*IOSR Journal of Research & Method in Education (IOSR-JRME)*
*e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 9, Issue 5 Ser. I. (Sep. - Oct .2019), PP 24-37*
*www.iosrjournals.org*

# Effects of Computer Assisted Instruction (CAI) On Achievement and Retention of Students with Hearing Impairment in Computer Studies

NWEKE Nkiruka Maureen[1], OKEKE S.O.C[2]., ANUSIUBA Ifeanyi Overcomer[3], EGBO Faith Nnenna[4]

*1-Community High School, Nsugbe, Anambrastate, Nigeria*
*2 – Department of Science Education, Faculty of Education, NnamdiAzikiwe University, Awka, Nigeria*
*3 – Department of Computer Science, Faculty of Physical Sciences, NnamdiAzikiwe University, Awka, Nigeria*
*4- Living Stone International School, Onitsha, Anambra state, Nigeria*

***Abstract:****The study investigated the effects of computer-assisted instructional strategy on achievement and retention of students with hearing impairment. Four research questions and six hypotheses guided the study. The quasi-experimental design was used in the study. A sample of 25 SS 2 computer studies students with hearing impairment from Onitsha and Awka Education Zones was used in the study. The instrument for data collection was Computer Studies Achievement Test (CSAT) validated by two lecturers in Science Education Department from NnamdiAzikiwe University, Awka and one experienced computer studies teacher in the school of students with hearing impairment. The reliability of CSAT was established using Kudder-Richardson formula 20 for CSAT to be 0.84. The data obtained was analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The results showed indicated that there is significant difference between the mean achievement and retention scores of students with hearing impairment taught computer studies using computer-assisted instructional strategy and those taught with sign language in favour of computer-assisted instructional strategy. There was also significant influence of gender on the achievement and retention scores of students with hearing impairment taught computer studies using computer-assisted instructional strategy and those taught with sign language. The study recommended that seminars and workshop should be organized for computer studies teachers in order to help them become acquainted with the use of computer-assisted instructional strategy and effectively adopt them in the teaching and learning process of students with hearing impairment.*

***Keywords:*** *Computer assisted instruction, computer studies, hearing impairment, achievement, retention*

---

Date of Submission: 26-08-2019 Date of Acceptance: 10-09-2019

---

## I. Introduction

The indispensable nature of education in the 21st century demands that every human being in the world irrespective of gender, race, ability or disability ought to be educated. Every country of the world develops instructional curriculum and programme in an effort to make education systematic, organized and effective in meeting the goals of education. However, the instructional curriculum developed in some country especially Nigeria do not have special focus for students with disabilities. The disabilities could be physical, psychological, emotional, spiritual, or medical. The commonest cases that constitute a major challenge in teaching students with disabilities are those of the blind and dumb and those with hearing impairment (Spencer &Marschark, 2010).

Hearing impairment is a global term which includes both deaf and hard of hearing individuals and refers to any type or degree of hearing loss ranging from slight to profound (Schafer & Bryant, 2013). This term has been used by the medical community to describe a deviation in either auditory structure or auditory function, usually outside the range of normal hearing. Many different assistive technologies are available to those who are hearing impaired. People with cochlear implants and hearing aids or neither of these can also use additional communication devices to reduce the interference of background sounds, or to mediate the problems of distance from sound and poor sound quality caused by reverberation and poor acoustic materials of walls, floor and hard furniture (Lewis, Manninen, Valente, & Smith, 2014). Hearing aids are used by students who have some residual hearing. The hearing aid amplifies all sounds and does not distinguish between wanted and unwanted sounds (Spencer &Marschar, 2010). Background noise is equally amplified and therefore, hearing aid may be of little or no use in noisy situations. Radio microphone is another instructional medium for the hearing-impaired (Jing-Ming, 2009).

Students with hearing impairment just like other students with disabilities have hearing challenges peculiar to them. The researcher observed that although, students with hearing impairment may perform well in a quiet setting using hearing devices, a classroom setting is typically noisy, with fast-paced peer-to-peer conversations and teachers that move about the classroom, causing significant listening challenges. It has been reported also that students with typical hearing impairment problems require considerable listening effort when listening at noise level typical of the school classroom (Fraser, Gagne, Alepins, Dubois, 2010; Howards, Munro, &Plack, 2010; Picou, Rickettes, & Hornby, 2011). In such cases, the students concentrate more on watching and processing visual cues required for speech recognition or sign communication. Visual processing of information however requires cognitive faculties and resources from the students, and when the information is overloaded or at a pace greater than that of the cognitive capacity (working memory of the learner), speech recognition becomes slow for hearing impaired student listening and watching at the same time (Schafer & Bryant, 2013).

Thus, students with learning impairment who expend more effort learning may decrease their potential to satisfy learning demands and thereby feel frustrated when the expected rewards for learning as expected are not received (Spencer &Marschark, 2010). In Anambra state, there are four school where students with disabilities are taught. In these schools, the researcher observed the teacher still stick to the traditional sign language. The problems therefore become how can the students learn and improve their achievement by mere observation.

Academic achievement is the outcome of learning. It is often an expression of what the students have gained from an educational programme or lesson. The achievement of students have been shown to be affected by innumerable factors amongst which the instructional approach, availability of laboratory materials, and teacher's mastery of subject area and instructional techniques hold prominent place (Adegoke, 2011). For students with hearing impairment, many factors both teacher and student related have been implicated as affecting their achievement (Omoniyi&Oluniyi, 2012) in various subject areas including Computer studies.

Computer studies deals with computer devices, their operation and application in solving different problems to the benefit of the user and others. The importance of computer studies cannot be over-emphasized in the contemporary world of technological advancement. Students despite the importance of computer studies lack computer literacy, and interest in computer studies and have low achievement. It is thought that the major problem is that of lack in adequate computer laboratory for practising the computer studies concepts taught. This is so because computer studies learning demands doing and frequent practical exercises. One can therefore imagine how much challenge students with hearing impairment face in the learning of computer studies given that they cannot function effectively in one sense. Worse still is the absence of specially designed programme for teaching such concepts to students with hearing impairment, absence of power to practice where the instrument is available and teachers' lack of skill in managing such special students. These challenges have not only resulted in the under-achievements of students with hearing impairment (Lewis, Manninen, Valente, & Smith, 2014) but may also affect their retention of learning.

Retention is simply the ability of students to recall what has been learnt over a period of time. Research findings indicate that the strongest factors that correlate retention are academic-related skills, academic self-confidence, and academic goals (Omoniyi&Oluniyi, 2012). Academic related skills include study skills, time management skills, and study habits. Self-confidence is defined as the belief in one's ability to perform well in school. Study skills are defined as the extent to which you believe you know how to assess an academic problem, organize a solution, and successfully complete academic assignments (Lotkowski, Robbins, &Noeth, 2004). However, students with hearing impairment where they are isolated bear low self-concept and study skill as they cannot prove so competitive to students who have no disabilities (Bettinger& Long, 2009). Also, using one sense (eye) in learning limits the level of content to be learnt and this thought dwindles the perceptions of self, thus, low self-efficacy.

Another important factor affecting retention is the quality of interaction a student has with a concerned person and with others (Bettinger& Long, 2009). Such activities that can bring students together make it possible to create a social learning environment and a community where institutional goals are met and achievement improved. Students with hearing impairment cannot fit in with students without any impairment as their pace of communication often limits their ability to contribute meaningfully to such social gathering. Even when isolated and in special schools for such disabilities, students do spend less of their time communicating in the bid to meet the days' learning and exercises accompanying such learning. Therefore, in the light of the on-going discourse on the challenges of the students with hearing impairment, the connections that the technology provides for teachers and students are important.

Technological adjustments in education are quite innovative. Concepts like online-distance learning, virtual classrooms, use of simulations and interactive white boards are becoming well known. These applications of the technological advancements in teaching and learning provides a rich learning experience for the learner even those with impediments. One of such technologies that is becoming common is the use of

computer assisted instruction. Computer assisted instruction is one of the technological advancement in recent time that could be beneficial and could attend to students with hearing impairment.

Computer assisted instruction (CAI) can be defined as an automated or manual instructional strategy whereby an electronic machine (computer) is used to aid instructional process. According to Ahiatrogh, Madjoub and Bervell (2013) CAI is one way computer may be used in teaching and learning. In this kind of instructional approach, the lesson is student-centred but teacher-directed. A number of approaches are common with CAI, such as: the use of information packed CD ROM, simulations, animations, graphics, test, sounds and video instruction. It may also involve the projection of lesson contents to be viewed by the students.

In this study, the concept of CAI involved the teacher's projection of the lesson contents while using animated texts, graphics and video and simulation tutorials. The teacher while projecting these contents simultaneously explained to the students the concept being taught. The teacher repeated some of the animated text and graphics as need be to emphasize on the content being taught and to ensure students' mastery. Students with hearing impairment were allowed to view the contents projected and sometimes are engaged on a discussion about what they have observed unlike what was obtainable with the sign language which was their traditional mode of learning.

Sign languages (also known as signed languages) are languages that use manual communication to convey meaning. This can include simultaneously employing hand gestures, movement, orientation of the fingers, arms or body, and facial expressions to convey a speaker's ideas (Aronoff, Meir & Sandler, 2005). Sign languages often share significant similarities with their respective spoken language, such as American Sign Language (ASL) with American English. Grammar and sentence structure, however, they may vary to encourage efficiency and fluidity in speaking. Sign language is often used for hearing impaired students.

The students with hearing impairment in Anambra state are few. More so, there is no department under the Post Primary School Service Commission (PPSSC) Anambra state nor Post Primary Education Board in the Education Zones that are devoted to students with disabilities. Thus, there is the likelihood that government projects and funding of education barely get to these schools. Research focus directed at innovating teaching methods to improve achievement and interest for students with hearing impairment are lacking in Awka Education Zone and Onitsha Education Zone delimited for this studies. On visit to the schools in both Education Zones (Awka and Onitsha), the researcher observed that the number of students in the school and the rate of enrollment have dwindled.

The teachers in the schools complained that they lack the necessary facilities to teach students with disabilities including those with hearing impairment. The hearing impaired students therefore manifest many learning needs which are often not met in the classroom. When learning demands are not met over time with a feeling of frustration and anxiety, academic achievement dwindles. It is hoped that, by effectively integrating CAI into teaching and learning, students' achievement, interest and retention for male and female students alike may improve. Gender predictions of achievement have remained inconclusive (Maduabum, 2006). Studies focusing on gender differences for students' with hearing impairment are rare especially when CAI is used. This study therefore, examined further, the gender differences in achievement and learning retention among hearing impaired students.

## II. Purpose Of The Study

The purpose of this study was to investigate the effect of Computer Assisted Instruction (CAI) on the achievement and retention of students with hearing impairment. Specifically, the study sought to find out the:

1. Difference in the mean achievement scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language.
2. Influence of gender on mean achievement scores of hearing impaired students in computer studies.
3. Interaction effect of teaching methods and gender on the achievement of hearing impaired students in computer studies.
4. Difference in the mean retention scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language.
5. Influence of gender on the mean retention scores of hearing impaired students in computer studies.
6. Interaction effect of teaching methods and gender on the retention of hearing impaired students in computer studies.

## III. Research Questions

The following research questions guided the study.

1. What are the mean achievement scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language?
2. What are the mean achievement scores of male and female hearing impaired students in computer studies?
3. What are the mean retention scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language?

4. What are the mean retention scores of male and female hearing impaired students in computer studies?

## IV. Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference in the mean achievement scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language.
2. There is no significant difference between the mean achievement scores of male and female hearing impaired students in computer studies.
3. There is no significant interaction effect of teaching methods and gender on the achievement of hearing impaired students in computer studies.
4. There is no significant difference in the mean retention scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language.
5. There is no significant difference between the mean retention scores of male and female hearing impaired students in computer studies.
6. There is no significant interaction effect of teaching methods and gender on the retention of hearing impaired students in computer studies.

## V. Literature Review

### *Theoretical Framework*

**Cognitive Theory of Multimedia Learning (CTML)**

The Cognitive theory of multimedia learning (CTML) was developed principally by Richard E. Mayer in 2005. The CTML states that words and graphics are more conducive to learning, rather than just text or graphics alone. The CTML is based on the idea that learners learn better and meaningfully when they engage in relevant cognitive processes attending to the relevant information or materials in the lesson, mentally organizing the material into a coherent cognitive representation and mentally integrating the material with their existing knowledge. The idea promulgated by Mayer is that students irrespective of their condition can learn better when a combination of media is used to teach them. The use of mix media is thought to be beneficial to students with hearing impairment.

The implication of the theory to this study is that hearing impaired students often use only their visual senses to learn, to provide for meaningful learning therefore, requires a visual approach that would arouse interest, sustain it, improve achievement and facilitate retention. One such approach to teaching and learning that could be used to achieve such goal for hearing impaired students is through the use of Computer Assisted Instruction. This underscored the need to examine the effect of CAI on achievement, retention, and interest of hearing impaired students.

### *Empirical Studies*

**Studies on the effect of CAI on achievement of students with hearing impairment**

Alongkorn, Wiphasith, Nipon, and Tongluan (2014) examined the development a Computer Assisted Instruction with drill and practice for English teaching to primary school grade 6 students with hearing impaired. The purposes of the study were specifically to: develop a Computer Assisted Instruction (CAI) program that incorporated drilling and practice, compare the learning achievement of students before and after using the newly- developed CAI with drilling and practice, and determine the satisfaction (interest) of hearing-impaired students with that CAI with drilling and practice. The design of the study was the ADDIE model comprising five steps of analysis, design, development, implementation and evaluation. The area of the study was Thailand. The population of the study consisted of all the forty (40) hearing impaired students in primary schools at the Surin Deaf schools, Bereau of Special Education, Thailand. The sample size for the study comprised twenty (20) hearing impaired primary school students from grade 6 at the Surin Deaf School during the 2011 academic year.

The instruments for the study were the newly-developed CAI that incorporated drilling and practice, a student-taken achievement test, and a questionnaire for evaluating the student's satisfaction with the program. In the experimental procedure, the students were provided with computers. They learnt and did the exercises on the topics: my story, my family, animals and good health. Each lesson consists of the learning objectives, pre-test, contents, quizzes, post-test, and reported grades. CAI was used by the sample group for three weeks: 3-4 days/week: 1.5-2 hours/day during the first semester of academic year 2011. After the treatment, posttests were administered. The data obtained were analyzed using t-test. The results revealed that CAI improved the achievement of the students significantly and their mean achievement scores were higher in the posttest (43.25) than in the pre-test (14.45). The results further revealed that positively affected and improved the students' interest for learning.

The study used the same sample all through the study and established the effect of the treatment by comparing the achievement scores of the students in the pretest and posttest. This method of comparism did not

take into account, the students' initial imbalances among the students and this may have affected the outcome of the study. In the current study, analysis of covariance was used to check initial group differences among the students. Also, CAI was applied in the subject area of Computer studies at senior secondary school level of education.

Omoniyi and Oluniyi (2014) examined the impact of Captioned Video Instruction on Nigerian hearing-impaired pupils' performance in English language. The objectives of the study were to investigate the effect of captioned video instruction on Nigerian hearing-impaired pupils' performance in English language. The design of the study was quasi-experiment, pretest posttest design. The area of the study was Sagamu town of Ogunstate, Nigeria. The population of the study consisted all the students with hearing impairment in primary school in Sagamu area of Ogun state. The sample for the study comprised 40 students from two primary schools chosen purposively. The instrument for data collection was a Primary English Performance Test (PEPT), consisting of 20 objective test items drawn from field validated Common Entrance Examination Questions produced by the State Ministry of Education, the captioned video instruction and lesson plans which were face validated by experts in Educational Technology, Special Education and Educational Evaluation from OlabisiOnabanjo University, Ago-Iwoye, Ogun State and the University of Ibadan, Oyo State, Nigeria.

The treatment procedure involved exposing the students to topics in English Comprehension and grammar, drawn from the past questions of 2003-2008 Common Entrance Examinations and divided into six lessons for this study using captioned video and conventional teaching methods. For the experimental group, Video discs were developed using sign language, body language and lip reading, with the captions in bold typeface and written in English language. A pre-test was administered before commencement of the treatment and post-test after the treatment. The performance scores of the pupils in PEPT were analyzed using descriptive Statistics and Analysis of Variance.

The findings of this study revealed that there was no significant effect of captioned video instruction on hearing impaired students' performance in English Language ($F(1.35) = 2.063$; $p > .05$). Also gender did not significantly influence hearing impaired students' performance in English language ($F1.35) = 2.245$; $p > .05$). The result further indicated that there was no significant two-way interaction effects of treatment and gender ($F(1.35) = .600$; $p > .05$) on hearing impaired students' performance in English Language. The current study adopted similar approach as used in this study except that the lesson content was projected via a projector as teacher interacts with the students and in the subject area of computer studies.

Jing-Ming (2009) investigated the effects of multimedia stories of Deaf orHard-of-Hearing Celebrities on the ReadingComprehension and English Words Learning ofTaiwanese Students with Hearing Impairment. The main purpose of this study was to improve the reading comprehension and to increase theEnglish vocabulary of students with hearing impairment; with the sub-goal of encouraging them tostrive for success. The design of the study was quasi-experimental. The area of the study was Taichung City in Taiwan. The population of the study was all the students with hearing impairment in the elementary schools in Taichung City. The sample for the study comprised eight (8) students with hearing impairment in elementary schools in Taichung city. The instrument for the study were Assessment of English word recognition, English word listening, comprehension, English word lip-reading administered as multiple choice questions, five point likert scaled attitude questionnaire, and multimedia stories of Taiwanese deaf or hard-of-hearing celebrities including famous models, professor, teachers, athletes, a computer programme with an illustrator and deaf leader. The instruments were validated and the reliability of the assessment test established.

The experimental procedure involved two itinerant special education teachers visiting the eight hearing-impaired students separately for two hours a week, and taught the students a story for about an hour each week. Prior to teaching, the students were assessed in main idea identification, English word pronunciation, English word recognition, English word listening comprehension and English word lip-reading. The students were given the stories in Chinese on paper and asked to write the main ideas and English words on paper to read aloud for the assessment of pronunciation. Assessment of English word recognition, English word listening comprehension, and English word lip-reading was administered as multiple-choice items. During the computer assisted instruction students read from the screen and teachers encouraged them to guess and click on the English key words for their meanings and pronunciations. The teachers also explained unfamiliar Chinese words. The main ideas, the stories' implications and important details were discussed with the help of the graphical organizers. After teaching, the students were assessed in main idea identification and English word pronunciation, recognition, listening comprehension, and lip-reading the same way as in the pre-test.

The assessment, teaching and re-assessment lasted for eight weeks, as there were eight stories. After the last reassessment, a questionnaire was administered to the students to find their attitude toward the computer assisted instruction of multimedia stories of Taiwanese deaf or hard of hearing celebrities. Two weeks later, a follow-up assessment in English word pronunciation was administered to test the maintenance effect. The whole experiment lasted for ten weeks from beginning to end. The data obtained were analysed using mean, standard deviation and analysis of variance (ANOVA).

The results of the study revealed that the post-test was significantly higher than the pre-test in English word recognition, English word listening and comprehension; students improved from 13.7500 to 31.6250, in English word lip-reading improving mean scores from 17.3750 to 32.6250, in English word pronunciation improving from 6.8813 to 64.6875. The results also revealed that their attitude was positive and significantly improved toward English language learning. In this study, similar approach was used but only multimedia videos, motion pictures and simulations were displayed on a projector for the students on Computer studies concepts to be taught. Also secondary school students class II in their intact classes were used in the study. The current study did not also measure students' attitude but measured interest as affected by the use of CAI.

Gentry, Chinn, and Moulton (2005) examined the effectiveness of multimedia reading materials when used with children who are deaf. The purpose of the study was to assess the relative effectiveness of print, sign, and pictures in the transfer of reading-related information to children who are deaf by means of personal computers and CD-ROM-generated stories in four different formats: print only, print plus pictures, print plus sign language, and print plus pictures plus sign. The design of the study was a repeated measure design. The area of the study was Louisiana and Texas. The population of the study consists of all the deaf students in Louisana and Texas, United States of America. The sample for the study comprised twenty eight deaf students between ages 9 – 18 who were recruited form the mainstream settings and from residential, non-integrated school settings.

The study participants met three criteria: (a) third-to-fourth-grade reading levels as determined by scores on the Stanford Achievement Test for the Hearing-Impaired (SAT-HI); (b) at least "average" IQ as documented on 3-year multidisciplinary evaluations provided by the participating school systems; and (c) use of sign language as the primary means of communication, as reported by the classroom teacher.

The treatment procedure involved the use of Multimedia stories on CD-ROM as stimuli. The stories were at the third-grade reading level, as determined by the readability scale on WordPerfect 7.0 word-processing software. Specifically, children's stories were embedded in CD-ROM in a three-media format. Media formats included printed words, pictures, and sign language. Multimedia options allowed the participants to access specific prompts presented in each of four treatments:

• Treatment 1: print only
• Treatment 2: print and pictures
• Treatment 3: print and digital video of sign language
• Treatment 4: print, pictures, and digital video of sign language

American Sign Language (ASL) or Signed English options (or both) were available to the participants under treatments 3 and 4. The transfer of factual information was measured by a story-retelling activity suggested by Morrow (1988). Participants were asked to recall or retell various aspects of the stories that were presented through the multimedia treatment options. Accuracy in retelling was determined by scoring specific features (such as setting, plot, theme, and sequence of the story) and subheadings under features (such as main character). Story retelling was documented by means of a score sheet. To prevent confounding test-order effects, the four treatments were presented in random order to each participant. In all treatment conditions, participants received CD-ROM-generated presentation options via a personal computer and were allowed to work at their own pace. During each treatment, each participant worked independently. For those treatments containing more than a single option (treatments 2–4), the participant was permitted to move freely among options. Upon completion of each treatment, each participant used sign language to retell the story to the investigator.

The retelling was videotaped for future scoring. Rater error was assessed through interrater reliability measurement. Cohen's kappa procedure was used to compare reliability. The resulting Cohen's kappa score of 95 indicated acceptable reliability among the three raters. A repeated measure analysis of variance (ANOVA) design was used to assess retelling scores under the treatment options. An acceptable alpha level for significance was designated at .01. Tukey's post hoc analysis was performed to determine specific areas of significance.

The results of the study revealed significant differences between treatments at a $p$ value of .00001 ($df$= 3; $F$ = 22.27). That is, participants performed significantly differently when retelling stories presented to them through the different treatment options. The Tukey post hoc analysis indicated significant differences for story retelling when treatment 1 was compared to treatments 2 and 4. Significant differences were also found when treatment 3 was compared to treatments 2 and 4. There were no significant differences for story retelling between treatment 1 and treatment 3. There were no significant differences between treatment 1 and treatment 3 nor were there significant differences between treatment 2 and treatment 4. The results indicated that comprehension was weakest when the stories were presented in a print-only format. Comprehension was strongest when stories were presented in the print with pictures format.

The findings suggested that multimedia presentation of reading material is significantly more effective for reading comprehension than is the use of print only. However, the findings also suggest that the use of multimedia presentation is not significantly better than the use of print plus pictures alone. This approach used in this study is quite different from the current study both in design, experimental procedure, subject area and

level of study. While is used interraters' assessment method to evaluate the students, the current study will make use of an achievement test. The treatment procedure was categorised into two groups taught as two different groups and obtained data was analysed using analysis of covariance.

**Studies on the effect of CAI on retention of students**

Gambari, Falode, and Adegbenro (2014) examined the effectiveness of computer animation and geometrical instructionalmodel on mathematics achievement and retention among juniorsecondary school students. The purpose of study was to investigate the effectiveness of computer animation package and geometry instructional model on the achievement and retention of junior secondary schools students in mathematics. Four hypotheses guided the study. The design of the study was pretest posttest and delayed posttest design. The area of the study is Minna, Nigeria. The population of the study consisted of all public coeducational junior secondary schools in Minna, Nigeria. The sample size for the study comprised 60 students from three public coeducational junior secondary schools obtained through stratified random sampling.

The instruments for data collection were Geometry Achievement Test (GAT) and Computer Animation Package (CAP) designed with six topics in geometry: Cube, Cuboid, Cylinder, Cone, Sphere and Hemisphere, and Pyramid. The CAP was validated by computer programmers and educational technology experts, subject content (mathematics) specialists, and finally field tested on sample representative similar to the students used for the final study. The Geometrical Achievement Test (GAT) which consists of 40 multiple choice objective items with four options adopted from past examination of West African Examination Council (WAEC, May/June, 1988-2011) and National Examination Council (NECO, June/July, 2000-2011) were validated by experts in mathematics education and tested for reliability using 20 randomly selected JSII students outside the study.

The reliability test was established using the Kuddar-Richardson (KR-20) which yielded a reliability coefficient of 0.82. The treatment involved exposing students to the geometry concepts earlier listed using the CAP, GIM, TTM. Data collection was by means of the administration of the GAT. The method of data analysis was Analysis of variance. The results of the analysis revealed that there was significant difference in the mean achievement scores of students in the three groups (F-cal = 64.022, df = 59, p = 0.000). Scheffe'spostHoc analysis revealed that students in the CAP performed best, followed by those in GIM. The results further revealed that mean achievement scores for male did not differ significantly from that of the female counterparts when both groups were exposed to geometry using computer simulation package and GIM. Also, there was significant difference in the mean retention scores of junior secondary students taught geometry with CAP, GIM and CTM with the CAP having the highest retention scores. Computer animation package was more effective in teaching the mathematical concept of geometry, improved learners' performance, enhanced their retention, and is also gender friendly. The study differed from the current study in the subject area as the current study is similar in approach except that the study was conducted in the subject area of Computer studies and for students with hearing impairment.

Staniger (2014) investigated the impact of digital organization on retention in college algebra. The overall goal of this study was to examine the impact of technologically mediated tools to contribute to student study skills and academic self-confidence in a remedial beginning algebra course to increase retention in a college algebra course. Three research questions guided the study. The design of the study was mixed methods approach incorporating both quantitative and qualitative methods was used in this study. Quantitative methods were used to provide a mathematical analysis based on Quantifiable Affective Survey results, successful completion of Beginning Algebra and College Algebra Exit Interviews while qualitative methodologies to interpret the perspectives of the participants in terms of the effect the technologically mediated tools had on the variables. The area of the study was North Iowa. The population of the study consisted of developmental mathematics students enrolled in Beginning Algebra, an eight-week semester course, during the fall term of 2011 at a private Midwestern University.

The sample size for the study comprised 14 developmental mathematics students enrolled in Beginning Algebra, an eight-week semester course, selected using a convenience sampling technique since they enrolled in a section of the Beginning Algebra course offered in the fall of 2011. Instruments for data collection were the Student Readiness Inventory (Academic College Testing, 2008), Stages of Concern Questionnaires (SoCQ), a dimension of Concern-Based Adoption Model (George, Hall, &Stiegelbauer, 2006), and records of student successful completion of Beginning Algebra and College Algebra were collected. The instructional tools used in the study were standard pen enabled tablet PCs loaded with software including Microsoft Office OneNote, an interactive notebook created for the course, and a Microsoft Office OneNote notebook, created by the instructor to provide resources for interactive coursework, was loaded on each student's tablet PC.

Data obtained from these instruments after treatment were analysed using descriptive statistics of Quantifiable Affective Surveys, College Algebra Exit interviews, and Student Readiness Inventory (SRI) and Academic College Testing pretest and posttest scores and Pearson correlations. The results revealed that of the

100% of the Beginning Algebra students who successfully completed Beginning Algebra, 93% successfully completed College Algebra with high rate of retention.

The success of retention was reiterated when 100% of the students who responded in the College Algebra Exit interview said that they felt the technologically mediated tools in Beginning Algebra contributed to their success in College Algebra. Qualitative data analysis from the interviews indicated 75% of the responses revealed organization and efficiency as a means to sharpened study skills. Similarly, 79% revealed organization and efficiency as a means to increase self-confidence implying the positive impact of digital organization on retention in College Algebra. The researcher concluded that the technologically mediated tools used in this study were beneficial for developmental mathematics students helping them to digitally organize work to enhance study skills and academic self-confidence to improve retention in College Algebra. In the study, students' retention was obtained by their self-report of their retention rate followed by an analysis of their responses. This in the view of this researcher is not objective and therefore underlines the need for further investigation. In this study, retention scores were determined through the use of academic retention test in the subject area of computer studies for students with hearing impairment.

***Gap in Literature***

Computer assisted instruction is thought to be beneficial for students with hearing impairment as it could affect the achievement, interest and retention. Literatures reviewed showed that CAI improved achievement in various subject areas especially for English and mathematics for students with hearing impairment. However, the studies were mostly conducted outside Nigeria and were conducted using programmed educational software or application for learning. The positive effect of CAI in those studies underlined the need to further investigate whether CAI will be beneficial to students with hearing impairment in Nigeria especially for those in Onitsha and Awka Education Zones were these technologies have not been applied before. There were no studies that investigated the effect of CIA on achievement in computer studies neither were there studies that examined the use of CAI for teaching students with hearing impairment in computer studies in Onitsha and Awka Education Zone been studied. Since the importance of computer studies cannot be over-emphasized, the researcher saw the need to investigate the effect of CAI in this subject area for hearing impaired students. There were no research studies, to the researcher's knowledge on the effects of CAI on the retention of hearing impaired students in computer studies. There is need to determine whether CAI is effective in facilitating retention of learnt material. Hence, this study sought to examine the effect of CAI on achievement and retention of students with hearing impairment.

## VI. Method

***Research Design***

The design of the study is quasi-experimental. Specifically, the pretest posttest non-equivalent control group design was used. In this kind of study, it is not possible to assign subjects randomly into groups. It thus, involves the use of intact classes when variables are manipulated in order to check the resultant effects of such manipulation on other variables (Nworgu, 2015). The pretest posttest design was chosen because it helped to check initial group difference among students through the inclusion of pretest as covariates. The design of the study is given in Figure 1.

| Group | Pre-test | Treatment | Post-test |
|---|---|---|---|
| E | $0_1$ | X | $0_2$ |
| C | $0_1$ | ~X | $0_2$ |

**Figure 1: Design of the Study**

Where,
E = Experimental Group
C = Control Group
$0_1$ = Pre-test
$0_2$ = Post-test
X = Treatment – Computer Assisted instruction (CAI)
~X = Treatment- using sign language
---- = non-equivalence of the two groups

***Area of the Study***

The area of study is Onitsha Education Zone and Awka Education Zone of Anambra State. Both Education Zones are known for their commercial activities with a few private higher institutions. The Education Zones are a host to many secondary schools including special schools for students with disabilities in Onitsha and Awka. The schools include schools for students with hearing impairment which constituted the major target for the study. Also, the area serves as a host community to a number of farmers, traders and civil servants of

various classes. There are also reputable higher institutes of learning in the area such as NnamdiAzikiwe University, Awka. The Education Zones were chosen for the study because they have the highest number of hearing impaired students.

***Population of the Study***

The population of the study consisted of all the twenty-five (25) senior secondary school two (SS2) students in the special schools for students with disabilities in Onitsha and Awka South Education Zones of Anambra state.They are the special schools where the highest number students with hearing impairment are found in Anambra state. The two schools which are situated in Umuayom, Awka and Odoakpu, Onitsha were used in this study.

***Sample and Sampling Technique***

The sample size for the study is comprised of all the 25 senior secondary school II students with hearing impairment (16 from Special Secondary School for the Deaf, Onitsha and 9 from God's care Secondary School, Umuayom, Awka). Since the population was very small, the researcher used the entire SS2 students with hearing impairment in the special schools. With the toss of a coin the two schools were categorized into experimental and control groups.

***Instrument for Data Collection***

The instrument for the study was Computer Studies Achievement Test (CSAT). CSAT was made up of 20 items constructed based on the concepts of computer data conversion, file structure organization, basic operations on computer files as contained in the senior secondary school two (SSII) computer studies scheme of work. A table of specification was used to determine the lower and higher order cognitive abilities to be measured in the pool of 20 multiple choice objective test questions used in the CSAT. Also, an instructional package designed with computer assisted instruction (CAI) was prepared by the researcher for teaching the experimental group. The control group teachers' lesson plan was collected by the researcher from the regular computer studies class teacher in the control school and was used to ensure uniformity of content between what is taught among the experimental and control groups.

***Validation of the Instrument***

The initial copies of the instrument and instructional plan with the objectives of the study, research questions and hypotheses were sent to two lecturers in Science Education department, NnamdiAzikiwe University, Awka and one experienced computer studies teacher in the school of students with hearing impairment for validation. The validators were asked to vet the lesson plan and the questions in the CSAT for the appropriateness of the distractors, construct in the question items, the clarity of words and suitability for the level of learners and the conditions of learning. Their corrections, recommendations and suggestions were effected in the final copy of the instruments.

***Reliability of the Instrument***

The reliability of the instrument was established using Kuder-Richardson formula 20 (KR-20). The choice of Kr-20 reliability estimate for CSAT was because the items are dichotomously scored with heterogeneous level of difficulty. The instruments were administered once to ten (10) students with hearing impairment outside the study area at Orafite. The generated scores were tested for reliability co-efficient using the stated methods of reliability estimates. The coefficient of internal consistency obtained for the CSAT was 0.84.

***Experimental Procedure***

The experiment was conducted in two phases. The first phase was used to brief the research assistants who were the regular school teachers of the students. The second phase involved teaching of the students and administration of the instruments.

**Briefing of Research Assistants**

The briefing of the research assistant (regular class teacher for computer studies) was done in one week and in four contacts, with each contact lasting for two hours. The briefing was conducted at Special Secondary School for the Deaf (SSSFD), Onitsha. In the meeting, the CAI lesson packages for each lesson contents were used to brief the teacher using their computer systems and projector.

**Teaching of Students**

In the experimentation, students in the CAI group were exposed by the research assistants (regular computer teachers) to the computer concepts of Computer Data Conversion II, File Structure Organization, and

Basic Operations on Computer Files using CAI and those in the control group were exposed to the same content using the traditional teaching method of sign language. The students were given a pretest before the treatment without any feedback on their achievement. After the treatment they were given a posttest and retention test after 3 weeks. The interval of 3 weeks between the posttest and retention test is to ensure that the test knowledge due to the posttest does not influence the students' achievement in the retention test. The students in the CAI group were taught with a projector and computer systems which included images, videos and animations and simulations in explaining the concepts in the lessons. In each week, lesson lasted for a double period. The experiment was carried out as follows:

***Week 1:*** in the first week the students were given a pretest using the CSAT. The pretest was collated and organized for analysis. No feedback was given to the students.

***Week 2:*** in week two, students were taught the concept of computer data conversion. They were taught the meaning of data-fetch-execute cycle displaying animated text definition of the concept on the projector screen. The steps involved in data-execute-fetch cycle was demonstrated to the students using video showing the steps which will be projected on the screen. Animated text was projected sequentially to explain the factors affecting the speed of data transfer, the definition of terms relating to data and file conversion and types of data.

***Week 3:*** inweek 3, the students were taught file structure organization. Animated test and graphic was projected on projector screen to explain the meaning of file structure organization and types of file organization, criteria for file classification while a video tutorial was displayed on the screen on methods of accessing files.

***Week 4:*** for week 4, animated text and graphics was used to explain to the students the meaning of file classification and types of file classification.

***Week 5:*** in week 5, students were taught the basic operation on computer file. A video tutorial was projected to guide the students on the basic operations of opening computer file, closing computer file, retrieval of computer files, copying and viewing computer files. Animated texts were projected on the screen to explain sequential file and with a video lesson, steps to creating a sequential file was demonstrated to the students. A video was also displayed on the methods of accessing files.

***Week 6:***in week 6, a summary of all the contents taught was done and a posttest given to the students using the CSAT. The same instrument (CSAT) was administered to the students after four week of the posttest. The instrument was however, reshuffled in the question numbers and answer options and a coloured paper used for the print out in order to reduce the effect of pretest and posttest on retention test.

The control group was exposed to the same contents using the lecture method which involved sign language method. The lesson was planned after due consultations with the teacher of the control group to understand their traditional approach to teaching students with hearing impairment especially as it relates to sign language.

***Control of Extraneous Variables***

**1. Experimenter bias**: the regular computer studies teachers in the schools were used as research assistants in the study in order to reduce experimental bias.

**2. Teacher variable:** in order to control for teacher variables, the teachers taking the students on computer studies were trained on how to use the instructional plans prepared by the researcher. This helped to ensure uniformity and reduce teacher variables in the study.

**3. Hawthorne Effect:** this is where the outcome of the study is affected as a result of students being aware that they are being used in an experiment. To reduce the effect, the class teachers of the students were used.

**4. Initial group difference:** Analysis of covariance (ANCOVA) was used to control for any initial differences among the students.

**6. Effect of Posttest on retention-test:** the CSAT instrument for the study was administered after four weeks to reduce the effect of posttest on retention test.

***Method of Data Analysis***

All the research questions were answered using pretest posttest mean. The hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA). ANCOVA enabled the researcher to eliminate the initial differences among the students. The decision rule was that when P-values was less than 0.05, the null hypothesis was rejected, otherwise the reject the null hypothesis was not rejected.

## VII. Results

**Research Question 1**: What are the mean achievement scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language?

**Table 1:** Mean pre-test and posttest achievement scores of students with hearing impairment taught using CAI and Sign language

| Groups | N | Mean pretest | Mean posttest | Gain in Mean | Pretest SD | Posttest SD |
|---|---|---|---|---|---|---|
| CAI | 16 | 7.81 | 50.06 | 42.25 | 6.58 | 9.53 |
| Sign language | 9 | 12.77 | 36.11 | 23.34 | 6.67 | 4.86 |

Table 1 shows that the group taught using Computer Assisted Instruction (CAI) has gain in mean achievement score of 42.25, while those taught using sign language has gained mean score of 23.34.

**Research Question 2:** What are the mean achievement scores of male and female hearing impaired students in computer studies?

**Table 2:** Mean pre-test and posttest achievement scores of male and female students with hearing impairment

| Group | Gender | N | Mean pretest | Mean posttest | Gained Mean | Pretest SD | Posttest SD |
|---|---|---|---|---|---|---|---|
| CAI | Male | 8 | 5.00 | 50.63 | 45.63 | 3.78 | 11.16 |
| | Female | 8 | 10.63 | 48.50 | 37.87 | 7.76 | 8.02 |
| Sign language | Male | 5 | 15.00 | 37.00 | 22.00 | 7.91 | 5.70 |
| | Female | 4 | 10.00 | 35.50 | 25.50 | 4.10 | 4.08 |

Table 2 shows that the male students taught using Computer Assisted Instruction (CAI) has a gain in mean achievement score of 45.63, while the females has gain in mean score of 37.87 whereas male students taught using sign language has gain in mean achievement scores of 22.00 while the females has gain in mean achievement scores of 25.50.

**Research Question 3:** What are the mean retention scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language?

**Table 3:** Mean posttest and retention scores of students with hearing impairment taught using CAI and Sign language

| Groups | N | Mean posttest | Mean Retention | Loss in mean | Posttest SD | Retention SD |
|---|---|---|---|---|---|---|
| CAI | 16 | 50.06 | 44.38 | 5.68 | 9.53 | 8.54 |
| Lecture method | 9 | 36.11 | 32.22 | 3.89 | 4.86 | 4.41 |

Table 3 shows that the group taught using Computer Assisted Instruction (CAI) has mean retention score of 44.38 with loss in mean score of 5.68, while those taught using sign language has mean retention score of 32.22 with loss in mean score of 3.89.

**Research Question 4:** What are the mean retention scores of male and female hearing impaired students in computer studies?

**Table 4:** Mean pre-test and posttest retention scores of male and female students with hearing impairment

| Group | Gender | N | Mean posttest | Mean retention | Loss in Mean | Posttest SD | Retention SD |
|---|---|---|---|---|---|---|---|
| CAI | Male | 8 | 50.63 | 44.38 | 6.25 | 11.16 | 9.80 |
| | Female | 8 | 48.50 | 44.35 | 4.15 | 8.02 | 7.76 |
| Sign language | Male | 5 | 37.00 | 33.00 | 4.00 | 5.70 | 5.70 |
| | Female | 4 | 35.00 | 31.25 | 3.75 | 4.08 | 2.50 |

Table 4 shows that the male students taught using Computer Assisted Instruction (CAI) has mean retention score of 44.38 with loss in mean score of 6.25 while the females has retention mean scores of 44.35 with loss in mean score of 4.15, whereas the male students taught using sign language has retention mean score of 33.00 with loss in mean score of 4.00 while the female has retention mean score of 31.25 with loss in mean score of 3.75.

**Hypothesis 1:** There is no significant difference in the mean achievement scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language.

**Table 5:**Ancova on significance of observed difference in the mean achievement scores of hearing impaired students

| Source | SS | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1056.901[a] | 4 | 264.225 | 3.622 | .022 |
| Intercept | 9554.724 | 1 | 9554.724 | 130.967 | .000 |
| Pretest | 42.776 | 1 | 42.776 | .586 | .453 |
| Gender | 39.612 | 1 | 39.612 | .543 | .470 |
| Method | 989.965 | 1 | 989.965 | 13.570 | .001 |
| Gender * Method | 15.041 | 1 | 15.041 | .206 | .655 |
| Error | 1459.099 | 20 | 72.955 | | |
| Total | 51800.000 | 25 | | | |
| Corrected Total | 2516.000 | 24 | | | |

Table 5 shows that there was a significant main effect of the treatment on the achievement scores of the students with hearing impairment, F (1, 24) = 13.570**,** P <0.05. Thus, the null hypothesis was rejected. Therefore, there is significant difference in the mean achievement scores of students taught computer studies using computer-assisted instructional strategy and those taught using sign language.

**Hypothesis 2:** There is no significant difference between the mean achievement scores of male and female hearing impaired students in computer studies.

Table 5 also shows that there was no significant main influence of gender on the achievement scores of the students with hearing impairment, F (1, 24) = 0.543**,** P>0.05. Thus, the null hypothesis was not rejected. Therefore, there is no significant difference between the mean achievement scores of male and female hearing impaired students taught computer studies.

**Hypothesis 3:** There is no significant interaction effect of teaching methods and gender on the achievement of hearing impaired students in computer studies.

Table 5 further shows that there was no significant main interaction effect of teaching methods and gender on the mean achievementscores of the students with hearing impairment, F (1, 24) = 0.206**,** P>0.05. Thus, the null hypothesis was not rejected. Therefore, there is no significant interaction effect of teaching methods and gender on the achievement of hearing impaired students in computer studies.

**Hypothesis 4:** There is no significant difference in the mean retention scores of hearing impaired students taught computer studies using computer-assisted instructional strategy and those taught using sign language.

**Table 6:**ANCOVA on significance of observed difference in the mean retention scores of hearing impaired students

| Source | SS | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 864.926[a] | 4 | 216.232 | 3.502 | .025 |
| Intercept | 8213.286 | 1 | 8213.286 | 133.001 | .000 |
| Pretest | 7.426 | 1 | 7.426 | .120 | .732 |
| Gender | 4.674 | 1 | 4.674 | .076 | .786 |
| Method | 798.959 | 1 | 798.959 | 12.938 | .002 |
| Gender * Method | .654 | 1 | .654 | .011 | .919 |
| Error | 1235.074 | 20 | 61.754 | | |
| Total | 42100.000 | 25 | | | |
| Corrected Total | 2100.000 | 24 | | | |

Table 6 shows that there was a significant main effect of the treatment on the retention scores of the students with hearing impairment, F (1, 24) = 12.938**,** P <0.05. Thus, the null hypothesis was rejected. Therefore, there is significant difference in the mean retention scores of students taught computer studies using computer-assisted instructional strategy and those taught using sign language.

**Hypothesis 5**: There is no significant difference between the mean retention scores of male and female hearing impaired students in computer studies.

Table 6 also shows that there was no significant main influence of gender on the achievement scores of the students with hearing impairment, F (1, 24) = 0.076**,** P>0.05. Thus, the null hypothesis was not rejected. Therefore, there is no significant difference between the mean retention scores of male and female students taught computer studies.

**Hypothesis 6:** There is no significant interaction effect of teaching methods and gender on the retention of hearing impaired students in computer studies.

Table 6 further shows that there was no significant main interaction effect of teaching methods and gender on the mean retention scores of the students with hearing impairment, F (1, 24) = 0.011**,** P>0.05. Thus, the null hypothesis was not rejected. Therefore, there is no significant interaction effect of teaching methods and gender on the retention of hearing impaired students in computer studies.

## VIII. Discussion

The findings of the study indicated that there is significant difference between the mean achievement scores of students with hearing impairment taught computer studies using computer-assisted instructional strategy and those taught using lecture method (sign language). The positive effect of computer-assisted instructional strategy on the achievement of students with hearing impairment is observed because of the aid which computer-assisted instructional strategy avails the students with hearing impairment in the learning process. Students with hearing impairment concentrate more on watching and processing visual cues required for speech recognition or sign communication. Schafer and Bryant (2013) noted that such visual processing of information however requires cognitive faculties and resources from the students, and when the information is overloaded or at a pace greater than that of the cognitive capacity (working memory of the learner), speech recognition becomes slow for hearing impaired student listening and watching at the same time. The use of computer-assisted instructional strategy brings the learning to the pace of the learners. The students interact with the learning materials at a pace due to them individually. The simulation of the learning materials also reduced cognitive load as the use of simulations and multimedia remove the abstraction associated with understanding some of the computer studies concepts taught.

The use of computer-assisted instructional strategy makes lessons more elaborate through the use of multiple media and which is more appropriate for students with hearing impairment who can only benefit from the visual aspect of the instructional approach (Gokhan, 2012). Also, the drill and practice common in the use of computer-assisted instructional strategy enabled the students with hearing impairment to evaluate their own learning and know their weaknesses and strength. Also, the combinations of videos, texts, and graphics in the learning process provided the students with rich learning experiences that facilitated proper understanding of the lesson contents. According to Philip, Jackson & Dave (2011) computer-assisted instructional strategy enhances learning through the overall positive motivational factors associated with technology integration into the curriculum. They claim that CAI improves achievement through increased motivation. computer-assisted instructional strategy improves motivation through is rich context of instruction, challenging and stimulating curiosity.

The findings of this study support the finding of Alongkorn, Wiphasith, Nipon and Tonguing (2014) who revealed that CAI improved the achievement of the students with hearing impairment significantly. The findings of this study also supports that of Jing-Ming (2009) whose results revealed that the post-test was significantly higher than the pre-test of students with hearing impairment when taught using computer-assisted instructional strategy. The findings of this study lend credence to those of Gentry, Chinn, and Moulton (2005) whose report revealed significant difference when students with hearing impairment are taught using computer-assisted instructional strategy. The findings of the study however contradicted that of Omoniyi and Oluniyi (2014) who reported no significant difference in the mean achievement of students with hearing impairment taught using computer-assisted instructional strategy.

The findings of this study revealed thatthere is significant difference between the delayed posstest mean scores of students with hearing impairment taught computer studies using computer-assisted instructional strategy and those taught using sign language. The use of computer-assisted instructional strategy as observed by the researcher enabled the students to get detailed information into the learning contents that facilitate proper conceptualization and retention of the material learnt. Omoniyi and Oluniyi (2012) indicated that the strongest factors that correlate retention are academic-related skills, academic self-confidence, and academic goals. Using the computer-assisted instructional strategy aroused interest and which led the students to set goals that could satisfy their interest. The continual interaction with learning materials made the information to be processed in an organized order and finally reach the long-term memory. Students who understood the learning materials this way were able to reproduce the material after the interval for which the retention test was administered.

The quality of interaction either with learning materials or among students or with their teacher is one of the major factors affecting retention (Bettinger& Long, 2009). Students with hearing impairment cannot fit in with students without any impairment as their pace of communication often limits their ability to contribute meaningfully to such social gathering. Even when isolated and in special schools for such disabilities, students do spend less of their time communicating in the bid to meet the days' learning and exercises accompanying such learning. computer-assisted instructional strategy however, availed the students the opportunity not only to interact with learning materials but also with their teacher and among each other over confusing issues. Students with hearing impairment sought clarification often with content areas they could not understand. This continuous interaction enabled them to record the information properly for easy recall.

The findings of this study support the findings of Gambari, Falode, and Adegbenro (2014) who reported that when computer-assisted instructional strategy is used, there was significant difference in the mean retention scores of junior secondary students taught geometry when compared with traditional method of teaching. The findings of this study also supported that Staniger (2014) who reported that that of the 100% of the Beginning Algebra students who successfully completed Beginning Algebra, 93% successfully completed

College Algebra with high rate of retention. The success of retention was reiterated when 100% of the students who responded in the College Algebra exit interview said that they felt the technologically mediated tools in beginning algebra contributed to their success in college algebra.

The use of computer-assisted instructional strategy significantly improved the achievement, interest and retention of students with hearing impairment. It is therefore, necessary that in teaching students with hearing impairment, computer-assisted instructional strategy need to be adopted. The following recommendations are therefore made in the light of the findings of the study:

1. Students with hearing impairment should be taught computer studies using computer-assisted instructional strategy. Computer studies teachers in schools for students with hearing impairment should adopt the use of computer-assisted instructional strategy to aid students with hearing impairment in their learning process.
2. Seminars and workshop should be organized by the ministry of education for computer studies teachers in order to help them become acquainted with the use of computer-assisted instructional strategy and effectively adopt them in the teaching and learning process of students with hearing impairment.
3. Special attention should be given to the classroom environment where students with hearing impairment learn. Their classrooms should be duly equipped with computer facilities such as computer systems, uninterruptible power supply (UPS), projection screen, and interactive white-boards to help them in their learning process.

## Acknowledgement

The researchers are highly grateful to their supervisor Prof. S.O.C. Okeke, and all others who gave all the necessarily correction and guidance that led to its successful completion.

## References

[1]. Adegoke, B. A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in physics.*European Journal of Educational Studies,3(3),* 537-550.

[2]. Ahiatrogah, P.D., Madjoub, M.B., &Bervell, B. (2013). Effect of computer assisted instruction on the achievement of basic school students in pre-technical skills. *Academic Journal of Interdisciplinary Studies, 2*(1), 77-87.

[3]. Alongkorn, A., Wiphasith, H., Nipon, P., &Tongluan, S. (2014). Developing a Computer Assisted Instruction with drill and practice for English teaching to primary school grade 6 students with hearing impaired. *International Journal of the Computer, the Internet and Management, 22(2),* 47-53.

[4]. Aronoff, M., Meir, I., & Sandler, W. (2005). The paradox of sign language morphology. *Language, 81(2),* 301 344.

[5]. Bettinger, E. P. & Long, B.T. (2009).Addressing the Needs of underprepared students in higher education: Does college remediation work? *Journal of Human Resources, University of Wisconsin Press, 44*(3).

[6]. Fraser, S., Gagne`, J. P., Alepins, M., & Dubois, P. (2010). Evaluating the effort expended to understand speech in noise using a dual-task paradigm: the effects of providing visual speech cues. *Journal of Speech, Language, and Hearing Research, 53,* 18-33.

[7]. Gambari, A.I., Falode, C.O., &Adegbenro, D.A. (2014).Effectiveness of computer animation and geometrical instructionalmodel on mathematics achievement and retention among juniorsecondary school students.*European Journal of Science and Mathematics Education, 2(2),* 127-146.

[8]. Gentry, M. M., Chinn, K. M., & Moulton, R. D. (2005).Effectiveness of multimedia reading materials when used with children who are deaf.*American Annals of the Deaf, 149(5),* 394 – 404.

[9]. Gokhan, A. (2012). The Effects of Animation Technique on the 7th Grade Science and Technology Course.*Creative Education, 3(3),* 304-308.

[10]. Howard, C. S., Munro, K. J., &Plack, C. J. (2010).Listening effort at signal-to-noise ratios that are typical of the school classroom.*International Journal of Audiology, 49(12),* 928-932.

[11]. Jing-Ming, J. (2009). The effects of multimedia stories of deaf orhard-of-hearing celebrities on the readingcomprehension and English words learning ofTaiwanesestudents with hearing impairment.*Asian Journal of Management and Humanity Sciences, 4(2-3),* 91-105.

[12]. Lewis, D., Manninen, C.M., Valente, D. L, & Smith, N. A. (2014). Children's Understanding of Instructions Presented in Noise and Reverberation. *American Journal of Audiology, 23(3),* 326-336.

[13]. Lotkowski, V. A., Robbins, S. B., &Noeth, R. J. (2004).The role of academic and non-academic factors in improving college retention.*ACT Policy Report, 1*.

[14]. Maduabum, C. P. (2006). *The Machinery of Government in Nigeria (Including the Structure and Objectives of the Federal Public Service).*Lagos: Administrative Staff Collage of Nigeria (ASCON).

[15]. Nworgu, B. G. (2015). *Educational research: Basic issues and methodology*. Ibadan: wisdom Publisher Limited.

[16]. Omoniyi, T. &Oluniyi, E. A. (2012).Impact of captioned video instruction on Nigerian hearing-impaired pupils' performance in english language. *Online Journal of the African Educational Research Network, 12(2),* 1-8.

[17]. Philip, M. K., Jackson, T.K., & Dave, W. (2011).*The Effect of computer assisted instruction on student's attitudes and achievement in matrices and transformations in secondary schools in UasinGishu District, Kenya*. Retrieved from http://www.muk.ac.ke/ijci/

[18]. Picou, E. M., Ricketts, T. A, & Hornsby, B. W. Y. (2011). Visual cues and listening effort: Individual variability. *Journal of Speech, Language, and Hearing Research, 54,* 1416-1430.

[19]. Schafer, & E., Bryant, D. (2013).Listening comprehension in background noise in children with normal hearing.*Journal of Educational Audiology, 19,* 58-64.

[20]. Spencer, P. E., &Marschark, M. (2010).*Evidence-Based practice in educating deaf and hard-of-hearing students*. New York, NY: Oxford University Press.

[21]. Staniger, M. B. (2014). The impact of digital organization on retention in college algebra.*Electronic Theses and Dissertations.*Paper 19.