning in ICT lessons	200	2.90	1.08	Accepted
Use of ICT encourages students' independence	200	2.86	1.34	Accepted

It was found that ICT use facilitates multiple representations; and facilitated procedural and conceptual representation of the same concepts in different ways. This is because ICT integration harmonises and integrates both the procedural and conceptual understanding of the subject. Multiple representation and online algorithms facilitated CU and PU. Pierce et al., (2011), Zbiek et al., (2007), thereby activating CU and PU (Haapasalo et al., 2004) simultaneously. ICT can enable a paradigm shift. It allows a variety of approaches (graphical, numerical, algebraic, and tabular) to solving the same problem. This was supported by Pierce & Ball, (2009), Tarmizi et al. (2009); and Webb (2005) that ICT use helped to facilitate the student-centred approach. The offer and reach of ICT was also profound on teachers and was used as a planning tool to assemble up-to-date information from a resources repository (Ibieta et al. (2017).

The results also revealed that ICT enables the digital classroom, that is, given of assignments and engaging students after school hours as well as in the administration of CBT examinations and communication with students. It also helped with the compilation and dissemination of examination results. This confirms (Osang, 2012) and OECD (2015) that ICT was used to set home-learning tasks.

Table 3: *Constraints of ICT integration into Mathematics education*

Item Description	N	Weighted mean	Std. Deviation	Overall response
Lack of support by management to access internet services	200	4.13	1.26	Rejected
Locally generated power supply	200	4.12	1.17	Accepted
Access to Intranet	200	3.60	1.53	Accepted
Access to power from National grid	200	3.53	0,86	Accepted
Teachers' ownership of computer	200	2.65	0.78	Accepted
Students' ownership of computer	200	3.87	0,58	Accepted
Lack of mathematics soft wares	200	3.48	0.97	Accepted
Theft and vandalism	200	2.97	1.12	Accepted
Poor internet services	200	3.26	0.63	Accepted
Inadequate training and skills of teachers to use ICT	200	2.78	0.98	Accepted
Students' misuse of ICT	200	3.90	0.94	Accepted

The results in Table 3 above reveals that all the eleven items that were presented for opinion were critical constraints in ICT integration in the study area. On access, the finding confirms the study conducted by Chijioke (2013), Mwingirwa & Mihesco-O'Connor (2016). Wanjala (2016) who stated that lack of access was a crucial disabler in emerging economies. The school is a production unit which uses inputs, in expectation of outcomes which are the students that would acquire skills to drive the economy for growth and development. Hew & Tan (2016) also confirmed that ICT integration depends on unhindered access. The finding is also in consonance with Nwabude et al., (2020) who stated that VLE are not available, while Tayo et al.; (2015) blamed lack of access on low income and high cost of ICT infrastructure.

An inadequate power supply confirms the report by CIA World Factbook (2018) and Rani (2018) who stated that Nigeria's annual electricity consumption is low. It was also revealed that one of the constraints to the integration of ICT in schools is the anti-social vice of theft and vandalisation of ICT resources. This supports the reports of African News Agency (2019); Ground Up (2017); Maromo (2020); Mbuza (2019); Mdlongwa (2012); News24 (2019); Sedibe (2011), who indicated that over the years, the vulnerability of ICT resources is the bane of the integration of ICT in schools. This reiterates the argument that the impact that the lack of ICT resources has on teaching and learning may continue to linger for much longer unless the impending challenges, including that of security, are tackled holistically.

It was also revealed that inadequate training is a significant obstacle to ICT integration into Mathematics education. This also corroborates the study carried out by Leask & Younie (2013), Prieto-Rodriguez (2016), Mirzajani et al.; (2015) and Thorvaldsen et al.; (2012). Students' misuse of ICT technology was in line with the findings of Kale & Goh (2012), OECD (2015) which confirmed that distractions accompany ICT use. Adepoju (2020) also reported that some students use it to play games, watch films and sometimes yahoo activities rather than for academic activities.

CONCLUSION AND RECOMMENDATIONS

The foregoing analysis is far from capturing a complete picture of ICT integration in the Niger Delta. However, it represents a first step in examining ICT integration in secondary education, in this case, mathematics education in the region. The study found that ICT is hardly used in the teaching of Mathematics in the private secondary schools in the five cities of Niger Delta because it is clouded

by numerous constraints that stand in the way of the teacher. These constraints according to the findings range from lack of access to laptops/desktops, lack of access to ICT software, inadequate projectors or interactive whiteboards, acute shortage of computer laboratory, data rationing, unstable power supply, students' misuse of ICT, non-inclusion of ICT in the mathematics curriculum, lack of training, and inadequate ICT policies.

Though teachers indicated a high knowledge about the usefulness of ICT, they only used it to facilitate the traditional teacher-centred approach in the teaching and learning of Mathematics. ICT was predominantly used for sourcing lesson materials, projecting lessons, conducting multiple-choice exams, a compilation of exam results, disseminating homework, and communicating with students/parents. Mathematics teachers in the five cities studied rarely used dynamic software or ICT-enabled hands-on activities to explore mathematical concepts, and in the few instances of the use of dynamic software, they were used as a presentation tool without a carefully planned pedagogy.

Based on the findings, it is recommended that to ensure successful ICT integration in schools, teachers should be adequately trained in ICT literacy and competency, and the government should create an enabling social environment that would reduce vices and reduce the cost of access to Internet services through supportive policies, and subsidies funding allocation in ICT.

REFERENCES

Abdullahi, U. and Sirajo, M. (2020). "Effect of resource factors and quality of instruction on performance in mathematics of Nigeria secondary school Students". *Journal of Mathematics Education,* vol. 5, no. 1, pp. 61 – 69.

Adepoju, E.O. (2020). Perceived Impact of Utilisation of ICT Facilities on Academic Performance of Undergraduates in Universities in Southwest, Nigeria. International Journal of Research and Innovation in Social Science (IJRISS) | vol. iv, no. v, pp. 1- 9

African News Agency. (2019), January 16. ANC irked by theft of computers from new state-of-the-art primary school. IOL. Retrieved from https://www.iol.co.za/news/politics/anc-irked-by-theft-of-computers-fromnew-state-of-the-art-primary-school-18833497

Aremu, A., and Adebagbo, A. (2016). "Games, Game flow, and gender as they affect the mathematics achievement of pupils in Nigeria". *Bulgarian Journal of Science and Education Policy,* vol. 10, no.1, pp. 156 – 170.

Ball, D.L., Thames, M.H. & Phelps, G. (2008). Content Knowledge for Teaching: What makes it special? Journal of Teacher Education, vol. 59, no. 5, pp. 389-407

Bhat, S. (2013). Top 10 skills required to be in the global workforce. Retrieved on 10 April, 2022 from http://www,chillibreeze.com

Cassim, V. (2010). The Pedagogical Use of ICTs for teaching and learning within grade eight mathematics in South African schools. Dissertation submitted in the fulfilment of the requirements for the degree Master of Education at the Potchefstroom campus of the North-West University, South Africa.

Chijioke, A. I. (2013). "Computer Technology in Nigerian Secondary School Education: Problems and Prospects". *Journal of resourcefulness and distinction*, vol. 6, no.1, pp. 1 – 11.

CIA World factbook, (2018). “Energy: Electricity consumption, Nigeria”. [Online] https://www.indexmundi.com/g/g.aspx?c=ni&v=21

Clarke, G., and Zagarell, J. (2012). “Technology in the classroom: Teachers and technology: A technological divide”. *Childhood Education*, vol. 88, no. 2, pp. 136 – 139.

Clark-Wilson, A., and Oldknow, A. (2016). “Teachers using ICT to help with ‘hard to teach’ topics”. *Mathematics in Schools*, vol. 38, no.4, pp. 3 – 6.

Federal Ministry of Education (2014). Nigeria EFA Review report for 2000 – 2014. Strides and Milestones. Unesco Digital Library [online] http://unesdoc.unesco.org/images/0023/002310/231081e.pdf.

Gambari, A. I., Falode, C. O., and Adegbenro, D. A. (2014). “Effectiveness of computer animation and geometrical instructional model on mathematics achievement and retention among junior secondary school students”. *European Journal of Science and Mathematics Education,* vol. 2, no.2, pp. 127 – 137.

Ground Up. (2017). “Thieves steal primary school children’s education in Nyanga”. The South African. Retrieved from https://www.thesouthafrican.com/news/school-children-denied-educational-help-due-to-thieves/

Haapasalo, L. Zimmermann, B. and Rehlich, H. (2004). “A versatile tool to promote link creative production and conceptual understanding”. *The Teaching of Mathematics*, vol. 7, no.2, pp. 61 – 70.

Hew, K. F., and Tan, C. Y. (2016). “Predictors of information technology integration in secondary schools: evidence from a large scale study of more than 30,000 students”. *Public Library of Science One,* vol.11, no.12, [Online] https://doi.org/10.1371/journal.pone.0168547.

Hill, C. A., & Helmers, M. (2014). “Whole school improvement and restructuring as prevention and promotion”: Boston, MA: Wadsworth.

Houston, W. (2017). The effects of student teams-achievement divisions on relational achievement in primary schools. Retrieved on 10th April, 2022 from http:www.unesdoc.unesco.org/

Ibieta, A. Hinostroza, E., Labbe, C. and Claro, M. (2017). “The role of the Internet in teachers’ professional practice: activities and factors associated with teacher use of ICT inside and outside the classroom”. *Technology, Pedagogy and Education*, vol. 26, no. 4, pp. 425 – 438.

Ike, P. (2017). “Problems and prospects of secondary education in Nigeria”. *International Journal of Education and Evaluation.* vol. 3, no. 1, pp. 44 – 51.

Imam, H. (2012). “Educational policy in Nigeria from the Colonial Era to the post-independence period”. *Italian Journal of Sociology of Education*. vol.1, pp. 181 – 201.

Jo, S. F. (2013). “ICT in Education: A critical literature review and its implications” International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2013, vol. 9, no. 1, pp. 112-125

Kale, U. and Goh, D. (2012). “Teaching style, ICT experience and teachers’ attitudes towards teaching with Web 2.0”. *Educational Information Technology,* vol.19, pp. 41 – 60.

Leask, M., and Younie, S. (2013). "National models for continuing professional development: the challenges of twenty-first-century knowledge management". *Professional Development in Education*, vol. 39, no.2, pp. 273 – 287.

Lugalia, M. (2015). "Pupils learning algebra with ICT in Key Stage 3 mathematics classroom". PhD Thesis, University Warwick, Coventry, retrieved October 8, 2020 from http://wrap.warwick.ac.uk/72804/

Maromo, J. (2020), April 17. Almost 400 SA schools vandalized during the Covid-19 lockdown. African News Agency/ANA. Retrieved from https://www.iol.co.za/news/politics/almost-400-sa-schools-vandalisedduring-covid-19-lockdown-46832389

Mbuza, E. (2019) July 25. Stealing SA's future: 250 computers stolen from Gauteng schools in 2019. Times Live. Retrieved from https://www.timeslive.co.za/news/south-africa/2019-07-25-stealing-sasfuture-250-computers-stolen-from-gauteng-schools-in-2019/

Mdlongwa, T. (2012). "Information and communication technology (ICT) as a means of enhancing education in schools in South Africa". Policy Brief: Africa Institute of South Africa. Retrieved from http://www.ai.org.za/wpcontent/uploads/downloads/2012/10/No.-80.-ICTas-a-means-of-enhancingEducation-in-Schools-in-South-Africa.pdf

Mirzajani, H., Mahmud, R., Ayub, A. F. M., and Laun, W. S. (2015). "A review of research literature on obstacles that prevent use of ICT in pre-service teachers' education courses". *International Journal of Education and Literacy Studies*, vol. 3, no.2, pp. 25 – 31.

Mishra, P. & Koehler, M.J. (2006b). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. Teacher College Record, vol. 108, no. 6, pp. 1017-1054

Motamedi, V. (2019). "The promises of presentational technology for teaching and learning". *Journal of Education and Learning*, vol. 13, no.3, pp. 416 – 419.

Munje, P. N and Jita, T. (2019). "The impact of the lack of ICT resources on teaching and learning in selected South African primary schools. International Journal of Learning, Teaching and Educational Research vol. 19, no. 7, pp. 263-279

Mwingirwa, I. M., and Mihesco-O'Connor. (2016). "Status of teachers' technology uptake and use of GeoGebra in teaching secondary school mathematics in Kenya". *International Journal of Research in Education and Science,* vol. 2, no.2, pp. 286 – 294.

News24. (2019), January 8. SA's biggest challenges in 2019. News24. Retrieved from https://www.news24.com/MyNews24/sas-biggest-challenges-in-2019- 20190108

Nwabude, A. R., Ogweleka, F. N. And Irhebhude, M. E. (2020). "Approach to methodology and design issues for a customised Virtual Learning Environment (VLE) model/framework for universities in developing countries". *Computer Science and Engineering,* vol.10, no.1, pp. 7 – 21.

Oppenheimer, T. (1997). "The computer delusion". *The Atlantic Monthly*, vol. 280, no.1, pp. 45 – 62.

Organisation for Economic Co-operation and Development, OECD (2015). "Students, computers, and learning: Making the Connection, PISA". OECD Publishing. [Online] https://www.oecd-ilibrary.org/education/students-computers-and-learning_9789264239555-en

Osang, F. (2012). "Electronic examination in Nigeria, academic staff perspectives- Case study: National Open University of Nigeria (NOUN)". *International Journal of Information and Education Technology,* vol. 2, no.4, pp. 304 – 307.

Papadakis, S., Kalogiannakis, M., and Zaranis, N. (2016). "Comparing Tablets and PCs in teaching Mathematics: An attempt to improve mathematics competence in Early childhood education". *Preschool and Primary Education,* vol. 4, no. 2, pp. 241-253.

Pierce, R., Stacey, K., Wander, R., and Ball, L. (2011). "The design of lessons using mathematics analysis software to support multiple representations in secondary school mathematics". *Technology, Pedagogy and Education*, vol. 20, no.1, pp. 95 – 112.

Prieto-Rodriguez, E. (2016). "It just takes much time! A study of teachers' use of ICT to convey relevance of mathematics content". *International Journal for Technology in Mathematics Education,* vol. 23, no.1, pp. 13 – 24.

Rani, R. (2018). "Role of ICT to enhance Mathematics teaching and to raise educational standards". *International Journal of Scientific Research,* vol. 6, no.9, pp. 488-490.

Reddy, V., Ignou I., and Srivastava, M. (2003). "ICT and the future of distance learning". *Turkish Online Journal of Distance Education – TOJDE*, vol. 4, no. 4.

Ruthven, K. and Lavicza, Z. (2011). "Didactical conceptualization of dynamic mathematical approaches: Example analysis from the InnoMathEd program", *International Electronic Journal of Mathematics Education*, vol. 6, no. 2, pp. 89 – 110.

Sanders, M., and George, A. (2017). "Viewing and changing world of educational technology from a different perspective: Present realities*". Educational Information Technology*, vol. 22, pp. 2915 – 2933.

Sedibe, M. (2011). Inequality of access to resources in previously disadvantaged South African high schools. Journal of Social Sciences, vol. 28, no. 2, pp. 129-135.

Soludo, C. C. (2012). Nigerian graduates are unemployable. The Nation Online. Retrieved on 5th of September, 2022 from www.thenationonlineng.net

Suleiman, M. M., Yahya, A. T. and Tukur, M. (2020). "Effective Utilization of ICT Tools in Higher Education". *Journal of Xidian University*, vol. 14, no. 9, pp. 1- 4

Tarmizi, R.A., Yunus, A.S.; Ayub, A.F.; Bakar, K. A. (2009). "Integration of Autograph *Technology for learning Algebra". European Journal of Social Sciences,* vol. 9, no.1, pp. 129 – 146.

Tayo, O., Thompson, R. and Thompson, E. (2015). "Impact of the digital divide on computer use and internet access on the poor in Nigeria". *Journal of Education and Learning,* vol. 5, no.1; pp. 1 – 5.

The Ministerial Committee on ICT Policy Harmonization (2012). *National Information and Communication Technology (ICT) Policy*. The Ministerial Committee On ICT Policy Harmonization, Nigeria
[Online] http://www.researchictafrica.net/countries/nigeria/Nigeria_National_ICT_Policy_(draft)_2012.pdf

Thorvaldsen, S., Vavik, L, and Salomon, G. (2012). "The use of ICT tools in Mathematics: A case control study of best practice in 9th grade classrooms". *Scandinavian Journal of Educational Research,* vol. 56, no.2, pp. 213 – 228.

Turk, H. S., and Akyuz, D. (2015). "The effects of using Dynamic Geometry on Eighth Grade students' achievement and attitude towards triangle". *International Journal of Technology in Mathematics Education,* vol. 23, no.3, pp. 95 – 101.

Wanjala, M. S. (2016). "Information Communication Technology Pedagogical Integration in mathematics instruction among teachers in secondary schools in Kenya". *Journal of Education and Practice*, vol. 7, no.2, pp. 66 – 72.

Webb, M.E. (2005). "Affordance of ICT in science learning: Implications for integrated pedagogy". *International Journal of Science Education*, vol. 27, no.6, pp. 705 – 735.

Yuan, Y. and Chun-Yi, L. (2012). "Elementary school teachers' perceptions towards ICT: The case of using Magic board for teaching mathematics". *Turkish Online Journal of Educational Technology*, vol.11, no.4, pp. 108 – 118.

Yusuf, M. O. (2005). "Information and Communication Technology and Education: Analysing the Nigerian national policy for Information technology". *International Education Journal,* vol. 6, no.3, pp. 316 – 321.

Zbiek, R M.., Heid, M. K., Blume, G., and Dick, T.P. (2007). "Research on technology in mathematics education: The perspective of constructs". In F. K. Lester (Ed.), *Second Handbook of Research in Mathematics Teaching and Learning* (pp. 1169-1207). Charlotte, NC: Information Age Publishing.
