

EFFECT OF COMPUTER GRAPHICS INSTRUCTIONAL MODE ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN CIVIC EDUCATION

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Abstract. The study examined effect of computer graphics instructional mode on senior secondary school students' achievement in civic education. Three null hypotheses were drawn to guide the study. The study adopted a pre-test, post-test, control group quasi-experimental design. Purposive sampling techniques was used to select the sample size of 110 participants of two intact classes that form the control and experimental groups. The instruments used for data collection was an adopted Civic Education Achievement Test (CEAT). Data collected were statistically analyzed with Mean and Standard Deviation, Analysis of Covariance (ANCOVA) and T-test at 0.5 significant level. Finding from the study revealed that: there was significant difference in the pre-test and post- test mean score of students exposed to computer graphics instructional mode and those exposed to expository method ($F_{1,110} = 52.743, df = 1, P < 0.05$ and $sig = .000$); there was significant difference between the academic achievements of students taught using computer graphics instructional mode and those taught using the expository method (Means 15.69, $SD = 1.701, t = 18.499, df = 108, p 0.000$) and there was no significant difference between academic achievement of male and female students taught or exposed to computer graphics instructional mode (mean =15.53, $SD = 1.778, t = 0.617, df = 56, p$

.538). Based on the findings it was recommended that computer graphics instructional mode should be used for teaching at secondary school.

Keywords: computer graphics, ICT, instructional technology, civic education, curriculum

Introduction

Nigeria is naturally endowed with competent human and material resources critical for national socio-economic development. The state had great prospects at independence and was predicted to lead Africa out of underdevelopment and economic dependency. However, since obtaining political independence in 1960 the country continues to find her feet on the path of sustainable development. The country is still among the league of economic dependent states with high indexes of corruption, economic mismanagement, misappropriation of funds, terrorism, banditry, kidnapping, cybercrime, herdsmen vs farmers conflict, abuse of fundamental human rights and lack of democratic principles. Instead of being an example for transformational leadership, modern democracy, national development, national integration and innovation Nigeria seems to be popular for mediocre and violence (Ezirim, 2018). Thus, one cannot but agree with the position that Nigeria is a victim of poor leadership, nepotism and systemic mismanagement which have become pervasive in the national life.

In order to address the menace of socio-political problems all countries of the world are interested in the ways their young ones are prepared for citizenship and how they learn to take part in civic life. Civic education has become an increasingly important means to educate citizens about their country history, participatory democracy, good governance, rights, duties and responsibilities (Olawepo, 2017). The introduction of civic education in Nigerian schools was immediately after independence to create the needed awareness of individual person and develop love for the country (Tannenbaum, 2016). To achieve this,

the government later introduced the course 'Citizenship Education' in universities, colleges of education and polytechnics in the year 1992. Nigeria being the largest population in Africa needs to encourage peaceful co-existence among the citizens with different ethnicity, culture, religious and political background to support the unity of the country (Akinbi, 2017). Government agencies and civil organizations have made concerted efforts to inculcate patriotism, rule of law, human rights, democracy and national consciousness in the minds of the citizens but they have achieved little success (Agbor & Ogbunwezeh, 2017). Therefore, the federal government thought it wise to introduce civic education at primary and secondary education curriculum. This was done through the Nigerian Educational Research and Development Council (NERDC) and the aim is to teach the youths the spirit of national consciousness and love for their country. The objectives for inclusion of civic education in the school curriculum are: to re-orientate Nigerian youths; to educate Nigerian youths on their rights; to prepare the youths for leadership roles; to educate Nigerian about their duties and obligation; to promote national unity, integration and consciousness; to sustain Nigerian democracy and national building; to promote good fellowship among Nigerian youths; and to build a strong and progressive nation.

Curriculum is a systematic packaging of learning experiences in terms of knowledge, skills and attitudes provided by the school to achieve pre-determined objectives (Olori, 2007). Curriculum is a document geared towards provision of values and learners should acquire these values through organized learning experiences both in formal and informal settings. A good curriculum plays significant role in lifelong learning abilities, skills and values such as tolerance, respect, peaceful coexistence, and respect for human rights, democratic principles, citizens' duties, obligations, nationalism, gender equality and social justice (Adepoju, 2011). With the introduction of civic education in schools, studies have reported that students still face the challenges of understanding the concepts of the subjects and this showed in their performance in internal and external examinations. Students find some concepts in civic education difficult

and this could be as a result of poor methodology employed by the teachers (Adelakun, 2015). This position is reinforced by the West African Examination Council Examiners' reports for 2016, 2017 and 2018 which indicate that many candidates did not have deep understanding of some concepts in civic education. There are cases in which students do not really have understanding of some topics in the school curriculum because they are presented by the teachers in abstract instead of concrete or rather representational mode instead of real and purposeful experience. Mayer (2005) observed that most times the major reason why students find some topics difficult to comprehend is students' attitude, poor teaching methods and non-use of relevant instructional materials on the part of teachers.

The incompetence of a teacher to utilize relevant educational media has been said to be one of the factors responsible for poor performance of learners in schools. A competent teacher selects, modifies and uses a wide range of instructional media (audio, visual, audio-visual and interactive) appropriate to the content and the needs of each student (Adediran, 2012). Resourceful teachers are equipped with repertoire of best teaching practices such as strategies in planning, implementing and assessing classroom instruction in accordance with the pre-determined objectives (Olori, 2010). Teachers are prepared with skills to integrate emerging 21st century technologies into classroom practices to facilitate effective communication for improved learners' performance. The need for educational technology in teacher education is the application of technology of education and technology in education in order to facilitate human learning. In other words, the application of software and hardware approaches in education.

It has been observed empirically that the use of computer graphics in instruction has been successful in several disciplines (Salandanan, 2005). Computer graphics is receiving much attention in the development of interactive educational software, multimedia systems and many other applications. If skillfully utilized it can be a component of computer assisted instruction which has

wonderful potentials. Computer graphics are static visuals created using computers and more generally, the representation and manipulation of image data by a computer with help from specialized software and hardware. The development of computer graphics has made computers easier to interact with and better for understanding and interpreting many types of data. Developments in computer graphics have had a profound impact on many visualized instructional technology' driven strategies (Simpson & Weiner, 2021).

Computer graphics is a sub-field of computer science which studies methods for digitally synthesizing and manipulating visual content. Computer graphics is a significant development in visual education because of its uses in medicine, sciences, engineering and education. Images generated through computer graphics are static and when made motion they are called computer animation (Dewey, 2017). One could say that computer graphics is an art of drawing pictures, lines, cartoons, posters, maps, charts, etc using computers with the help of programming. Graphic presentation is used in form of still maps, pictures, drawing, charts, posters, diagram and other 2-dimensional visual media. Computer graphics instructional presentation can be used for illustration because it generates more realistic representational visual messages unlike verbal which is in abstract form. Perhaps, this is the reason Simpson & Weiner (2021) submitted that computer graphics when supplemented with verbal messages can improve motivation and retention among learners. Therefore, the expectation of this study is to investigate if computer generated pictures, posters and other visual representation of concepts in citizenship education will significantly enhance learning of civic education.

The application of computer technologies in education has grown and will continue to grow at an ever-increasing rate (Chiemeka, 1997; Skalka & Drlik, 2009). As digital technologies continue to gain increasing prominence in

schools, computer graphics will introduce new dimensions to the roles of illustration in education. Computer graphics is a computer aided teaching tool (CAT) for instructors which could be display of information, design and user interface with raster or vector. The tool provides graphics allowing the learners to visualize complex learning concepts for creative thinking and problem solving. According to Mayer (2001) some concepts are difficult to learn, thus many techniques and approaches have been undertaken to help students grasp complex concepts. Graphical representations of information such as flowcharts, drawings, diagrams and other graphic representations is additional teaching tool for instructors who wish to promote permanent learning. The computer provides graphics and animations, allowing the instructors and students to visualize selected complex concepts in form of representational images. According to Adekoya & Adekoya (2002) computer graphics software packages that are being used in production of instructional materials include Corel WordPerfect, Adobe Photoshop, Adobe illustration, Coreldraw designs, Microsoft Paint, Paintshop pro, Sketch, Adobe InDesign and computer aided design (CAD). The areas in which computer graphics is used include but not limited to cartography, visualization of measurement data (2D and 3D), visualization of computer simulation, preparation of publications, computer games, computer arts design, medical diagnostics, special effects on movies, presentation graphics, entertainment, digital photography, animation and geometric objects.

Justello (2018) assessed the effect of concept mapping and read and discuss on a science unit. Students were randomly assigned to either a concept mapping group or read and discuss group. The concept mapping group constructed organizational maps of the unit material with the assistance of the teacher as the students read the chapter in the book. The read and discuss group read the chapter in sections and participated in discussion and questioning following each reading. The results of the study indicate the concept mapping group achieved significantly than read and discuss group. Most recently, Tai & Stone (2019) carried out a research on the impact of static graphics on a complex

learning task in English Language and the study revealed students in the experimental group significantly outperformed the control group. Asoodeh (1993) conducted a study in which subjects who used static visuals were compared with those who used expository method in statistical aspect of mathematics and the result showed that subjects who used statics visuals scored significantly higher on statistics tests than those who used expository. Hawk (2016) investigated the effect of computer graphics on students' understanding of organic reaction mechanisms in chemistry and the result showed that students who used computer graphics performed significantly better than those who used chalk and talk methods.

According to studies, gender could be a significant factor when computer and other digital devices are used for teaching - learning. The common assertion is that since boys are more predisposed to technology they may benefit more from digitally driven teaching and learning process. Girls, on the other hand may be limited in their learning when it involves technology use because of the stereotype believe. Taylor (2018) investigated computer related gender difference in high-school and found that boys did not do significantly better in an online research task than girls. Baek & Layne (1988) investigated the effect of gender on students' attitude towards mathematics, the results showed that there is no significant difference in the attitude of male and female students towards mathematics. Schaumburg (2004) evaluated a laptop project in schools and collected data on the increase in computer knowledge, the results showed that boys and girls had benefited from explicit instruction at the same rate and that there was no significant difference between boys and girls as far as knowledge of standard software and standard internet applications were concerned.

The theoretical framework of this study is based on theoretical assumptions in the computer-based multimedia learning environment, which have been extensively applied in guiding research with computer-generated graphics or animated displays. Mayer's Cognitive Theory of Multimedia Learning (2001)

ascertains that learners are much more likely to learn effectively if information is presented both verbally and visually simultaneously. While justifying the cognitive theory of multimedia learning Mayer (2005) explained that words enter the cognitive system through the ears (if the words are spoken), and pictures enter through the eyes. In the cognitive process of selecting words, the learner pays attention to some of the words, yielding the construction of some word sounds in working memory. In the cognitive process of selecting images, the learner pays attention to some aspects of the pictures, yielding the construction of some images in working memory. In the cognitive process of selecting images, the learner pays attention to some aspects of the pictures, yielding the construction of some images in working memory. In the cognitive process of organizing words, the learner mentally arranges the selected words into a coherent mental representation in working memory that we call a verbal model. In the cognitive process of organizing images, the learner mentally arranges the selected images into a coherent mental representation in working memory that we call a pictorial model (Ainsworth, 2006; Clark & Mayer, 2008). In the cognitive process of integrating, the learner mentally connects the verbal and pictorial models, as well as appropriate prior knowledge from long-term memory. According to the cognitive theory of multimedia learning, meaningful learning occurs when learners engage in appropriate verbal and visual-spatial thinking.

Statement of the problem

Civic education is a relatively new subject in Senior Secondary Certificate Examination, thus, there is dearth of literature in empirical studies on civic education especially in Nigerian context. Few studies reviewed show that teachers are complacent and are still using traditional method to teach civic education in schools. The introduction of ICT-driven mode would have improved the teaching method but most teachers are not ready to embrace the use of emerging instructional technologies. The use of computer graphics has been identified to

improve teaching and learning in other discipline therefore, the researchers investigated the effect of computer graphics instructional mode on secondary school students' achievement in civic education.

Objective of the study

The main purpose of this study is to examine the effect of computer graphics instructional mode on secondary school student's achievement in civic education and interacting effect of gender on students' achievement in civic education.

Hypotheses

H0₁: There is no significant difference in the pretest and post-test mean scores of students assigned to experimental and control conditions

H0₂: There is no significant difference between the academic achievements of Students taught using Computer graphics instructional mode and those taught using expository method.

H0₃: There is no significant difference in the academic achievement of male and female students taught using Computer graphics instructional mode.

Methods

Research design

The study employed the use of pre-test, post- test, control group, quasi-experimental design. The design is 2x 2 factorial matrixes and these represents two groups: computer graphic instructional mode and expository method while the moderating variable is two level of gender (male and female).

Population of the study

The target population of the study consisted of all senior secondary one (SS1) students of public secondary schools in Ijebu - Ode local government area of Ogun State.

Sample and sampling technique

110 students constitute the sample for the study while two coeducational public schools were purposively selected in Ijebu-Ode local governments of Ogun State. However, simple random sampling technique was adopted in assigning two intact classes to experimental and control group respectively.

Instrumentation

Computer graphics instructional package

The researchers developed Computer Graphics Learning Package on Civic Education (CGLPCE) with the help of computer graphics programmer. Carefully planned activities that elicited and exploited visual potentials of the experimental group members were developed. It contains computer generated graphic pictures, posters and drawings depicting illustration on citizenship education on civic and political rights such as voter registration, ballot paper, ballot box, voting exercise, electoral malpractices and this was prepared on CD-Rom. The topics were carefully selected from SS1 curriculum for civic education such as: Election and voters' responsibilities, qualification for registration for election in Nigeria and electoral malpractices.

Civic education achievement test

Civic Education Achievement Test (CEAT) was adopted from the previous WAEC multiple choice examination questions in civic education and it was meant to measure students' achievement in citizenship education aspect of civic education. The instrument is made up of two sections: session A is background information from the respondents such as gender and school. Section B consisted 40 multiple choice objective test items that survived the item analysis statistical processes with four alternatives (A-D). The test items cover the categories of cognitive domain such as knowledge, comprehension and application.

Validation

The instrument (CEAT) was reviewed by experts for construct and content validity. To establish the reliability of the test items, it was trial-tested on ten SS1 students of two schools not selected to participate in the study but with similar characteristics with the subjects of the study. From the students' responses a reliability coefficient of 0.71 was established using split – half method. Three instructional guides (one for each topic) were prepared based on senior secondary one curriculum on citizenship education for civic education. The trained research assistants (teachers) in the two schools strictly followed the instructional guide for the purpose of uniform standard.

Procedure for data collection

Training of the research assistants

In the first week, the participating research assistants (civic education teachers) in the two groups were subjected into comprehensive training on how to use the instructional guides. This involved practical demonstration by the researchers on the types of activities expected from the research assistants and the students during the lesson.

Exposure of study subjects to pre-test

In the second week a pretest was administered to the study subjects in order to determine their academic comparability level. The Civic Education Achievement Test (CEAT) was administered to both the control and experimental groups to assess the study subjects' academic achievement before the commencement of the experiment. The scores of the students in the pre-test were compared to the post-test scores to determine the subjects gained score at the end of the experiment.

Treatment of experimental group to computer graphics instructional mode

With the aid of an instructional guide the trained research assistant (civic education teacher) presented the lesson contents to the experimental group through the “Computer Graphics Learning Package on Civic Education” which has been installed on all the computer systems in the computer laboratory. One co-educational public senior secondary school (SS1) in Ijebu-Ode Local Government Area with at least 30 functional computer systems was purposively selected to form the experimental group so that two (2) students were assigned to a computer system. The learning package on the CD-Rom was installed on all the computer systems in the school laboratory. After a brief introduction of the topic, students were instructed by the teacher to start the computer system and open the file named “computer graphics” depicting pictures and posters of citizens’ performing their civic responsibilities, age qualification for registration, voting exercise and electoral malpractice. The learning package is individualized digital module which has features of computer - assisted learning such as active interaction, breaking complex topic into smaller pieces, promoting engagement, self-pace, monitoring learner’s progress, provision of immediate feedback, multimedia content etc. The subjects were then instructed to carefully observe the pictures and respond to the teachers' questions during the teaching activity. The graphic learning package encourages students' participation at every step of the instructional process. For instance, given the stimulus of a broad concept "citizenship education" students were able to generate examples of the concept from their own understanding and experiences. Focusing questions such as “what does this picture mean to you? Can you give examples of this concept and so on generate open-ended responses in which students of different intellectual abilities participated? Again three weeks was used for the treatment, this comprised of two lessons per week. Each lesson had duration of 40 minutes.

Presentation of oral instruction to control group

The research assistant used expository method to teach the subjects in the control group by exposing them to lesson content through lecture method. One co-educational public senior secondary school (SS I) in Ijebu – Ode Local Government Area was purposively selected to form the control group. During the teaching process the study subjects were instructed to ask questions on issues that requires further clarifications from the teacher and to copy down the important points written by teacher on the chalkboard into their exercise books. Assignment was given to the subjects after each lesson and they were encouraged to read their textbooks for further clarifications. Three weeks were used for the oral presentation of lesson content, this comprised of two lessons per week and the duration of each lesson was 40 minutes.

Administration of post-test

After the treatment, the two groups were exposed to Civic Education Achievement Test (CEAT) so as to compare the performance of the participants in pre-test and post-test, effect of treatments and effect of gender on students' achievement. In all, field activities lasted for six weeks.

Procedure for data analysis

Mean and standard deviation, analysis of covariance and t-test statistics were used to test the hypotheses, while the rejection or retention region of the stated hypotheses was set at $P \leq 0.05$ level of significance.

Results

Hypothesis 1: There is no significant difference in the pretest and post-test mean scores of students assigned to experimental and control conditions.

Table 1. Descriptive results of students' pretest and post-test scores in the instructional strategies

Instructional Strategies		N	Mean	SD	Mean Gain
Conventional method	Pretest	52	13.23	9.224	18.98
	Post test	52	32.21	12.303	
Computer graphics instructional mode	Pretest	58	15.17	5.074	27.95
	Post test	58	43.12	19.092	

Table 1 shows the results of pretest and post-test for experimental and control groups. Students in the experimental group recorded a post – test mean achievement score of 43.12 (SD=19.092, N=58) while students in expository group recorded a post-test mean achievement mean score of 32.21(SD=12.303, N=52). Students in the computer graphics presentation mode recorded the highest mean achievement gain of 27.95, while students in the expository method recorded the least mean achievement gain of 18.98.

Table 2. Result for ANCOVA analysis of students' achievement in civic education based on treatments

Source	Type III sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1432.450 ^a	9	195.244	6.235	.000
Intercept	2063.225	1	2063.225	152.256	.000
Pre-test	1.797	1	1.797	121.043	.000
Instructional Strategies	748.034	1	748.034	52.743	.000
Error	408.413	117	5.263		
Total	32107.000	110			
Corrected Total	2389.696	119			

a. R Square = .426 (Adjusted R Square = .301)

From Table 2 the results show significant outcome ($F_{1,110} = 52.743, df = 1, p < 0.05$ and $sig = .000$) which implies the difference noticed is significant to reject the hypothesis and conclude that there is a significant difference in the pretest and post-test mean scores of students assigned to experimental and control conditions.

Hypothesis 2: There is no significant difference between the academic achievements of Students taught using Computer Graphics and those taught using expository method.

In testing hypothesis two which stated that, there is no significant difference between the academic achievements of students taught using computer graphics and those taught using the expository method, the students taught using conventional method had statistically significantly lower score (Mean= 9.97, SD = 2.774) at the end of treatment compared to those students taught using graphics instructional materials (Means 15.69, SD =1.701, $t = 18.499$, $df (108)$, $p 0.000$). Therefore the hypothesis which stated that, there is no significant difference between the academic achievements of students taught using computer graphics and those taught using the expository method was rejected.

Table 3. T-test analysis of mean scores of experimental group and expository group

Variables	N	X	SD	t-cal	df	sig. (2-tailed)	Remark
Conventional Method	52	9.97	2.774	18.449	108	0.000	Sig.
Computer Graphics presentation	58	15.69	1.701				

Hypothesis 3: There is no significant difference in the academic achievement of male and female students taught using Computer Graphics.

Table 4. T-test analysis of mean scores of male and female students in the experimental group

Variables	Gender	N	X	SD	t-cal	df.	sig. (2-tailed)	Remark
Academic Achievement	Males	26	15.75	1.678	0.617	56	.538	Not sig.
	Females	32	15.53	1.778				

In Table 4 the study found no significant difference between male and female students taught using computer graphics instructional materials. The male recorded (mean =15.75, SD = 1.678) at the end of the treatment compared to the female students taught using graphic instructional materials score (mean =15.53, SD = 1.778), $t = 0.617$, $df = 56$, $p = .538$). Therefore, the hypothesis which stated that there is no significant difference between academic achievement of male and female students exposed to computer graphics was accepted.

Discussion of findings

The result of hypothesis one shows that students in computer graphics presentation mode recorded the highest mean achievement gain while students in the expository method recorded the least mean achievement gain. The result of hypothesis two indicates that the experimental group which was exposed to computer graphics presentation mode performed significantly better than their counterparts in the control group who were taught using expository method. The findings of the study are in conformity with Justello (2018) which found significant effect of graphics instructional media on improving teaching and learning. It was reported that integrating graphics to instruction is superior over the use of traditional lecture method of teaching in enhancing students' higher academic performance. As reported by Tai & Stone (2019) students taught through the use of graphics showed a remarkable gain in academic performance compared to those in the same course taught in traditional lecture format. The higher academic performance obtained from the use of graphics might be due to their appeal to students' visual abilities, motivation of learners and inducing students' active participation in instructional processes which ultimately enhance the retention of lesson content.

Hypothesis three indicates that there was no significant difference in the means scores of male and female students when exposed to graphics as teaching

strategy. This implies that the use of graphics in teaching- learning process is gender friendly, meaning both sexes benefit equally from its instructional values. Similar findings have been made by Taylor (2018) who independently reported that boys are not better than girls in terms of educational performance, after he had independently carried out studies on sex differences and student performance at the secondary school level. Also, Baek & Layne (1988) reported no significant difference between male and female students in terms of attitude towards science, technical and mathematical subjects.

Conclusion

The study has emphasized the intrinsic worth of computer graphics in boosting students' academic achievement. Students exposed to computer graphics instruction in civic education performed significantly better than those exposed to expository method of instruction. Again, there was no significant difference in the academic achievement of male and female students exposed to computer graphics instructional mode. Therefore, incorporating computer generated graphics as a teaching mode is a recommended recipe for the improvement of civic education instruction at primary and secondary schools in order to promote spirit of nationalism, civic engagement and participatory governance among the citizens.

Recommendations

(1) Since this study shows improved students' academic achievement when exposed to computer graphics, its application as a teaching strategy should be encouraged among civic education teachers from primary to secondary education level.

(2) Research organizations such as Nigerian Educational and Research Development Council (NERDC) should carry out seminars, workshops and conferences to intimate teachers on how to integrate computer graphics in the teaching of civic education.

(3) The Federal and State Ministry of Education should sponsor Civic Education teachers for refresher training on design, selection, and utilization of computer graphics instructional media.

(4) Civic education teachers should have more access to computer for instructional delivery especially in this 21st century digital age.

(5) Computer assisted instruction which is a sophisticated extension of programmed instruction must be integrated in the school curriculum

REFERENCES

- Adediran, A.Y. (2012). *Principles and practice of educational technology*. Ibadan: International Publishers.
- Adekoya, A.F. & Adekoya, B.A. (2002). The relevance of computer graphics to visual Arts production and exposition. *Nigerian J. Computer Literacy*, 3(1), 19-25.
- Adelakun, M.O. (2015). Citizenship education and Nigerian society. *J. Arts & Soc. Sci.*, 3(2), 21-32.
- Adepoju, M. (2011). *Introduction to aspects of educational technology*. Kano: Gidan Dabino Publishers.
- Agbor, L.A & Ogbunwezeh, K.P. (2017). Bureaucracy and challenges of good governance in Nigeria. *J. Business & Organizational Development*, 3(2), 88-96.
- Ainsworth, S. (2006). DeFT: a conceptual framework for considering learning with multiple representations. *Learning & Instruction*, 6(2), 183-198.
- Akinbi, K.B. (2017). The peripheral state: critical perspectives on the structure and role of the public bureaucracy. *J. Development Alternatives*, 24(4), 119-130.
- Asoodeh, M.M. (1993). *Static visuals vs. computer animation used in the development of spatial visualization: PhD thesis*. Unpublished doctoral dissertation, Midsize City: Texas A&M University.

- Baek, Y.K. & Layne, B.H. (1988). Color, graphics, and animation in a computer- assisted learning tutorial lesson. *Journal of Computer-Based Instruction*, 15(4), 131– 135
- Chiemeka, C. I. (1997). *Effects of two multimedia computer-assisted language learning programs on vocabulary acquisition of intermediate level ESL students: PhD thesis*. Blacksburg: Virginia Polytechnic Institute and State University.
- Clark, R.C. & Mayer, R.E. (2008). *E-learning and the science of instruction: proven guidelines for consumers and designers of multimedia learning*. Hoboken: Wiley.
- Dewey, D.F. (2017). The strategies instructional approach. *Int. J. Disability, Development & Education*, 30(2), 103-114.
- Ezirim, U.O. (2018). The political economy of public service accountability in Nigeria. *Arabian J. Business & Management Review*. 1(4), 23-29.
- Hawk, P. (2016). Using graphic organizers to increase achievement in middle school life science. *Sci. Educ.*, 70, 81-87.
- Justello, E.F. (2018). Concept mapping effects on science content comprehension of low-achieving inner-city seventh graders. *J. Remedial & Special Educ.*, 20, 356-364.
- Mayer, R.E. (2001). *Multimedia learning*. New York: Cambridge University Press.
- Mayer, R.E. (2005). *Learning and instruction*. New York: Merrill Prentice.
- Olawepo, O.J. (2017). Citizenship education as a panacea for Nigerian sustainable development. *J. Soc. Sci.*, 4(2), 29-38.
- Olori, A.L. (2007). *Issues in teacher education*. Ijebu-Ode:Yom-Yem Press.
- Olori, A.L. (2010). *Fundamentals of curriculum development*. Ijebu-Ode: Bo-sun Printing Press.
- Salandan, D.E. (2005). Effectiveness of a concept teaching routine in enhancing the performance of students in secondary mainstream classes. *Learning Disability Quarterly*, 11(1) 3-17.

- Schaumburg, H. (2004). Laptop computers in the classroom - a way to overcome the technological gender gap among students. *J. Media Psychology*, 16(4), 142–154.
- Simpson, D. C. & Weiner, E. J. (2021). The effects of teacher constructed graphic organizer instruction on sixth grade science students' comprehension and recall. *J. Educ. Res.*, 28(1), 32 -37.
- Skalka, J. & Drlik, M. (2009). Avoiding plagiarism in computer science e-learning courses. *Problems Educ. 21st Cent.*, 16, 95-101.
- Tai, F.Q. & Stone, T.J. (2019). Impact of static graphic, animated graphics and mental imagery on a complex learning task. *Australasian J. Educ. Tech.*, 28(1), 91 104.
- Taylor, J.L. (2018). The impact of computer and internet use of teachers' pedagogical practices and perceptions. *J. Res, Computing Educ.*, 2(3), 109-116.
- Tannenbaum, M.K. (2016). Corruption in Nigeria: a great challenge to economic development. *Int. J. Development &Management Review*, 2(1), 1-10.
- WAEC [West African Examination Council]. (2016; 2017; 2018). *West African senior secondary school certificate examination chief examiners' Report*. Lagos: WAEC.

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