

EFFECTS OF VIDEODISC MEDIATED AND COMPUTER ASSISTED INSTRUCTIONAL PACKAGES ON ACHIEVEMENT OF JUNIOR SECONDARY SCHOOL MATHEMATICS STUDENTS IN GEOMETRY IN MINNA, NIGERIA

ALABI, T. O. (Ph.D)¹, EMMANUEL OMEIZA² & FALODE, C. O. (Ph.D)¹

¹Science Education Department, Federal University of Technology, Minna, Nigeria

²Hill-Crest International School Minna, Nigeria

E-mail: dralabiomotayo2012@gmail.com Phone No: +234-806-453-1808

Abstract

The study was carried out to investigate the effects of Videodisc mediated and Computer assisted instructional packages on achievement of junior secondary school students' geometry in Minna metropolis, Niger State. A quasi – experimental, pretest – posttest experimental and control groups design was used in carrying out the research. The study strive to answer four research questions. One hundred and twenty students from three selected schools (male and Female) formed the sample for the study. Two treatment instruments were used which are Videodisc and computer instrument as they were assigned to the Experimental groups and the Convectional method was assigned to the control group. Geometry Achievement Test (GAT) containing twenty multiple choice tests was used for data collection. The reliability coefficient of the item instrument is ($r = 0.85$). Analysis of Covariance (ANCOVA) was used to test formulated four hypotheses and tested at 0.05 level of significance. The finding showed that videodisc mediated instructional package performed significantly better than the computer Assisted Instructional packages and the control group. There was statically no significant difference in the mean achievement of male and female students of Videodisc mediated and Computer Assisted instructional strategy. The study recommended that Mathematics teachers should endeavor to use VDMIS in presenting Mathematics lessons especially Geometry in schools to arouse the love for Mathematics by students.

Keywords: Achievement, Computer Assisted Instruction, Geometry, Mathematics, Video Disc

Introduction

Learning occurs right from the birth of the child and proceeds until he/she dies. Learning is acquired due to the prior experience one has gained. Learning is seen as a relatively permanent change in behavior, which includes both observable activity and internal processes such as thinking, attitudes and emotions (Jarvis, 2009). However, the essence of enrolling a child in the school is to acquire desirable/positive behavior under the tutelage of the teacher. To further ease the work of the teacher, facilities and other personnel are employed to provide an education designed for classroom learning, which is aim to prepare all the students to work and participate in the society which they live in. Also, the teacher further design a way to manipulate effectively the use of material or equipment meant for teaching and learning process in education.

Education is to assist individuals to maximize their potentials for optimal self and national development. Education is a prerequisite for meaningful and sustained national economy. Education cannot be of quality without effective teaching. The instructional method employed by teacher plays an important role in the acquisition of instructional contents for meaningful learning and development of necessary skills. Teacher-centered instructional methods make students passive with less interaction. Classrooms in Nigeria are predominantly dominated by such method of instruction which does not encourage students-students interaction. This is why educational technology has strived over the years in integrating instructional media into teaching and learning (Nsofor, 2010).

Discovery has shown that learning is better when information is referentially processed through two channels than when the information is processed through only one channel. This brings about the dual coding of information as it appeals simultaneously to learner's auditory and visual modalities. This is seen in the use of computers which have become the basis of data processing technologies used in realizing information production, manipulating, and storing, sharing and distributing processes. Since they address to more senses compared to other technological tools and make abstract and complicated concepts concrete digitally because of their extensive multimedia properties, they are one of the most important technological tools which are made use of in educational and instructional process. At the same time they play an influential part in accomplishing many pedagogical functions such as measuring and evaluating knowledge and giving feedback, observing activities and performances of students, being independent from time and environment, providing students with motivation and participation to the lesson, considering individual differences regulating education level according to existing knowledge and progress of the students, and supporting instruction with such materials as graphics, pictures, animation and sound used in all science subjects including Mathematics (Al Sharaideh, 2011).

Right from on set, cultures and societies have identified the significance of mathematics. Mathematics is more than simple subject it is a language that help us understand the world around us. Mathematics is a tool of science and technology that enables people to explore concept with idealized models before trying them in the real world (Boaler, 2008). As mathematics is being offered as a subject by pupils and students from primary and secondary school levels, if well taught and the attention of learner is properly captured, this is capable of preparing the learner for an assured tomorrow and a meaningful development both mentally and morally. It is important to note that the impact played by Mathematics in individual life makes it unique in our day to day activities. Not only for scientific and technological development, but for all forms of development. Mathematics being a universal subject has an advantage of been offered worldwide and is also entails the social, cultural, utilitarian and disciplinary qualities. Due to its efficacy it can be apply in economic, social, cultural, and environmental development of a nation since it is not restricted by sex, race, culture, and religion (Martin, 2007).

Teachers of mathematics are continually challenged to find the most effective methods of reaching students easily. Primary school and secondary school pupils and students today are the generation bombarded by little of media and more of social media networks. They watch DVDs, play video games, and listen to music constantly, visit internets and social networks like WhatsApp, Facebooks, twitters, wecharts and also watch more of television (Hunter, 2008). While these types of technology may seem more entertainment than tool, teacher today are finding ways to work with various forms of visual media to help gain and keep students' attention. The mathematics community nationwide is also seeing potential value in the variety of forms of technology now available. In 2000, the National Council of Teachers of Mathematics found technology to be of such import they included a Technology Principle in their Principles and Standards for School Mathematics. Specifically, they state that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students learning" (National Council of Teachers of Mathematics, 2010:24)

Ezike (2011) stated that: "educational technology awakens learner's interest by its ability to arouse their curiosity to know more. Once more the use of audio – visual aids makes the learners to be more alert and attentive. It captures their interest, and they would like to follow the explanation, procedure or the exercise sequentially and faithfully in order to get the precised meaning of the whole event. The use of educational technology processes and

devices help to make learning more permanent. It creates impressions that are so vivid and powerful that the learner hardly forgets the experiences into which he was exposed.

Video is a medium of transmitting information in the form of sound and image to be displayed on the screen of television tube. It is usually grouped along with television and films (Bada, 2006). Video, an audio – visual media is always recorded in tapes and disks. Video combines many kinds of data (images, motion, sounds, text) in a complementary fashion, thereby ensuring that learning can be adjusted more easily in the use of video than any other tools to the diverse learning styles and individual learning pace of students (Bates, 2012). Videodisc mediated packages are instructional materials that employ the stimuli of sight and hearing.

Many years ago, worldwide communication of information immediately was not so common. Nowadays, there is no doubt that modern communication technology has vastly increased our exposure to information and experience. Most media have implications for education that are only beginning to be fully understood and appreciated. The importance of using video in learning as presented by Kali and Linn (2009) stated that by using video as a learning media, students are not only able learning to make a mental representation from the semantic understanding of a story in either audio or visual form but when presented together, each source gives an additional information and completion which helps students in remembering symbols or pictures naturally. Video can be used in a variety of instructional setting in classrooms, on distance learning sites where information is broadcast to learners who interact with the facilitators via video or computer and in self-study evaluated situation (Ezike, 2011). Also with video, the learner has more control over the information he receives and an additional opportunity for deeper learning by being able to stop, rewind, fast-forward, and replay content as many times as needed. Video presentation or movies, in the classroom are more effective for students in learning (Kopcha, 2010). Video are more interactive and engaging. This helps stimulate the brain for better achievement and retention. This further shows that Video is a rich and powerful medium in learning especially e- learning, because it can present information in an attractive manner.

Videotape is a step up from audiotape as Videodisc is a step from Audio disc, i.e. DVD or VCD from CD. Videodisc mediated films are the best instructional media that can hold the attention of learners because they add motion to the projected visual image. Videodisc mediated film can be used to achieve educational objectives in the areas of present information that involves motion, describe processes, and shows relationship in order to convey knowledge, teach skills or affect an attitude through individual study or group viewing.

The practical use of microcomputer in the Nigeria classroom for teaching and learning process is slowly gaining acceptance as a result of great significance and educational appropriateness it brings. Computers and learning increasing recognized in the developing countries, especially as these form an essential part of everyday activities that generated kind information and ease its fast delivery. Computer can be used to assist instruction, manage instruction and aid design. However, when computer is used to assist instruction, it is referred to as 'Computer Assisted Instruction'. According to Ezeliiora (2010), the use of CAI provides the learner with different backgrounds and characteristics. Using teaching package such as CAI, concepts are presented to the students in such a well-organized manner that makes for greater clarity and easier understanding. Egunjobi (2002) and Karper, Robinson, and Casado – Kehoe (2005) found CAI effective in teaching geography and counseling education respectively; they all confirmed that CAI is seen to be effective in enhancing students' performance in other subjects than the conventional classroom instruction. Opportunities in the classroom are in the areas of drill and practice, tutorial, simulation demonstration, designing, data and collection, analysis and games.

In the early 1960s educational technologists developed some set of programs of Computer Assisted Instructional (CAI) in order to drill, tutor and evaluate students and to manage such programs effectively (Busturk, 2005). A lot of speculations have been made by educational technologists who believe that CAI will not only reduce educational costs in the long run but enhance educational effects.

Computer assisted instruction (CAI) delivered on a personal computer has been viewed optimistically by many researchers since its introduction, it has claimed that if judged by a number of criteria that include achievement gains most CAI uses one or a combination of techniques, which are Tutorial, Drill and practice, Learning games, Simulation, Problem solving, Assessment, and Demonstration/ presentation (Jarvis, 2009).

CAI is a new teaching and learning strategy in which the topics are carefully planned, written and programmed in a computer which can be run simultaneously in several computer units. It allows each student to use one computer terminal. The instructions are equally programmed on a computer disc (CD), this could be played in either audio or video system for the student to learn the programmed material at his/her convenient time without being hasty (Adegoke, 2011). CAI programs use tutorial, drill and practice, simulation and problem solving approaches to present topics and they test the student's understanding. One of the most challenging techniques used in CAI is problem solving. It helps students develop skills in logic, solving problems following directions, and is generally used to augment higher order thinking skills. Assessment is a valid part of any learning experience. Computer – based assessment can be used to initiate, place and then monitor students' progress within a curriculum. Demonstration or penetration is best used to support the introduction of new information. It can also be used as a review (Jarvis, 2009).

Gender issues too have been linked with performance of students in academic tasks in several studies but without any definite conclusion. But there is a general conclusion that gender imbalance exists in computer use, access, career and attitude. That is why Davies, Klawe, Nyhus, and Sullivan, (n.d.) based on their review suggested that current gender imbalance in technology and the role that technology will play in the future should be a concern for men and women, practitioners, policy makers and parents. Some studies revealed that male students perform better than the females in physics, chemistry, and biology (Afolabi & Yusuf, 2010; Gambari, Ezenwa & Anyanwu, 2014). This is one of the reasons why this study is designed to find out the effect of Videodisc Mediated Instructional Package (VDMIP) and Computer Assisted Instructional Package (CAIP) on teaching geometric shapes in Junior Secondary schools to and if it can be used as a tool to enhance student learning.

Objectives of the Study

The general objective for this study was effects of videodisc mediated and computer assisted instructional packages on achievement of junior secondary school mathematics students in geometry in Minna, Nigeria. The specific objectives of the study are:

- (i) To determine the achievement of junior secondary school students taught geometry with computer Assisted instructional strategy and those taught with conventional lecture method.
- (ii) To determine the achievement of Junior secondary school students taught geometry with Videodisc Mediated Instructional strategy and those taught with conventional lecture method.
- (iii) To examine the achievement of male and female students taught geometry with computer Assisted Instructional Strategy.
- (iv) To examine the achievement of male and female students taught geometry with Videodisc Mediated Instructional strategy.

Research Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance:

- Ho₁:** There is no significant difference in the mean achievement score of students taught geometry using computer Assisted Instructional Strategy, Videodisc Mediated Instructional Strategy and Conventional lecture method.
- Ho₂:** There is no significant difference between the mean achievements scores of male and female students taught geometry Using Computer Assisted Instructional Strategy.
- Ho₃:** There is no significant difference between the mean achievement scores of male and female students taught geometric shapes using Videodisc mediated Instructional Strategy.

Methodology

The research design for this study is a factorial design. The design consists of three groups (I, II, III), taught with videodisc mediated, computer assisted and chalk and talk method. The study was limited to all of the Junior Secondary School, class two (JSS II) students in Minna metropolis, Niger State. The target population was 1,200 junior secondary school two (JSS2) students. Three schools were randomly selected and assigned as experimental I, experimental II and Control group respectively. A total number of one hundred and twenty (120) JSS II students in Minna metropolis for the purpose of treatment, analysis and discussion. A total of forty (40), twenty (20) male and twenty (20) female students were selected from each school. The choice of three (3) schools was purposive and the selection of students was done randomly. The Experimental groups' one and two were taught VDMI and CAI respectively as the control group was taught with conventional method. The method of data collection used was based on the administering of the test instrument (GAT) on the experimental and control groups before and after teaching. The pretest was administered to the experimental and control groups. The scores obtained were used to determine the academic equivalence of the control group and experimental groups before the experiment started. The scope of the test was limited to geometry concept which was treated in Mathematics and was administered as pretest and post- test. The instrument was subjected to both the face and content validation by experts. The students were assigned to experimental and control groups, pretest, treated and posttest using test – retest method to ascertain the reliability of the Geometry Achievement Test (GAT) instrument. The instrument had reliability coefficient of 0.85 obtain using person's correlation.

Results

The summary of the data analysis and results are presented in Table 1.

- Ho₁:** There is no significant difference in the mean achievement scores of students taught mathematics using Videodisc Mediated Instructional Strategy, Computer Assisted Instructional Strategy and those taught with the conventional method.

Table 1: Mean and standard deviation of the posttest mean achievement scores of experimental group 1, 2, and the control group

Group	N	Mean(\bar{x})	SD
EXP 1(VDMI)	40	13.53	3.218
EXP 2 (CAI)	40	11.45	2.873
CONT.	40	9.70	4.767

Table 1: shows the mean scores and standard deviation of the experimental groups 1, 2, and the control group. From the results, Experimental Group 1 (M = 13.53, SD = 3.218); Experimental Group 2 (M = 11.45, SD = 2.873) and control Group (M = 9.70, SD = 4.767) respectively.

In order to find out if the mean difference between the groups is statistically significant, ANCOVA was carried out.

Table 2: ANCOVA result of the posttest mean achievement scores of experimental 1, 2, and the control group

Source	Sum of Square	df	Mean Square	F – Value	P – value
Corrected Model	1867.928	3	622.643	1917.678	.000
Intercept	153.682	1	153.682	473.326	.000
Covariance(Pretest)	1574.611	1	1574.611	4849.647	.000
Treatment	15.548	2	7.774	23.943	.000
Error	37.664	116	.325		
Total	17937.000	120			
Corrected Total	1905.592	119			

S = Significant at 0.05 level

Table 2 shows ANCOVA results of the posttest mean achievement scores of Experimental Group 1, 2 and the Control Group. The results yielded an F – Value of 23.943 and a P- value of .000 ($F(2,119) = 23.943, P < 0.05$). The result was significant because $P < 0.05$ and hypothesis one (H_{01}) was rejected. Therefore the Videodisc Mediated and Computer Assisted Instructional Packages used for the experimental groups produced a significant effect on the posttest achievement scores of students when Covariate effect (Pretest) was controlled. This implies that a statistically significant difference exist among the three groups (Videodisc Mediated and Computer Assisted Instructional packages and the Control Group).

H_{02} : There is no significant difference in the mean achievement score of male and female students taught geometric shapes using computer assisted Instructional Strategy (CAIS)

Table 3: Mean and standard deviation of the posttest mean achievement scores of male and female students taught with CAIS

Variable	N	Mean	SD
Male	20	11.05	2.964
Female	20	11.85	2.796
Total	40	11.45	2.873

Table 3 shows the mean and standard deviation of male and female students taught with CAIS. The mean of the male is 11.05 with standard deviation 2.964 while that of the female mean is 11.85 with standard deviation of 2.796.

Table 4: ANCOVA result of the posttest mean achievement scores of male and female students taught geometric shapes using computer assisted instructional strategy

Source	Sum of Squares	df	Mean Square	F- value	P- Value
Corrected Model	9.832	2	4.916	.583	.563
Intercept	3.432	1	3.432	.407	.527
Covariance(Pretest)	361.495	1	361.495	42.860	.000
Treatment	3.771	1	3.771	.447 ^{NS}	.508
Error	312.068	37	8.434		
Total	5566.000	40			
Corrected Total	321.000	39			

S = Not Significant at 0.05 level

Table 4 shows ANCOVA results of the posttest mean achievement scores of male and female students. The result yielded an F – value of 0.447 and a P – Value of 0.508 ($F(1, 39) = 0.447, P > 0.05$). This shows that the result was not significant because $P > 0.05$. Hence, hypothesis two (H_{02}) was not rejected. It indicate that there was statistically no significant difference in the mean achievement scores of male and female students taught geometric shapes using Computer Assisted Instructional strategy (CAIS).

Hypothesis Three

There is no significant difference between the mean achievement scores of male and female students taught geometric shapes using Videodisc Mediated Instructional Strategy.

Table 5: Mean and standard deviation of the posttest mean achievement scores of male and female students taught with VDMIS

Variable	N	Mean (\bar{x})	SD
Male	20	14.70	2.736
Female	20	12.35	3.297
Total	40	13.53	3.218

Table 5 shows the mean and Standard deviation of male female students taught with VDMIS. The mean of the male is 14.70 with standard deviation 2.736 while that of the female mean is 11.85 with the standard deviation 3.297 respectively.

Table 6: ANCOVA comparison of the posttest Mean Scores of Male and Female Students taught geometric shapes using Videodisc Mediated Instructional Strategy

Source	Sum of Squares	df	Mean Square	F- value	P- Value
Corrected Model	86.082	2	43.041	1.209	.310
Intercept	4.857	1	4.857	.136	.714
Covariance(Pretest)	468.586	1	468.586	13.166	.001
Treatment	65.615	1	65.515	.1.841 ^{NS}	.183
Error	1316.893	37	35.592		
Total	8137.000	40			
Corrected Total	1402.975	39			

NS = Not Significant at 0.05 level

Table 6 shows ANCOVA results of the Posttest Mean Achievement Scores of Male and Female students. The result yielded an F – value of 1.841 and a P – Value of 0.183 ($F(1, 39) = 1.841, P < 0.183$). This shows that the result was not significant because $P > 0.05$. Hence, hypothesis three (H_{03}) was not rejected. It indicate that there was statistically no significant difference in the mean achievement score of male and female students taught geometric shapes using Videodisc Mediated Instructional Strategy (VDMIS).

Discussion

The result of the analysis of covariance on the performance of students taught geometric shapes using Computer Assisted instructional Packages and Videodisc Mediated Instructional Packages and those taught with the Conventional Classroom Instruction indicated a significant difference in favour of the students in the experimental groups.

Also in the case of the Computer Assisted Instructional Package the result shows that, there is

no significant difference between the mean achievement scores of students taught using CAIS and Conventional method. The result is in agreement with the findings of Jarvis (2009), Adegoke (2011) and Yusuf and Afolabi (2010), which found and reported that there was significant differences in the mean achievement scores of male and female students taught using CAIS. Similarly, the findings agree with the studies of Ajala and Eraywoke (2010) on Integrated Science, Hunter, (2008) in Mathematics confirmed that CAIS has been effective in enhancing students' performance in other subjects than the conventional classroom instruction. However, when similar comparison was made between VDMI and CAI, it is shown to be in favour of experimental 1 which is VDMI. This means that there is no significant differences in the achievement of students taught geometry using Videodisc Mediated Instructional Package could be attributed to the fact that they are more focused, conscious and committed when learning from this package than the Computer assisted Instructional Package or Conventional Method. Similarly, a video presentation embedded with graphics, pictures, sound effect and narration hold the Key to better assimilation and retention of knowledge especially when students are conversant with the control features such as play, pause, forward, repeat and next.

The above result is in agreement with previous findings of Al Sharaideh (2011), Kopcha (2010), Kali and Linn (2009) who reported that videodisc have the potentials of increasing the probability that students will learn more, retain better and even improve their performance of the skills they are expected to develop. The findings was also in agreement with the findings of Egunjobi (2002) who found that a combination of audio, video and print media mode of instruction is more effective than the audio or print mode alone.

Conclusion

The result of the study brought about the following;

- (i) The effect of using the videodisc mediated instructional package and the computer assisted instructional package researcher has been positive and effective in teaching geometry than the conventional lecture method.
- (ii) The use of the package has helped provided empirical basis for maximizing classroom teaching and learning of mathematics, especially geometry.
- (iii) The videodisc mediated and computer assisted instructional package has given both the male and female students the ample opportunity to study at their own pace.
- (iv) It was evident from the research work that the groups taught with videodisc mediated and computer assisted instructional packages performed significantly higher than those taught using conventional method.
- (v) Gender was not a factor that could have annul the positive effect of the use of videodisc mediated and computer assisted instructional as it bridge the gap between male and female students.

Recommendations

Based on the outcome of this study, the following recommendations are made:-

- (i) Mathematics teachers should endeavor to use VDMIS in presenting Mathematics lessons especially Geometry in schools to arouse the love for Mathematics by students.
- (ii) Necessary attention should be accorded to the effective use of electronic media and computer literacy and the operation in the secondary schools. Also, videodisc instructional packages and computer assisted instructional packages should be developed for use within the Nigerian school systems.
- (iii) Nigerian public schools should be equipped with necessary ICT facilities to leverage the potentials of ICT in Nigerian schools.

maintenance of modern teaching facilities. As such, government should ensure the training of teachers through the organizing of seminars and workshops in the area of effective use of modern technological teaching equipment and materials.

- (v) Adequate fund should be provided by the government, non-governmental organizations and international organizations in the provision of enabling environment, sufficient man-power and enough instructional media resources to schools.
- (vi) Government should ensure the availability of steady power supply in order to keep the machines alive for adequate utilization in teaching with the videodisc mediated instructional packages and computer assisted instructional packages.

References

- Abimbola, I. O. (1988). The role of computer in education in Nigeria. *National Journal of Technical Education*, 5(1 & 2), 26 – 33.
- Achebe. A. E. (2005). *Effect of videotape instructional package on achievement and retention in food and nutrition at senior secondary school level in Minna, Niger State*. An M. Tech Thesis submitted to the department of science and science education, Federal university of technology, Minna, Nigeria.
- Adegoke, B. A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in Physics. *European Journal of Educational Studies*, 3(3), 537 – 541.
- Yusuf, M. O. & Afolabi, A. O. (2010). Effects of computer assisted instruction on secondary student' achievement in Biology. *TOJET: The Turkish Online Journal of Educational Technology*, 9(1), 1 - 8.
- Aguisiobo, B. C. (2000). The level of use of resources utilization in integrated science master plan. *Journal of Science Teacher Association of Nigeria*, 27(2), 50 - 53.
- Ajaja, O. P, & Eravwoke, O. U. (2010). Effects of cooperative learning strategy on junior secondary school student's achievement in integrated science. *Electronic Journal of Science Education*, 14(1). Retrieved from <http://eise.southwestern.edu>
- Akour, M. A. A. (2006). The effects of computer assisted instruction on Jordanian college students' achievement in an introductory computer science course. *Electronic journal for the Integration of Technology in Education*, 5, 17 - 24. Retrieved July 20, 2008, from <http://ejite.isu.edu/volume5/Akourpdf>.
- Al Sharaideh, S. T. S. (2011). The impact of using computer-assisted programs for teaching national education in Jordanian schools. *Institute of Interdisciplinary Business Research*, 8(3), 860 - 873.
- Aluko, K. O. (2004). *Effects of cooperative learning and individualistic instructional strategies on student's problem solving abilities in secondary school chemistry in Ilesa*. Unpublished PhD Thesis, Department of Curriculum Studies and Education Technology, University of Ilorin
- Awe, B. (1990). The role of Nigerian women in management. *Management in Nigeria*, 26(6), 8 - 11.

- Ayogu, Z. U. (2000). Enriching science technology and mathematics education. The role of new media. *Journal of STAN*, 42(2), 18.
- Bada, T. A. (2006). *The effects of locally produced interactive instructional package and demographic variables on the acquisition of textile design skills of junior secondary school students*. Unpublished Ph.D Thesis, ObafemiAwolowo University, Ile-Ife.
- Bailozor, R. C., Fine, L. P. & McLaughlin, T. F. (1991). An analysis of computer assisted on scholastic aptitude test performance of rural high school students. *Education spring* 111, (3) 400 - 403.
- Batchhelder, J. S. (2000). Efficacy of a computer assisted instruction program in a prison setting: An experimental study. *Adult Education Quarterly*, 50 (2), 120 - 129.
- Baynes, J. F. (1999). The development of a Van Hiele - based summer geometry program and its impact on student van Hiele levels in achievement in High School Geometry.
- Berge, Z. (1995a). Facilitating computer conferencing: Recommendations from the field. *Educational Technology*, 35(1), 22 - 30.
- Boaler, J. (2008). Promoting 'relational equity' and high mathematics achievement through an innovative mixed-ability approach. *British Educational Research Journal*, 34, 167 - 194.
- Brown, M. D. (1999). The relationship between traditional instructional methods, contract activity packages and mathematics levels in achievement of fourth grade students.
- Busturk, R. (2005). The effectiveness of computer assisted instruction in Introductory Statistic. *Educational Technology and Society*, 8 (2), 170 - 178.
- Egunjobi, A. O. (2002). *The efficacy of two computer-assisted instructional modes on learners' practical geography achievement at the secondary school level in Ibadan metropolis, Nigeria*. Paper delivered at NAEMT conference, 20,23, 12-22.
- Ezeliora, B. (2010). Motivating secondary school science teacher to face the challenge of the Third Millennium. *Journal of Science Teachers Association Niger*, 39(1&2), 14 - 18.
- Gambari, A. I., Ezenwa V. I. & Anyanwu, R. C. (2014). Comparative effects of two modes of computer-assisted instructional package on solid geometry achievement. *Contemporary Educational Technology*, 5(2), 110 - 120.
- Hunter, R. (2008). Facilitating communities of mathematical inquiry. In M. Goos, R. Brown, & R. Makar (Eds.), *Navigation currents and charting directions* (Proceedings of the 31st annual Mathematics Education Research Group of Australasia conference, Vol. 1, pp. 31-39). Brisbane Australia: MERGA.
- Jarvis, p. (ed.) (2009), *The Routledge International Handbook of Lifelong Learning*. London: Routledge.
- Kell, Y. & Linn, M. C. (2009). Designing effective visualizations for elementary school science.

- Karper, C., Robinson, E. H. & Casado-Kehoe, M. (2005). Computer assisted instruction and academic achievement in counselor education. *Journal of Technology in Counseling*, 4 (1), 12 - 15.
- Kopcha, T. J. (2010). A systems-based approach to technology integration using mentoring and communities of practice. *Education Technology Research and Development*, 58, 175 - 190.
- Martin, T. S. (Ed.) (2007). *Mathematics teaching today: Improving practice, improving student learning (2nd ed.)*. Reston, VA: Author.
- National Council of Teachers in Mathematics (2010). *Principles and standards for mathematics in secondary schools*. Abuja: Addis Publishing.
- Nsofor, C.C. (2010). *Effects of developed instructional media on Niger State secondary school students achievement in biology*. Unpublished Ph.D Thesis Minna Federal University of Technology.