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Full Length Research

ICT skills activation for secondary school students and its implication on mathematics proficiency

Omoniyi Israel Oginni[1*] and Eunice Oluwayemisi Alebiosu[2]

[1]Department of Science Education, Ekiti State University, Ado Ekiti, Ekiti State, Nigeria.
[2]Department of Human Kinetics and Health Education, Faculty of Education, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria.

*Corresponding author. Email: omoniyi.oginni@eksu.edu.ng; Orcid ID: https://orcid.org/0000-0002-1905-8881.
Co-author. Email: eunice.alebiosu@eksu.edu.ng; Orcid ID: https://orcid.org/0000-0002-0770-2182.

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ABSTRACT: The study investigated an assessment of ICT skills needed for mathematical proficiency among secondary school students. Mathematics proficiency made up of procedural fluency (PF), conceptual understanding (CU), strategic competence (SC), adaptive reasoning (AR) and productive disposition (PD) were examined in the study. The research design employed was descriptive survey, as it enables the researcher describe the existing situation regarding participants' opinion towards the integration of Information Communication Technology (ICT) into teaching and learning of mathematics. The population of this study consists of mathematics teachers and students of senior secondary schools in Ado-Ekiti Local Government of Ekiti State. The sample for the study consists of 1000 students selected from 189 public and private secondary schools in Ado-Ekiti. The instrument used in carrying out this research was a questionnaire on the level of students' use of Information Communication Technology (ICT) and mathematics proficiency. Face and content validity of the instrument was ascertained while the reliability of the instrument was ensured by administering it on 20 students outside the sample used in this study. The Pearson's Product Moment Correlation analysis was used which yielded a reliability co-efficient of 0.80. Data collected were analyzed using the descriptive statistics of frequency, percentage, and inferential statistics such as t-test, regression and analysis of variance. The findings of the study revealed that the procedural fluency in ICT makes students more effective in learning mathematics. Also, there were significant possible correlations among senior secondary school students' conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, productive disposition and performance in mathematics. Based on these findings, it was recommended that PF, CU, SC, AR and PD should be applied in order to achieved mathematics proficiency expectations and teachers and students should be skillful in ICT.

Keywords: Adaptive reasoning, conceptual understanding, ICT skill activation, mathematics proficiency, procedural fluency, productive disposition, strategic competence.

INTRODUCTION

Mathematics is a unique subject, which encourages the acquisition of specialized science skills and knowledge. This skills and knowledge when activated would enable practical challenges of man to be tackled through headlong. Learners involved in the process of problem solving create mathematical knowledge and understanding by dealing with and resolving real problems as against carrying out apparent exercises. Mathematics is embraced worldwide as an asset to all knowledge (Oginni, 2013). Learners adopt reasoning and proof to make sense of mathematical tasks and concepts and to cultivate, defend, and assess mathematical arguments and solutions. Learners construct and deploy representations such as diagrams, graphs, symbols, pictures, and manipulative to think through mathematical problems. Learners also involve in communication as they explicate their ideas and thinking orally, in writing, and through illustrations. Recent development in mathematics teaching has enabled learners not only evolve and deploy connections between mathematical ideas as they acquire novel mathematical concepts and procedure from teachers, but also build connections between mathematics and other disciplines by relating it to real-world situations (UNESCO, 2002).

The National Council of Teachers of Mathematics (NCTM, 2018) has identified five process standards by which learning mathematics to include problem solving, reasoning and proof, representation, communication, and connections. These standards are ways to think about how learners should engage in learning the mathematical content as they develop mathematical proficiency.

Mathematical proficiency is used to capture what it means for learners to learn in mathematics successfully. It is an indicator that someone understands (and can do) mathematics. Mathematical proficiency is the quality of being skilled and exhibiting expertise, competence, knowledge, beliefs, and facility in doing mathematics and becoming proficient problem solver with high productive disposition. According to NRC (2018), mathematical proficiency consists of five interwoven and interdependent strands. This includes conceptual understanding, procedural fluency, strategic competence, adaptive reasoning and productive disposition.

Conceptual understanding refers to an integrated and functional grasp of mathematical ideas. Students with conceptual understanding know more than isolated facts and methods (NRC, 2018). A significant indicator of conceptual knowledge is being able to represent mathematical situations in different ways and knowing how different representations can be useful for different purposes (NRC, 2018). Thus, any student having conceptual understanding is a function of the many connections to different representations he/she has. To attain conceptual understanding, students should be made to see the multiple entry points in solving a problem. Conceptual understanding allows students to build new knowledge as they make connections with previously learned knowledge. This method is far more beneficial to students than simple memorization of facts and procedures (Markovits and Weinstein, 2018). Conceptual understanding promotes retention and fosters the development of fluency.

Strategic competence is the ability to formulate mathematical problems, represent them, and solve them (NRC, 2018). In the same vein, strategic competence is concerned with a person ability to formulate a problem mathematically and then use his or her previous mathematical experiences to solve it. Strategic competence enables a learner to decipher which strategies might be useful in tackling the problem and in connecting these strategies to previous mathematical experiences. Strategic competence can be nurtured through constant exposure to mathematical problems that reflect real life problematic situations. Mathematical problems that require students to comprehend the problem, devising a plan, and carrying out the plan to solve the problem mathematically promote the development of strategic competence.

Procedural fluency is defined as the knowledge of procedures, knowledge of when and how to use the right knowledge and skills appropriately, and skill in performing them flexibly, accurately, and efficiently (NRC, 2018). Procedural fluency is knowledge and use of rules and procedures in carrying out mathematical processes and also the symbolism used to represent mathematics. A student may choose to use the traditional algorithm or employ an invented approach. A student who is procedurally fluent might move part of one number to another or use a counting-up strategy. Procedural fluency is more than memorizing facts or procedures, and it is more than understanding and being able to use one procedure for a given situation. Procedural fluency builds on a foundation of conceptual understanding, strategic reasoning, and problem solving (NCTM, 2000; NCTM, 2018). Research suggests that once students have memorized and practiced procedures that they do not understand, they have less motivation to understand their meaning or the reasoning behind them (Markovits and Weinstein, 2018).

Procedural fluency without conceptual understanding will yield non-meaningful and inappropriate strategies for solving mathematical problems. Conceptual understanding without procedural fluency will yield inefficient strategic applications (Martins, 2009). According to Awofala et.al. (2019), effective application of mathematics demands that both procedural fluency and conceptual understanding be considered necessary components of mathematics proficiency and literacy. Procedurally fluent students ostensibly develop the ability to evaluate and simplify various expressions, solve simple equalities, and represent mathematical relationships in graphical form. Students that do not possess an adequate level of procedural fluency will devote much of their attention to the task of basic computation at the expense of developing a deep understanding of more complex mathematical ideas (Oginni, 2016). No wonder that most students do not appreciate Mathematics learning beyond primary and post primary in Nigeria.

Adaptive reasoning is defined as the capacity to think logically about the relationship among concepts and situations (NRC, 2018). Ability in adaptive reasoning enables one to consider alternative approaches, to follow the mathematical logic of a proposed proof, to note logical inconsistencies or contradictions, and to justify any conclusions (Siegfried, 2012). Students with adaptive reasoning are able to justify the solution steps employed in solving a problem in a logical manner in such a way that they know when the solution steps are wrong or right. Students are said to be capable of adaptive reasoning when they are able to think logically about the existing problems, estimating and reflecting through the problems and giving justifications for solving the problems.

Productive disposition is defined as the tendency to see sense in mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in learning mathematics pays off, and to see oneself as an effective learner and doer of mathematics (NRC, 2018). Rather than see mathematics as a set of arbitrary rules that one must memorize, students with productive disposition view mathematics as a system of connected conceptions that can be understood with perseverance and diligent effort. A line of distinction can be drawn between this strand and the other four strands although productive disposition is needed to build the other four strands (NRC, 2018). While the other four strands deal with a learner's cognitive processes and relate to mathematical content knowledge, productive disposition is enshrined in a learner's affect, beliefs, and identity and strengthening of the other four strands helps build a learner's productive disposition. Thus, a symbiotic relationship exists between productive disposition and the other four strands.

The development of ICT has become a vital issue to meet the needs of the education system (Chao, 2015). ICT is one of the tools that supports learning process and proffers solutions to the challenges that education is facing (Oduma and Ile, 2014). Information and Communication Technology (ICT) is contemporary model which has combined in many streams. It has several assistances in mathematics connected pedagogical performs. Research conducted by Grouws and Cebulla (2000) has shown that ICT in educational system is beneficial for the development of pedagogical skills, teaching efficiency, professional skills, content knowledge, teaching skills, communication skills, adjustment skills and other related skills for teachers to be incorporated while teaching mathematics in order to foster knowledge driven among learners as well as performance by enhancing self-learning capacity. It could also enhances communication skills by developing problem solving ability, promote mathematical understanding, funny learning and engage with mathematical problem solving to the students.

The appropriate use of ICT matching the ability of children leads to them more efficiently understanding the different mathematical notions (Zaranis and Synodi, 2016). It improves learners' poor handwriting and language skills, balanced individual differences with special needs and simplifies self-pacing. It helps to enables and encourages for collaborative and independent learning, ensures individual preferences, develops communication skills, access to resource based learning and real world information through the Internet. It increases reliability of information, accuracy and student motivation, gives students more control, allows to produce high quality multimedia products, changes teacher practices, planning tools and assessment headers, increases learning occasions in the classroom (Youssef and Dahmani, 2008). ICT helps to increase the critical thinking skills, analyzing skills (Fitzallen, 2015), understanding and application skills of students. It is extra favorable for conceptualize mathematical thinking, self-learning by Internet and other audio visual instruments, professional development of teachers, to make effectiveness of classroom activities, motivate students towards learning, updated teachers and students with new technologies and so on. Noor-Ul-Amin (2013) found that ICT affect the escape of education, it increases the flexibility of learning activities and achievement of students. Mdlongwa (2012) explored some benefits of using the ICT in teaching and learning as learners can connect to experts and have access to global resources, learners have access to quality learning material, learners can improve owns knowledge and standard of work, makes communication easier and faster, and easily get information's from the Internet, learners acquire skills which they can use beyond school or university or workplace. Goos (2010) mentioned that digital technology helps students to learn mathematics more quickly and accurately.

School types determines the level of performance in mathematics by students. In Nigeria public and private secondary schools, observations have shown that public secondary schools (owned by government) hire more qualified teachers than the private schools. Ironically, private schools owners pay less remunerations to her workforce than the public schools teachers. The assertion become more worrisome since the elites do not warm at patronizing public secondary schools but private. According to Okon and Archibong (2013), the general impression people have is that private primary and secondary schools are meant for the privileged class of people in the society. Most of these private schools are well equipped with teaching resources that attract them.

Objectives

The objectives of this study is to investigate the influence of mathematics proficiency and information communication technology (ICT) skills activation for secondary school students in perspective. Specifically, the study:

1. Examine the influence of procedural fluency (PF), conceptual understanding (CU), strategic competence (SC), adaptive reasoning (AR) and productive disposition (PD) on ICT skills acquisition for mathematics proficiency.
2. Investigate whether ICT skills can predict mathematics proficiency.
3. Ascertain if school type can influence mathematics proficiency.

Research question

What is the extent of the use of ICT and mathematics proficiency?

Research hypotheses

H_{01}: ICT cannot predict significantly student's mathematics proficiency in secondary school.
H_{02}: School type do not significantly related to mathematics proficiency in secondary school.

METHODOLOGY

The research design employed was descriptive survey, as it enables the researcher describe the existing situation regarding participants' opinion towards the integration of Information Communication Technology (ICT) into teaching and learning of mathematics. The population of this study consists of mathematics students of senior secondary schools in Ado-Ekiti Local Government of Ekiti State. The sample for the study consists of 1000 students selected from 189 public and private secondary schools in Ado-Ekiti. The instrument used in carrying out this research was a questionnaire on the level of students' use of Information Communication Technology (ICT) and mathematics proficiency. Face and content validity of the instrument was ascertained while the reliability of the instrument was ensured by administering it on 20 students outside the sample used in this study. The Pearson's Product Moment Correlation analysis was used which yielded a reliability co-efficient of 0.80. The coefficient was considered to be high enough and adjudged to be reliable for the study. The data collected were analyzed, using descriptive and inferential statistics at 0.05 level of significance.

RESULTS

Research question

What is the extent of the use of ICT and Mathematics proficiency?

Table 1 shows the respondents' opinion on level of use of ICT. The findings revealed that 72% of the respondents agreed with the fact that conceptual understanding in ICT allows students to build new knowledge in mathematics while 28% disagreed. It also revealed that 59% of the respondents agreed with the fact that procedural fluency in ICT makes students more effective in learning mathematics while the remaining (41%) disagreed.

Out of the total respondents, the findings revealed that a large population of the respondents (55%) agreed that strategic competence facilitates students' effective learning of mathematics while the remaining respondents (45%) disagreed. As to know whether adaptive reasoning aids to formulate and solve difficult problems in mathematics, the greater population of the respondents (53%) agreed while (47%) of the respondents disagreed. Also, eliciting from the respondents whether procedural disposition makes students consistent in studying mathematics, 52% of the respondents disagreed while 48% agreed.

Research hypotheses

Hypothesis 1: ICT cannot predict significantly student's mathematics proficiency in secondary school

The r egression analysis result (Table 2) shows that since the p-value (0.046) less than 0.05 significant level, the null hypothesis is rejected. This implies that ICT predict significantly students' mathematics proficiency in secondary school.With the given regression model;

$Y= a + bx$:

Where; Y is the dependent variable (students mathematics proficiency, x = the independent variable (ICT application) a = the intercept/slope and b = the estimated parameter,

The regression equation can therefore be given as;

$Y = 22.060 + 0.013x$.

The equation shows that a unit increase in ICT application will lead to 0.013 unit increase in students' mathematics proficiency. This implies that the more the students learn ICT will determine their mathematics proficiency.

Hypothesis 2: School type do not significantly influence mathematics proficiency in secondary school

Table 3 shows the result indicates that the p-value (0.092) is greater than the 0.05 level of significance. The null hypothesis which stated that there is no significant relationship between school type and mathematics proficiency was not rejected. This implies that there is no significant relationship between school type and mathematics proficiency.

DISCUSSION

The findings of the study revealed that conceptual understanding in ICT allows students to build new knowledge in mathematics. This aligns with CTLI (2017) who said that technology develops abstract ideas for teachers by which they can build students prior knowledge, abilities and skills, links to the materials with mathematical concepts, address common understandings and introduce more advanced ideas. The finding also agreed with Gera and Verma (2017) who stated that pedagogical shift of technology engenders new teaching

Table 1. Frequency count on the use of ICT and mathematics proficiency.

S/N	Item		SD	D	A	SA	Total
1	Conceptual understanding in ICT allows students to build new knowledge in Mathematics	Ƒ	103	176	545	176	1000
		%	10.3	17.6	54.5	17.7	100
2	The procedural fluency in ICT makes students more effective in learning Mathematics	Ƒ	69	338	487	106	1000
		%	6.9	33.8	48.7	10.6	100
3	Strategic competence facilitates students effects learning of Mathematics	Ƒ	66	381	438	115	1000
		%	6.6	38.1	43.8	11.5	100
4	Adaptive reasoning aids to formulate and solve difficult problem in Mathematics	Ƒ	64	408	402	126	1000
		%	6.4	40.8	40.2	12.6	100
5	Productive disposition makes students consistent in studying Mathematics	Ƒ	61	456	421	62	1000
		%	6.1	45.6	42.1	6.2	100

Table 2. Summary of ANOVA on ICT and Mathematics proficiency.

Mode	Sum of squares	Df	Means squares	F	Sig.
Regression	0.758	1	0.758	0.003	0.046[b]
Residual	1893.642	188	236.705		
Total	1894.400	189			

Coefficients[a]

Model	Unstandardized coefficients			T	Sig.
	B	Std. error	Beta		
(Constants)	22.060	7.729		2.854	0.021
x	0.013	0.238	0.020	0.057	0.046

Table 3. Summary of the relationship between ICT and mathematics proficiency.

Source of Variation	N	Mean	SD	Df	t-cal	p-value	Remark
Public	95	45.62	7.079	188	6.965	0.092	Significant
Private	94	50.62	7.179				

$p<0.05$.

approaches to expand students' conceptual understanding, procedural fluency and strategic competence in mathematics. ICT makes mathematics teaching healthier and helps to increase the achievement of students.

The findings of the study also revealed that the procedural fluency in ICT makes students more effective in learning mathematics. About 59% of the students agreed while the remaining 41% of the students condemned it. This supports the views of Markovits and Weinstein (2018) and Dantani and Baba (2011) who suggested that once students have memorized and practised procedures that they do not understand, they have less motivation to understand their meaning or the reasoning behind them. Therefore, the development of students' conceptual understanding of procedures should precede and coincide with instruction on procedures. It also align with NCTM (2018) that procedural fluency is more than memorizing facts or procedures, and it is more than understanding and being able to use one procedure for a given situation. Procedural fluency builds on a foundation of conceptual understanding, strategic reasoning, and problem solving. The finding is also in line with Awofala et.al. (2019), that "It is pertinent to note that procedural fluency does not run contrary to conceptual understanding; in fact, the two work together to help promote mathematical proficiency. Procedural fluency without conceptual understanding will yield non-meaningful and inappropriate strategies for solving applications; conceptual understanding without procedural fluency will yield inefficient strategic applications".

This finding also revealed that strategic competence facilitates students' effective learning of mathematics. Majority (55%) of the students agreed with the statement while the remaining ones (45%) condemned it. The statement agreed with NRC (2018) view that "having strategic competence enables a person to decipher which strategies might be useful in tackling the problem and in connecting these strategies to previous mathematical experiences. Strategic competence is useful not only in mathematics classroom but in tackling problematic real life situations. Unlike the mathematics classroom environment, students in the real world lack the context with well-defined procedures necessary to help them decide how to approach a problem. In the real world, students are faced with situations that require them to understand the nature of the problem, formulate a model of the problem, think flexibly in choosing appropriate strategy, and solve the problem. Rather than approaching a problem strategically and with understanding, students that lack strategic competence often miss out in their approach to a mathematical problem; they have difficulty formulating a model of the problem and lack the requisite skill to flexibly adopt strategies appropriate to solve the problem. Students that do not possess adequate strategic competence will often approach a mathematical problem with the intention of using a trial and error strategy. Strategic competence can be nurtured through constant exposure to mathematical problems that reflect real life problematic situations. Mathematical problems that require students to comprehend the problem, devising a plan, and carrying out the plan to solve the problem mathematically promote the development of strategic competence".

Furthermore, this finding also revealed that the majority of the students agreed with statement 4 that adaptive reasoning aids to formulate and solve difficult problem in mathematics. About 53% of the students agreed while others (47%) disagreed. This is also in accordance with Siegfried (2012) view that "ability in adaptive reasoning enables one to consider alternative approaches, to follow the mathematical logic of a proposed proof, to note logical inconsistencies or contradictions, and to justify any conclusions". Students with adaptive reasoning are able to justify the solution steps employed in solving a problem in a logical manner in such a way that they know when the solution steps are wrong or right. Students are said to be capable of adaptive reasoning when they are able to think logically about the existing problems, estimating and reflecting through the problems and giving justifications for solving the problems.

However, with the statement 4, that whether productive disposition makes students consistent in studying mathematics, this research revealed that it does not foster consistency in studying mathematics. Thus, the majority (52%) of the students disagreed while only the few of the students (48%) agreed. It can be said, however, that students adopted only the four strands while productive disposition is not effective for making students studying mathematics.

Conclusion and Recommendations

Based on the findings of this study, it was concluded that procedural fluency (PF), conceptual understanding (CU), strategic competence (SC), adaptive reasoning (AR) and productive disposition (PD) influence mathematics proficiency. However, procedural fluency in ICT makes students more effective in learning mathematics, conceptual understanding in ICT allows students to build new knowledge in mathematics, strategic competence is useful not only in mathematics classroom but in tackling problematic real life situations, adaptive reasoning aids to formulate and solve difficult problem in Mathematics. Productive disposition makes students consistent in studying mathematics. In a nutshell, the 5 strands of mathematics proficiency needs to be well understood and applied by mathematics teachers for optimum performance in the learners, since the more the students learn ICT determine their mathematics proficiency. Based on these findings, it was recommended that PF, CU, SC, AR and PD should be applied in order to achieved mathematics proficiency expectations and teachers and students should be skillful in ICT. Also, mathematics teachers should be trained on the applicability on 5 strands for improvement in classroom achievement of the learners.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

HOW TO CITE THIS ARTICLE

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REFERENCES

Awofala, A. O. A., Arigbabu, A. A., & Awofala, A. A. (2013). Effects of framing and team individualized instructional strategies on senior secondary school students' attitudes toward Mathematics. *Acta Didactica Napocensia, 6*(1), 1-22.

Chao, G. M. (2015). Impact of teacher training on information communication technology integration in public secondary schools in Mombasa county. *Human Resource Management Research*, *5*(4). 77-94.

CTLI (2007).*Why should a teacher use technology in his or her mathematics classroom?* Research Note 8. Prepared for Texas Instruments by the Center for Technology in Learning, SRI International, December 7, 2007. Retrieved from http://ti-researchlibrary.com/Lists/TI%20Education%20Technology%20%20Research%20Library/Attachments/50/Research_Note_8%20-%20Handhelds.pdf.

Dantani, I. W., & Baba, G. K (2011). Science, Technology, Engineering and Mathematics: Nigeria in the emerging world order and militating issues for development, STAN, HERN Publishers. Pp. 23-26.

Fitzallen, N. (2005). Integrating ICT into professional practice: A case study of four mathematics teachers. Proceedings of the Annual Conference Mathematics Education Research Group of Australasia (MERGA 28). Pp. 353-360.

Gera, M., & Verma, S. (2012). Role of ICT in teaching to reduce learned helplessness in mathematics. *International Journal of Science and Research*, *3*(10), 2012-2014.

Goos, M. (2010). Using technology to support effective mathematics teaching and learning: What counts? Research Conference on Teaching Mathematics Makes It Count: What Research Tells Us About Teaching and Learning of Mathematics. Pp. 67–70. Retrieved from https://research.acer.edu.au/cgi/viewcontent.cgi?article=1067&context=research_conference.

Grouws, D. A., & Cebulla, K. J. (2000). Improving student achievement in mathematics, Part 1: Research Findings. ERIC Digest.

Güzeller, C. O., & Akın, A. (2012). The effect of web-based mathematics instruction on mathematics achievement, attitudes, anxiety and self-efficacy of 6th grade students. *International Journal of academic research in progressive education and development*, *1*(2), 42-54.

Martin, W. G. (2009). The NCTM high school curriculum project: Why it matters to you. Mathematics Teacher, 103(3), 164-166.

Markovits, R. A., & Weinstein, Y. (2018). Can cognitive processes help explain the success of instructional techniques recommended by behavior analysts?. *npj Science of Learning*, *3*(1), 1-3.

Mdlongwa, T. (2012). Information and communication technology (ICT) as a means of enhancing education in schools in South Africa: Challenges, benefits and recommendations. *Policy Brief, Africa Institute of South Africa*. Pp. 1-7. Retrieved from http://www.ai.org.za/wp-content/uploads/downloads/2012/10/No.-80.-ICTas-a-means-of-enhancing-Education-in-Schools-in-South-Africa.pdf.

National Council of Teachers of Mathematics (NCTM) (2000). *Principles and Standards for School Mathematics*. Retrieved from https://www.rainierchristian.org/NCTM_principles-and-standards-for-school-mathematics.pdf.

National Council of Teachers of Mathematics (NCTM) (2018). Principles and standards for school Mathematics.

National Research Council (NRC) (2018). Adding it up: Helping children learn mathematics. Kilpatrick, J., Swafford, J., & Findell, B. (eds.). Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press. Retrieved from https://nap.nationalacademies.org/catalog/9822/adding-it-up-helping-children-learn-mathematics.

Noor-Ul-Amin, S. (2013). An effective use of ICT for education and learning by drawing on worldwide knowledge, research, and experience. *ICT as a Change Agent for Education. India: Department of Education, University of Kashmir*, Pp. 1-13.

Oduma, C. A., & Ile, C. M. (2014). ICT education for teachers and ICT supported instruction: Problems and prospects in the Nigerian education system. *African Research Review*, *8*(2), 199-216.

Oginni, O. I. (2013). The relationship between secondary school students body parameters and their mathematics performance in Southwest Nigeria. *International Journal of Education and Culture, Untested Ideas*, 111.

Oginni, O.I (2016). Effects of mathematics innovation and technology on students performance in open and distance learning. *Research in Pedagogy*, *6*(1), 66-75.

Okon, C., & Archibong, U. (2014). Teachers’ attitudes to social studies and students’ academic performance in junior secondary three-certificate examination. *Asian Journal of Social Sciences & Humanities*, *3*(3), 44-48.

Siegfried, J. M. (2012). The hidden strand of mathematical proficiency: defining and assessing for productive disposition in elementary school teachers' mathematical content knowledge. An unpublished PhD Thesis, University of California, San Diego and San Diego State University, USA.

UNESCO (2002). *Information and Communication Technologies in Teacher Education: A Planning Guide,* UNESCO Publication.

Youssef, A. B., & Dahmani, M. (2008). The impact of ICT on student performance in higher education: Direct effects, indirect effects and organisational change. *RUSC: Universities and Knowledge Society Journal*, *5*(1), 45-56.

Zaranis, N., & Synodi, E. (2016). A comparative study on the effectiveness of the computer assisted method and the interactionist approach to teaching geometry shapes to young children. *Education and Information Technologies*, *22*(4), 1377-1393.