

**EFFECTS OF INFOGRAPHICS INSTRUCTIONAL STRATEGY ON
STUDENTS' ACHIEVEMENT IN SENIOR SECONDARY SCHOOL
ECONOMICS IN PANKSHIN LOCAL GOVERNMENT AREA OF PLATEAU
STATE, NIGERIA.**

ONUOHA, J.C (Ph.D)

Department of Social Science Education

Faculty of Education

University of Nigeria, Nsukka

08037550795

joseph.onuoha@unn.edu.ng

&

GOTIP, Nehemiah Wokji

Department of Social Science Education

Faculty of Education

University of Abuja

08067035467

gwokji@gmail.com

Iorliam. E.I.V. (Ph.D)

Department of Social Science Education,

University of Abuja,

Abstract

This study determined the effects of infographics instructional strategy on students' achievement in Senior Secondary School Economics in Pankshin Local Government Area of Plateau State, Nigeria. Two research questions were posed and two hypotheses were formulated and tested. A quasi experimental design was used. The population of the study was three thousand two hundred and thirty three (3, 233) public senior secondary II students of Economics in Pankshin Local Government Area of Plateau State. The sample of the study consist of 119 students made up of 68 male and 51 female SS2 students drawn using simple random sampling technique. The instrument

used for data collection was the Economics Achievement Test (EAT). Face and content validity were carried out on the instrument by three experts from University of Abuja in terms of relevance, suitability, clarity and coverage and Kuder-Richardson formula 20 (K-R, 20) was used to establish the reliability of the instrument which was 0.94. Mean and standard deviation were used to answer the research questions. Hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 alpha levels of significance. The result of the analysis indicated that there is a significant difference in mean achievement scores of students taught some concepts in Economics concepts using infographics instructional strategy and those taught using conventional teaching method and that there is no significant difference in mean achievement scores of male and female students taught some concepts in Economics concepts using infographics instructional strategy and those taught using conventional teaching method. Thus, it was recommended among others, that Economics teachers should adopt the use of the infographics to teach Economics.

Keywords: Achievement, Economics and Infographics.

Introduction

The advancement in technology led to the use of infographics which today is one of the instructional strategy used in teaching and learning in schools. The effect of technological development in education has rendered conventional methods of teaching inadequate for teaching and learning Economics while creating the need for new and sophisticated methods of teaching like infographics. Research has shown that use of infographic appeal to students' sense of sight and it helps the students to understand the subject better and also helps students to memorize the concept for longer time (Alrwele, 2017).

The term "infographics" combines the terms "information" and "graphics." An infographic is defined as a visualization of data or ideas that tries to convey complex information to students in a manner than can be quickly consumed and easily understood (Smiciklas, 2012). Infographics are essentially visual representations of information. They are used to convey ideas or explore issues through a range of different graphics. An infographic is a composition of concise explanatory text and visual representations that are blended to convey a story-like message that is attractive and easy to understand (Alrwele, 2017). The attraction and power of infographics is partly due to the variety of representations that can be used, including tables, pie charts, bar graphs, zoom boxes, histograms, icons, line charts, tree diagrams, and even pictures (Wertz & Saine, 2014; Rezaei & Sayadian, 2015 & Parkinson, 2016 in Alrwele, 2017). Infographics can convey a certain subject in a story-like presentation using a variety of graphical elements and text to present an introduction, details, and conclusion, whereas data visualization only provides a snapshot of a single moment within the story (Dur,

2014 &Islamoglu et al., 2015). Infographics are powerful standalone representations that convey an entire message quickly and clearly "even without accompanying text" (Davis & Quinn, 2014 and McDermott, 2014).

Infographics are now widely used in teaching Economics to increase a student's understanding of a particular topic or issue. While it might appear that infographics are a recent phenomenon that have developed alongside the internet the reality is that we have been using icons, graphics, and pictures throughout history to tell stories and share information (Futterman, 2020). In Economics, infographics are highly useful for presenting results gathered from survey data. Economist requires mathematical and statistical tools in economic analysis. Statistics and numbers can overwhelm a lot of students, and therefore lose much of their significance. When organized in an infographic it becomes much easier for students to quickly draw meaning from data. The core purpose of an infographic is to simplify a complex idea which makes them great educational tools, especially when presenting an overview of a topic. One topic that it suits particularly well is the basic tools for economic analysis. In addition to simplifying complex ideas, infographics are often used to reveal the mechanics behind how intricate Economics concepts work. Economics teachers can create infographics that pull apart complex concepts in Economics like concepts of demand and supply and graphically explain their core features. The simplicity of the infograph makes it easier to explain each concept. When drawing comparisons, infographic help organize similarities and differences by visually creating parallels that complement the information being presented (Futterman, 2020). Comparisons can be difficult to express with words, sometimes to the point of being more confusing than revealing to the students but, by presenting the same information in a neatly organized infographic, comparisons become clearer. There are lots of interesting facts that aren't quite interesting enough to be organized in simple lists. When displayed in an infographic, these facts can be brought to life. The teacher's interpretation of the facts and how they should be organized can attract students and turn a previously uninteresting topic into an engaging and enlightening topic. Facts related to market demand and supply schedules for books is a perfect example but, if the information in Fig.1 were written as a paragraph it would most likely slip by unnoticed. However, when displayed as an infographic, the teachers can organize relevant interesting facts into a visually appealing digestible series that catch the eyes and draw in an audience.

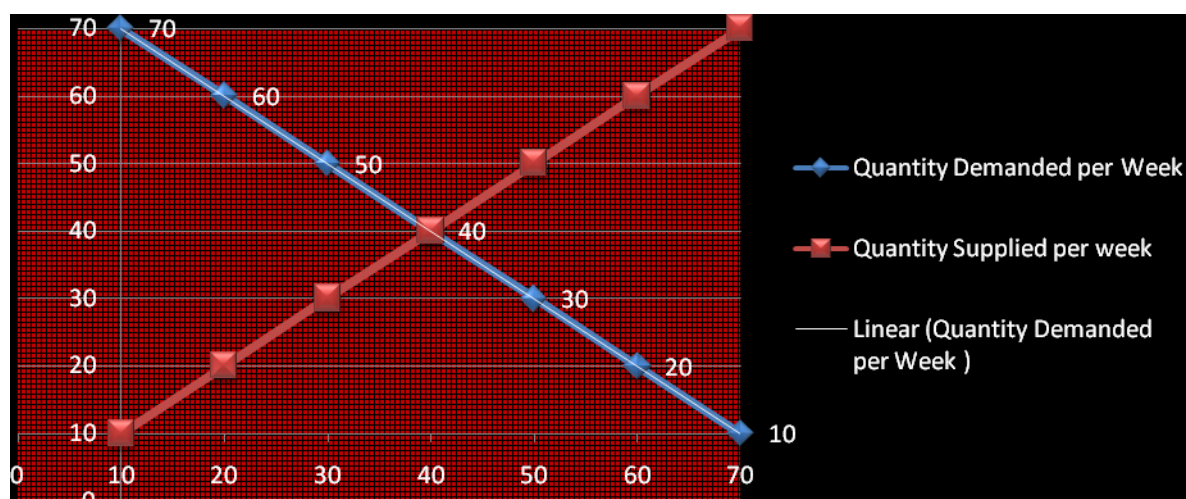


Fig 1: Equilibrium price of books

Students' achievement refers to performance in a school subject as designated by a score or mark obtained in an achievement test. Achievement is quantified by a measure of the student's academic standing in relation to those of other students of his age (Igweh, 2012)

Researchers have found out that the causes of students' poor academic achievement in Economics are traceable to poor teaching methods, the difficult nature of some Economics concepts and topics, negative attitudes of students towards Economics, gender factors, and teachers/students inability to cover their syllabus before they take their final examinations in Economics (Micheal, 2016).

It has been observed that the use of conventional teaching strategy which seemed to be successful due to the scanty Economics curriculum content as at then is no longer effective in teaching and learning Economics in secondary schools since the enrichment of the curriculum with new concepts, models and theories. Ossai (2014) stated that "instructional strategy otherwise known as teaching method can be conceived of as a plan of activities to teach content and sequence learning experience". Teaching strategies are the umbrella term, in fact an overall large scale teaching plan or framework, that encapsulates both teaching methods and teaching techniques (Micheal, 2016). Therefore, instructional strategy includes the method and the techniques used in and outside the classroom by the teacher and learners in order to achieve the planned learning outcome.

It has been observed that teachers in Nigeria predominantly use conventional instructional strategy for content delivery in various subjects (including Economics). In order to cover the scheme of work, teachers resort to transmission of facts, dogmas and theories to the students who have to regurgitate them in half digested form in examination. Conventional instructional method of 'talk and chalk' is grossly inadequate for teaching a problem-solving approach discipline such as Economics. The

prevalent uses of conventional teaching method in teaching Economics do not allow the students to have in-depth knowledge of Economics concepts which also adversely affects achievement and retention. This ugly development hinders the critical thinking skill that Economics develops in the learners and can make the topics difficult to the students. In order to achieve instructional objectives and education goals, students are expected to excel in the academic work, experience comfortable academic environment and provision of necessary infrastructural facilities (Micheal, 2016). The method adopted by any teacher in teaching any particular subject can affect learner's level of achievement". There is therefore, the need to employ appropriate instructional strategy that can enhance students' achievement in Economics irrespective of their gender.

Problem of the Study

The authors of the present study have taught Economics for several years and are well acquainted with students' academic achievement and methods of teaching and learning Economics. During this time, the authors have observed that students consider Economics to be boring and overloaded with complicated and troublesome concepts. Thus, the authors felt obligated to enliven the methods used to teach Economics by engaging students in the learning process in a way that might appeal to their senses and follow the development of 21st century students, who are often referred to in certain studies as "digital citizens" surrounded by communication media, smart phones, applications and information technologies. It is commonly documented in related studies that new technologies have transformed society and that their influence on the daily life activities of individuals have affected students' preferred information formats, leading them to favor "visually appealing information resources with concise textual content" (Brigas& Ramos, 2015; Islamoglu, Ay, Ilic, Mercimek, Donmez, Kuzu&Odabasi2015and Alrwele, 2017).

In a study conducted in 2011, Roehling, Kooi, Dykema, Quisenberry, & Vandlen2010 in Alrwele, 2017) stated that this new generation of students has been raised in a "multimedia environment in which they rapidly shift their attention from one source of information or stimulation to another. As a result, these students tend to have a low tolerance for boredom and require high levels of stimulation to remain focused. This study implies that students require "digital age" learning that involves a visual representation of data to attract their attention. Studies that compare visual and verbal communications claim that visual communication is more effective than verbal communication because the human mind is capable of perceiving visual representation in a short time and in a more efficient and permanent way compared to written or verbal information (Dur in Alrwele, 2017). Visual representation can convey a complex message in a mere snapshot rather than using several pages of explanation to convey the message (Zayan in Alrwele, 2017). A relatively new but widespread visual representation element is infographics.

Furthermore, the authors have observed the report from Federal Ministry of Education on NECO (2010-2015) that identified lack of application of effective methodology for teaching Economics as major reason for low academic achievements of students in Senior Secondary Schools Economics Examination. The conventional method of teaching Economics does not adequately equip teachers with contemporary views of student's intelligences and their vast learning capabilities. It lacks the required critical thinking potentiality for active and effective learning of concepts in Economics. These potentials that are absent in the conventional method could they be inherent in infographics. Hence, this study therefore is to examine the effects of infographics on students' achievement in Senior Secondary School Economics in Pankshin Local Government Area of Plateau State.

Purpose of the Study

The purpose of the study was to examine the effects of Infographics instructional strategy on students' achievement in Senior Secondary School Economics in Pankshin Local Government Area of Plateau State, Nigeria. Specifically, the study seeks to find out:

- i. The mean achievement scores of students taught some concepts in Economics using Infographics instructional strategy and those taught using the conventional teaching method.
- ii. The mean achievement scores of male and female students taught some concepts in Economics concepts using Infographics instructional strategy.

Research Questions

The following research questions were formulated by the researchers to guide the study:

- i. What are the mean achievement scores of students taught some concepts in Economics concept using infographics instructional strategy and those taught using the conventional teaching method?
- ii. What are the mean achievement scores of male and female students taught some concepts in Economics concept using infographics instructional strategy?

Hypotheses

The following null hypotheses were formulated by the researchers and tested at 0.05 levels of significance.

- Ho₁: There is no significant difference in mean achievement scores of students taught some concepts in Economics concepts using infographics instructional strategy and those taught using conventional teaching method.
- Ho₂: There is no significant difference in mean achievement scores of male and female students taught some concepts in Economics concepts using infographics instructional strategy and those taught using conventional teaching method.

Methodology

The study was conducted using quasi-experimental research design. Specifically, non-equivalent control group research design, involving two intact groups of one experimental group and one control group. The study was carried out in Pankshin Local Government Area of Plateau State, Nigeria. Pankshin Local Government Area has 50 secondary schools. The population of the study was made up of Senior Secondary School class 2 (SSS 2) students of Economics in fifty (25) public secondary schools in Pankshin Local Government Area of Plateau State. The population of SS2 students offering Economics in the Local Government Area for 2018/2019 session was three thousand two hundred and thirty three students (3, 233) made up 1, 809 male and 1, 424 female students. The choice of SS 2 as the population for the study was because the selected concepts and topics in Economics are in SS 2 scheme of work.

The sample size was 119 students made up of 68 male and 51 female SS2 students in public secondary schools in Pankshin Local Government Area of Plateau State. This sample size was based on the number of students in the intact classes in the sampled schools. Six out of twenty-two co-educational schools in Pankshin Local Government Area of Plateau State were used in the study. These schools were drawn using purposive sampling techniques. Simple random sampling involving balloting with withdrawal and replacement were used for assigning the sampled schools to control and experimental groups. The two instructional approaches were written on two identical square papers, rumped and mixed together. The instructional approach picked was assigned to the sampled schools that way; a school was assigned to each of the approaches: infographics (experimental group) and conventional lesson plan and chalk-talk approach (controlled) groups. The sample process was adopted in assigning three schools each to both the experimental and control groups. The experimental group schools were Government Model Secondary school Pankshin, Government Secondary school Bet and Government Secondary school Fier while the controlled group schools were Government Secondary school Takkas, Government Secondary school Wokkos and Government Secondary school Jing.

The Economics Achievement Test (EAT) developed by the researchers was used for data collection. The lesson plans used were six in number for each of the two groups. The prepared lesson plan covered the four concepts in Economics selected for the study (basic tools for economic analysis II and concepts of demand and supply).

Face and content validity were carried out on the instruments by three experts from University of Abuja: one from measurement and evaluation, one from department of social science education and the third expert from the department of Economics. Ninety (90) Economics Achievement Test items were face validated by the experts in terms of relevance, suitability, clarity and coverage. The instrument was also subjected to content validation using table of specification. The validates of the test instrument

made suggestions, which led to removal of some items. On the whole, 45 test items survived. The Economics Achievement Test was subjected to item analysis after the trial testing on 25 students of Boys Secondary School Gindiri, Plateau State. The difficulty index (DI), Item difficulty (ID) and item discrimination index of the items on the instrument were found. The analysis of these psychometric qualities of the instrument reduced the number of items from 65 to 45. The Economics Achievement Test used was pilot-tested on 30 students of Boys Secondary School Gindiri. Scores generated from their responses were used to establish the internal consistency of the test items using Kuder-Richardson formula 20 (K-R, 20) method. Thus an internal estimate of 0.94 was calculated for Economics Achievement Test. Kuder-Richardson formula K-R 20 method is suitable for determining the reliability of Economics Achievement Test because the instrument is dichotomously scored. This is in line with Nworgu (2015) who observed that K-R 20 “method of estimating internal consistency of an instrument is applicable to dichotomously scored item”

Pretests using the validated Economics Achievement Test were first administered on the subjects by the researchers and the result carefully recorded before the treatment session, which lasted for four weeks. A day after the treatment, post-tests was administered on the subjects by the researchers using the same Economics Achievement Test as in pretest.

The research questions were answered using mean and standard deviations in Statistical Package for Social Sciences (SPSS), version 23. The hypotheses were tested using analysis of Covariance (ANCOVA) at 0.05 alpha levels of significance.

The actual experiment was conducted by the regular Economics teacher in each of the sampled school using lesson plans developed by the researchers for each instructional approach. In group one where infographics instructional approach was used, the teachers taught the students using the approach. In group two the teachers taught the students the instructional content using conventional approach. The experiment lasted for four weeks.

The Extraneous variables, which might occur during the experiment, were controlled in order to ensure valid and reliable results. These variables included those arising from the teacher, inter-group, instructional procedure and test takers' interaction.

Results

The results were presented according to the research questions and hypotheses.

Research question 1: What are the mean achievement scores of students taught some Economics concept using infographics instructional strategy and those taught using the conventional teaching method?

Table 1: Mean achievement scores and standard deviations of scores of students in pre-tests and posttests due to treatment.

Treatment Groups		No of responses	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Infographics Strategy	Instructional	68	17.54	4.28	61.44	.50	43.90
Conventional Method	Teaching	51	18.57	3.40	40.61	.49	22.04

Table 1 shows that the experimental group has a pre-test mean score of 17.54, a post-test mean score of 61.44 and mean gain of 43.90 while the control group has a pre-test mean score of 18.57, a post-test mean score of 40.61 and mean gain of 22.04. The experimental group has a higher mean gain than control group. This shows that the group taught some concepts in Economics using infographics instructional strategy achieve better than those taught with conventional teaching method.

Table 1 also shows that in pre-test, scores in infographics instructional strategy group deviated from the mean score with the standard deviation of 4.28. The deviation of the pretest scores of conventional teaching method group from the mean score is less, having standard deviation of 3.40. In post-test, scores of infographics instructional strategy group deviated with standard deviation of .50 while the deviation of the posttest scores of expository instructional strategy group from the mean score is less, having standard deviation of .49

Research question 2: What are the mean achievement scores of male and female students taught some concepts in Economics using infographics instructional strategy?

Table 2: Mean achievement scores and standard deviations of scores of students in pre-tests and posttests due to treatment.

Gender	No of responses	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Male	36	17.41	4.52	61.44	.50	44.03
Female	32	17.68	4.05	61.43	.50	43.75

Table 2 shows that male students have a pre-test mean score of 17.41, a post-test mean score of 61.44 and mean gain of 44.03 while female students have a pre-test mean score of 17.68, a post-test mean score of 61.43 and mean gain of 43.75. Male students have a higher mean gain than the female students. This shows that male students taught some concepts in Economics using infographics instructional strategy achieved higher than their female counterparts.

Again, table 2 also shows that in pre-test, male students' scores deviated from the mean score with the standard deviation of 4.52. The deviation of the scores of female students from the mean score is less, having standard deviation of 4.05. In posttest, scores of male students deviated less from the mean score, having standard deviation of .50 while that of the female students is .50.

Research Hypothesis 1: There is no significant difference in mean achievement scores of students taught some concepts in Economics concepts using infographics instructional strategy and those taught using conventional teaching method.

Table 3: Summary of Analysis of Covariance (ANCOVA) for Test of Significance between the Mean Scores of Experimental and Control Groups and Interaction Effect of Treatment given to Students and their Gender with Respect to their Mean Scores in the Economics Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15814.658 ^a	4	5271.553	7.774	.001	.704
Intercept	8368.250	1	8368.250	12.341	.002	.176
Pretest	9585.309	1	9585.309	14.136	.000	.155
Groups	1755.817	1	1755.817	2.589	.001	.348
Gender	34.999	1	34.999	6.549	.252	.007
Group * Gender	20.171	1	20.171	3.774	.328	.004
Error	18986.263	114	678.081			
Total	729288.000	119				
Corrected Total	34800.921	118				

a. R Squared = .454 (Adjusted R Squared = .396)

The results shown in table 3 indicate that treatment has direct effect on students' achievement in some concepts in Economics. This is because the F-value at 2.589 in respect of treatment main effect is shown to be significant at 0.000. This, therefore, shows that at 0.05 level of significant, the F-value of 2.589 is significant. Therefore, it can be concluded that the research null hypothesis which states that there is no significant difference in mean achievement scores of students taught some concepts in Economics concepts using infographics and those taught using conventional teaching method is rejected. The observed difference between the mean scores of students taught some concepts in Economics using infographics and those taught using conventional teaching method is significant and not by chance.

Research Hypothesis 2: There is no significant difference in mean achievement scores of male and female students taught some concepts in Economics concepts using

infographics instructional strategy and those taught using conventional teaching method.

Table 3 shows that the difference in the mean achievement scores of male and female students taught some concepts in Economics concepts using infographics is not significant since the F-value at 6.549 in respect of treatment main effect is not significant at 0.252. This therefore, shows that at 0.05 level of significant, the F-value of 6.549 is not significant. The observed difference in achievement scores of between the two sex groups is merely due to chance. The research hypothesis is therefore accepted. There is no significant difference in mean achievement scores of male and female students taught some concepts in Economics concepts using infographics.

Discussion

The findings show that infographics instructional strategy yielded a significant difference on students' achievement in Economics than the conventional teaching method. This result could be attributed to the visual appeal of infographics, which attracted students' attention and facilitated their comprehension. The implication is that infographics instructional strategy being child centered and involving memory and strategy monitoring can be used to achieve the goals and the objectives of Economics education and Economics lessons, especially those involving Economics concepts of basic tools for economic analysis and concepts of demand and supply. This is in line with Oduolowu (2007) who calls for a shift from the conventional method of teaching to innovative methods of teaching and also in line with Alrwele, (2017) who demonstrated that the use of infographics instructional strategy can increase students' achievement. Infographics instructional strategy is learner-centered and more active than the conventional method of teaching. The simplicity and rapid communicative ability of visual representations enable them to be rapidly comprehended by students. Dowse and Ehlers (2005) in their study revealed that labels containing text and visual representations (pictograms) were comprehended by 95% of the subjects in contrast to labels that contained mere text, which were interpreted by 70% of the subjects. Furthermore, studies have revealed that students of all different learning styles are capable of learning through the use of visual aids (Katsioloudis, 2010). The significant difference in the achievement of the experimental group could be attributed to the high memorability of the learned information, which was visually presented in the form of infographics.

It is commonly understood that the visualization of infographics increases the retention of learned content. George (2013) and Yildirim (2016) state that "research has shown that people remember visual representation more accurately, more quickly, and for a longer period of time" than words alone. Zinonyev (2010) duplicated George's study and stated that the visual display in infographics allows individuals to visualize, analyze, and remember the message. Zinonyev justifies his statement and adds that the

visual memory of most individuals "is more persistent than verbal or auditory memory." In a study conducted by Vanichvasin(2013) the results revealed a positive impact of infographics on students' comprehension and retention of information. The results of the present study regarding students' achievement are consistent with results of prior studies (Gallicano, Ekachai, & Freberg, 2014; Gareau, Keegan, & Wang, 2015; Rezaei&Sayadian, 2015; Alotiabi, 2016 and Al Hosni, 2016) and indicated that using infographics positively impacts students' achievement. The outcomes of this study also support the claims of prior studies that infographics are a promising instructional tool that could improve students' achievement and capacities (Davis & Quinn, 2014; Dur, 2014; Saurbier, 2014; Fowler, 2015; Islamoglu et al., 2015; Karre, 2015; Yildirim, 2016; Young & Ruediger, 2016).

The conventional method of teaching encourages rote learning which in line with Ossai (2014) is not suitable for problem solving discipline, such as Economics. Therefore the abstract nature of Economics which contributes to students' perception of some concepts as difficult ones can be minimized drastically by using result oriented instructional strategies such as infographics instructional strategy. This finding is in agreement with Nwagbo in Michael (2016) who observed that high achievement is usually enhanced by proper instructional approach and that instructional approaches play major roles in realizing instructional objectives of Economics. Infographics instructional strategy is effective in enhancing academic achievement of students in secondary school Economics.

The findings show that gender as a variable had no significant effect on student's achievement in Economics. The table 2 shows that the interaction effect of the teaching strategies and gender was not significant on students' achievement. The implication is that the instructional strategy has similar effects on both male and female students. This is in line with Akinsolain Micheal (2016) who stated that gender differences may exist but a good method should be capable of neutralizing the differences. The findings also agree with Amosun (2011) and Onuoha and Enogu (2014) that there is no significant gender difference in academic achievement of students when exposed to treatment and that achievement does not depend on gender rather on instructional technique or strategy. However, this finding is not in agreement with that of Okah (2007); Ezeja, Ezeora and Ezeugwu (2008) who observed that girls achieve poorer in Economics. This disagreement could be as a result of the design of the studies, being ex-post facto research design which does not allow manipulation of any particular variable to bring about a specific effect. The finding of this research also disagrees with that of Onah and Omenuko (2011) who concluded that the male and female students' achievements using cooperative instructional strategy differ with male students achieving better than female students. This is an indication that with some instructional strategies, gender differences in academic performance could persist but with infographics instructional strategy, these differences can be neutralized which agrees with the position of Ibe (2004) who

stressed that education for future that will equip the individual with the power to adapt to change irrespective of gender should be the most important goal of education of any society that wants to progress. In this study infographics instructional strategy enhances the academic achievements of both male and female students evenly.

Conclusion

The results of this study indicate that infographics are effective for improving students' achievement and retention in some concepts in Economics. These outcomes may provide solutions for teachers who teach complex or abstract concepts in Economics and other subjects that are difficult to explain solely using written text and orally presented material because infographics represent alternative instructional tools. This study suggests that infographics are promising instructional instruments that align with the interests and characteristics of digital age students. This study contributes to a growing number of studies that investigate the benefits of infographics. It is hoped that this study will help researchers because it offers new and validated instruments that could be used in future studies.

Recommendations

Based on the findings of this study, the following recommendations were made;

- i. Economics teachers should adopt the use of the infographics to teach Economics.
- ii. Plateau State Ministry of Education and principals of Plateau State Senior Secondary Schools should organize seminars, conferences and workshops to sensitize Economics teachers on the use of infographics.

References

- Akinsola, M. K. (2007). Instructional methods employed by mathematics teacher. A managerial approach. *African Journal of Educational Planning and Policy Studies*.3(1), 25-32.
- Al Hosni, J. (2016). The power of image in English language teaching. *The Journal of Teaching English For Specific And Academic Purposes*, 4(1), 229-235.
- Alotiabi, W. (2016). *The impact of using instructional infographics on students' achievement in English language grammar of first grade in Riyadh*. Unpublished Master's Thesis. Riyadh: Al- Imam Muhammed bin Saud Islamic University.
- Alrwele, N. S. (2017). Effects of infographics on student achievement and students' perceptions of the impacts of infographics. *Journal of Education and Human Development*, 6(3), pp. 104-117.
- Amosun, P. A. (2011). Performance and attitude of male and female students in physical geography in urban and rural schools of Ogun State, Nigeria. *African Journal for the Study of Educational Issues*, 4(4,3), 195-198.
- Brigas, J., & Ramos, F. (2015). Infographics as an auxiliary tool for teaching/learning. *Revista de Comunicacion de la SEECI*, 36, 178-184.

- Davis, M., & Quinn, D. (2014). Visualizing text: The new literacy of infographics. *Reading Today*, 31(3), 16-18.
- Dowse, R., & Ehlers, M. (2005). Medicine labels incorporating pictograms: Do they influence understanding and adherence? *Patient Education and Counseling*, 58(1), 63-70. doi:10.1016/j.pec.2004.06.012.
- Dur, B. (2014). Data visualization and infographics in visual communication design education at the age of information. *Journal of Arts and Humanities*, 3(5), 39-50.
- Ezeja, B. K., Ezeora, B.C. & Ezeugwu, A.S. (2008). *Comparative analysis of male and female students' performance in economics in secondary school* (Unpublished research project). University of Nigeria, Nsukka.
- Fowler, K. (2015). For the love of infographics. *Science Scope*, 038(07), 42-48. doi:10.2505/4/ss15_038_07_42.
- Futterman, M. (2020). *Organizing instruction and study to improve students' learning*. Washington DC: National Center for Education Research.
- Gallicano, T., Ekachai, D., & Freberg, K. (2014). The Infographics assignment: A qualitative study of students' and professionals' perspectives. *Public Relations Journal*, 8(4), 1-22.
- Gareau, M., Keegan, R., & Wang, L. (2015). *An exploration of the effectiveness of infographics in contrast to text documents for visualizing census data: What works?* In S. Yamamoto (Eds.) Human interface and the management of information. Information and knowledge design. HIMI 2015. Lecture notes in Computer Science, vol 9172. Cham, Switzerland:Springer, doi:10.1007/978-3-319-20612-7_16.
- George, S. J. (2013). Teaching the smartphone generation: How cognitive science can improve learning in law school. *Maine Law Review*, 66(1), 164-190.
- Ibe, E. (2004). *Effects for guided inquiry and demonstration of some process skill acquisition among biology secondary school students* (Unpublished M.Ed thesis). University of Nigeria, Nsukka.
- Islamoglu, H., Ay, O., Ilic, U., Mercimek, B., Donmez, P., Kuzu, A., & Odabasi, F. (2015). Infographics: A new competency area for teacher candidates. *Cypriot Journal of Educational Sciences*, 10(1), 32-39.
- Karre, M. (2015). Infographics make an impact. *School Librarian's Workshop (Online)*, 35(3), 12-13.
- Katsioloudis, P. (2010). Identification of quality visual-based learning material for technology education. *Journal of Industrial Teacher Education*, 47(1), 71-99.
- McDermott, I. (2014). Show, don't tell; Data visualization for libraries. *Online Searcher*, 38(4), 35-37.
- Micheal, O. (2016). *Effect of meta-cognitive instructional strategy on students' achievement, interest and retention in secondary school Economics in Asaba education zone of Delta state, Nigeria*. Unpublished Master's thesis of Department of Social Science Education, University of Nigeria, Nsukka

- Nwagbo, A. (2006). Effects of two teaching methods on achievement and attitudes to biology of students of different levels scientific literacy. *International Journal of Education Research* 216-219
- Nworgu, B.G. (2015). In *Educational research. Basic issues and methodology (3rd edition)*. Nsukka. University Trust.
- Oduolowu, E. A. (2007). A Comparison of the universal basic education programme in Nigeria and grandkola of Sweden. *Essays in Education*. 20 (1), 90-102.
- Okah, E. A. C. (2007, June). *Clarification and analysis of gender concepts*. A paper presented at STAN national workshop of gender and STM panel. Abuja.
- Onah, O. O., & Omenuko, C. O. (2011). *Effect of co-operative learning instructional strategy on senior secondary school students' achievement in economics in Nsukka Education Zone, Enugu State* (Unpublished research project). University of Nigeria, Nsukka.
- Onuoha, J. C., & Enogu, N. D. (2014, November 21-23). *Effect of Jigsaw cooperative learning technique on students' achievement in junior secondary school social studies in Nsukka, Nigeria*. Paper presented at the 94th International Conference on the Civic Mission of Schools, organized by National Council of Social Studies held at Convention Centre, Boston, USA.
- Ossai, J.N. (2014, June) Effects of three instructional strategies on academic achievement in junior secondary school In J.C. Onuoha eta/. (ed.). *Nigerian Journal of Social Studies and Civil Education*, 6 (1), 151 – 154.
- Parkinson, M. (2016). Infographic tips and tools. *Talent Development*, 70 (5), p. 26-28.
- Rezaei, N., & Sayadian, S. (2015). The impact of Infographics on Iranian EFL learners' grammar learning. *Journal of Applied Linguistics and Language Research*, 2(1), 78-85.
- Roehling, P. V., Kooi, T. L. V., Dykema, S., Quisenberry, B., & Vandlen, C. (2010). Engaging the millennial generation in class discussions. *College Teaching*, 59(1), 1-6. doi:10.1080/87567555.2010.484035.
- Rosenberg, D. (2015). Against infographics. *Art Journal*, 74(4), 38-57. doi:10.1080/00043249.2015.1134918.
- Saurbier, A. (2014). Using Infographics as an integrative higher-order skill development assignment in undergraduate leadership instruction. Business education. *Innovation Journal*, 6(1), 13-23.
- Smiciklas, M. (2012). *The power of infographics. Using pictures to communicate and connect with your audiences*. Indianapolis, IN: Que Publishing.
- Vanichvasin, P. (2013). Enhancing the quality of learning through the use of infographics as a visual communication tool and learning tool. Paper presented at ICQA 2013 International Conference on QA Culture: *Cooperation or Competition* (pp. 135–142).

- Wertz, J., & Saine, P. (2014). Using digital technology to complement close reading of complex texts. *New England and Reading Association Journal*, 50(1), 78-82, 85.
- Yildirim, S. (2016). Infographics for educational purposes: Their structure, properties, and reader approaches. *Turkish Online Journal of Educational Technology*, 15(3), 98.
- Young, J., & Ruediger, C. (2016). *Incorporating visual literacy standards in an introductory statistics course*. In JSM 2016, (pp. 578-586).
- Zinonyev, A. (2010). Data visualization in political and social sciences. *The Quill*, 103(1), 31