Path Analysis of Student-Related Factors Affecting Academic Achievement in Chemistry among College of Education Students in Delta State

Nwanze, A. C. [1] & Okoli, J. N. [2]

[1,2] Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[1] *cinajoyd@gmail.com* [2] *jn.okoli@unizik.edu.ng*

Abstract

The study focused on the path analysis of student-related factors affecting academic achievement in chemistry among college of education students in Delta state. One research question and one hypothesis guided the study. The design adopted for the study was correlation survey with path-analytic research background. The population of the study was 1, 274 chemistry education students in Colleges of Education in Delta state. A sample of 200 SS 2 chemistry education students was involved in the study. The instruments for data collection were Chemistry Test Anxiety Questionnaire (CTAQ), Academic Motivation Scale (AMS), Chemistry Self-Efficacy Scale (SES), Study Habit Scale (SHS), Chemistry Attitude Scale (CAS), Academic Resilience Scale (ARS), Chemistry Interest Scale (CIS), Emotional Intelligence Questionnaire (EIQ), Self-regulated Learning Skills Questionnaire (CSRLSQ), Self-esteem Scale (SES). The instruments were validated by experts in relevant fields. The reliability of the instruments were established using Cronbach Alpha. The data obtained were analyzed using multiple regression analysis, multiple correlations, path analysis and analysis of moment structures. The findings of the study revealed that the joint predict of the 10 variables of achievement in chemistry was significant. The study also found out that the most meaningful path model for predicting achievement in chemistry involved the elimination of attitude and emotional intelligence after trimming the just-identified model. The study recommended that diagnostic analysis of student-related variables should be carried out at the point of admission and as the student progress academically by student affair departments in colleges of education in order to find out the areas the student may need orientation, guidance or counseling.

Keywords: Path-analysis, chemistry achievement, student-related factor, college of education

Introduction

Chemistry is the study of the composition, properties and changes and uses of matter that form the environment around us. The study of chemistry both at the senior secondary and tertiary education levels of education has however been bedeviled by serious and appalling notes. The problem of poor achievement in chemistry is compounded by the fact that fact that students carry the same poor knowledge and understanding of chemistry concepts to the tertiary institution. It is not expected that students should perform better at the tertiary level when they

have no basic understanding and foundation in chemistry. One becomes more disturbed seeing that research studies to improve on the implicated factors to students' achievement in chemistry (example teaching methods and innovations in instructional strategies) have been ongoing. The fundamental question therefore is: what factors actually predict students' achievement in chemistry.

Literature shows that such factors that predict and affect students' achievement could be environmental, psychological, social, cognitive, assessment, teacher, school, parent, location or student related (Hattie, 2009; Kocakaya & Gonen, 2012). Studies have been conducted in all the related factors predicting students' achievement but no proper attention has been given to how these factors interact to predict achievement. There is need therefore, to change the focus of research and channel studies on the causal paths to the prediction of achievement for some selected variables implicated in literature. Some of such student-related variable include academic resilience, attitude, study habit (Bajwa, Gujjar, Shaheen & Ramzan, 2011), self-efficacy and motivation (Mohamed, Mustafa, Abdullah & Hamdan, 2013). The present study focused on students' variables namely: motivation, self-efficacy, study-habit, attitude and academic resilience determined the causal paths of these variables in predicting achievement in chemistry through a path analysis.

Path analysis is a method employed to determine whether or not a multivariate set of non-experimental data fits well with a particular (a priori) causal model (Wuensch, 2016). Structural relations are the hypotheses about the directional effect or causal relationships of multiple variables. In path analysis, the cause and effect relationships between variables are expressed by means of a path coefficient. According to Niemczyk (2014), the coefficient informs which part of the variability of a dependent variable is expressed by the variability of the independent variable assuming the constancy of the remaining factors. Path analysis finds application in all disciplines but has barely been applied in the field of education in Nigeria.

The present study is necessitated by the facts that not only do the student-related variables such as motivation, self-efficacy, study-habit, attitude and academic resilience predict achievement individually but that they may also interact through different pathways to predict achievement of chemistry students. The interaction is informed by research findings, learning theories and principles of temporal order. However, to validate the nature of the interaction, one has to build a path model of the variables and trim the model for only those variables that meaningfully and significantly predict achievement in chemistry through different causal paths. Thus, the present study proposed a hypothetical model wherewith motivation, self-efficacy, study-habit, attitude and academic resilience all interact to predict achievement in chemistry.

The on-going discourse shows that achievement in chemistry could be predicted by a number of student-related variables through different path ways. Such factors affecting students' achievement in chemistry may do so directly or indirectly. The understanding therefore, of the causative paths, the weights (path coefficients), direct and indirect effects, and the most meaningful model for predicting students' achievement in chemistry is a worthwhile quest.

Purpose of the Study

The purpose of the study was to determine the path analysis of students-related factors affecting academic achievement in chemistry among college of education students in Delta state. Specifically, the study determined:

1. The most meaningful causal model (test anxiety, motivation, self-efficacy, study-habit, attitude, academic resilience, emotional intelligence, self-regulated learning, self-esteem and interest) for the academic achievement of students in chemistry.

Research Question

What is the most meaningful causal model (test anxiety, motivation, self-efficacy, study-habit, attitude, academic resilience, emotional intelligence, self-regulated learning, self-esteem and interest) for the prediction of academic achievement of students in chemistry?

Hypothesis

The extent of prediction of academic achievement in chemistry by the selected factors: test anxiety, motivation, self-efficacy, study-habit, attitude, academic resilience, emotional intelligence, self-regulated learning, self-esteem and interest is not significant ($P < 0.05$).

Formulating the Hypothesized Causal Model

The researcher formulated the confirmatory causal models based the principles for generating a hypothesized causal model namely: temporal order, research findings, theories of learning and opinion or position of researchers and authors. The resultant structural equations from the hypothesized effects of the ten explanatory variables ($X_1 \ldots X_{10}$) and their prediction of the criterion variable (X_{11}) is given in the equation:

$$X_{11} = \beta_1 X_1, \beta_2 X_2 \ldots\ldots\ldots \beta_{10} X_{10}$$

Where;
X_{11} = Academic achievement in chemistry
$X_1, X_2 \ldots\ldots X_{10}$ = Predictor (explanatory, independent) variables
$\beta_1, \beta_2 \ldots\ldots\ldots \beta_{10}$ = Associated Beta Weight (Path Coefficients)

Nine structural equations resulted from all the hypothetical linkages as shown the input path diagram of the causal model of the eleven variables system in figure

$$X_1 = P_{15}X_5 + \varepsilon_1$$
$$X_2 = P_{21}X_1 + \varepsilon_2$$
$$X_3 = P_{32}X_2 + P_{38}X_8 + \varepsilon_3$$
$$X_4 = P_{41}X_1 + P_{42}X_2\, P_{45}X_5 + P_{46}X_6 + P_{47}X_7 P_{49}X_9 + \varepsilon_4$$
$$X_5 = P_{53}X_3 + P_{57}X_7 + \varepsilon_5$$
$$X_6 = P_{62}X_2 + \varepsilon_6$$
$$X_9 = P_{92}X_2 + \varepsilon_9$$
$$X_{10} = P_{103}X_3 + P_{108}X_8 + \varepsilon_{10}$$
$$X_{11} = P_{111}X_1 + P_{112}X_2 + P_{113}X_3 + P_{114}X_4 + P_{115}X_5 + P_{116}X_6 P_{117}X_7 + P_{118}X_8 + P_{119}X_9 P_{1110}X_{10} + \varepsilon_{11}$$

The equation above implies that academic achievement will be predicted by all the ten explanatory variables though the path shown in the path model in Figure 1.

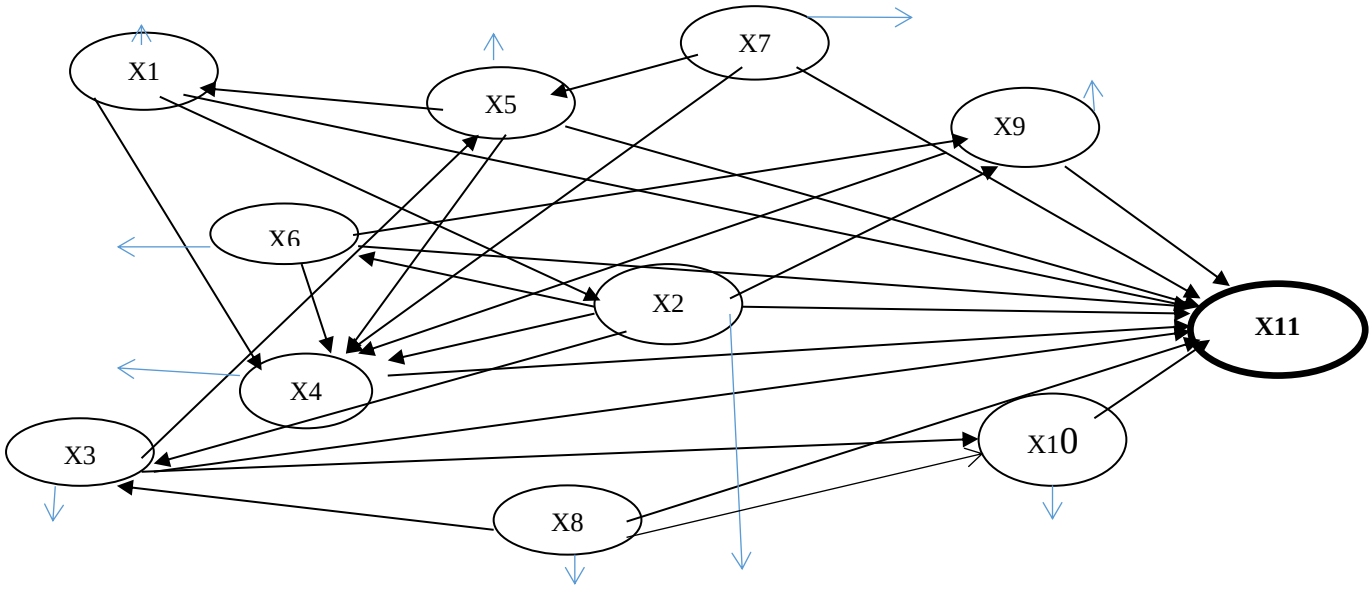


Figure 1: Hypothesized Diagram of Causal Model of an 11 Variables System Method

The design of the study is correlation survey with path-analytic background. The population of the study was 1, 274 (723 males and 551 females) chemistry students in Colleges of Education in Delta State. The sample size for the study was 200 chemistry students. The instruments for the study data collection are: Chemistry Test Anxiety Questionnaire (CTAQ), Academic Motivation Scale (AMS), Chemistry Self-Efficacy Scale (SES), Study Habit Scale (SHS), Chemistry Attitude Scale (CAS), Academic Resilience Scale (ARS), Chemistry Interest Scale (CIS), Emotional Intelligence Questionnaire (EIQ), Self-regulated Learning Skills Questionnaire (CSRLSQ), Self-esteem Scale (SES).

Chemistry Test Anxiety Questionnaire (CTAQ) is a 20 item questionnaire adapted from the Mathematics Test Anxiety Scale developed by Chukwu (2014). The major adaptation was changing the word 'mathematics' to 'chemistry'. Academic Motivation Scale (AMS) was adapted from Njiru (2003) who developed a scale for measuring academic motivation using the Rasch Model. The modification to the original instrument was the removal of the aspects

and sub-aspects while retaining the items since the study is not interested in the various dimensions of motivation measurement. Chemistry Self-Efficacy Scale (CSES) was adapted from the Webb-Williams (2006) self-efficacy scale. The instrument required the students to rate their belief or perception that they are capable of performing specific chemistry task on a scale of one (not at all) through five (very well). Study Habit Scale (SHS) was adapted from Gordon (2002). The instrument was designed to generate information on study habit, requiring the students to rate and indicate how each habit applies to them using a five-point response scale. The scale ranged from Never (1) through, to Very Often (5). Chemistry attitude Scale (CAS) was adapted from Myra's (2006) 42-item Chemistry Attitude Survey and Jassem's (2014) 21-item attitude questionnaire. The researcher adapted items from both questionnaires to form the 30 items in CAS. Items from both instruments were paraphrased. CAS requires the students to state their degrees of agreement to statements that describe their attitude to chemistry on four-point scale. The scales ranged from are Strongly Agree (SA) to Strongly Disagree (SD). Academic Resilience Scale (ARS) is 30-item scale on which the students are to rate the academic resilience on a five-point scale. The scale ranges from likely (5 points) to unlikely (1 point). Chemistry Interest Scale (CIS) is a 20-item scale developed by the researcher. The response scale ranged from very much likely to unlikely.

Emotional Intelligence Questionnaire (EIQ) adapted from Mayer, Salovey, and Caruso (2004) Emotional Intelligence Test (MSCEIT) is a 36 items questionnaire with a four-point scale ranging from SA to SD. EIQ requires the students to indicate their degree of agreement or disagreement with the statements. Chemistry Self-Regulated Learning Skills Questionnaire (CSRLSQ) was adapted from Maruff (2010) Distance Learners' Self-Regulations Skills Scale (DLSRSI). CSRLSQ is a 15-item scale drawn on four-point response scale ranging from SA to SD. Self-Esteem Scale (SES) is adopted from the Rosenberg (1965) self-esteem scale as re-validated Okwaraji, Nduanya, Obiechina, Onyebueke and Okorie (2018) using Nigerian

students. SES requires the students to give a self-report by rating themselves on the ten items with four-point response scale ranging from SA to SD. The instrument is composed of negatively and positively worded items that describe students' academic resilience on which the students are to rate their degrees of resilience based on the statements.

The instruments were validated by three experts from Nnamdi Azikiwe University, Awka. The reliability of each instrument was established using single administration method. The generated scores were subjected to Cronbach alpha technique. The coefficients of internal consistency obtained for the instruments are: 0.67 for AMS, 0.81 for CSES, 0.62 for SHS, 0.91 for CAS, and 0.78 for ARS. The instruments were administered with the aid of four research assistants. All relating to the study were analyzed using Analysis of Moment Structures (AMOS) and Statistical Package for Social Sciences (SPSS) version 25. Data relating to the research questions and hypotheses were analyzed using confirmatory causal modeling involved multivariate analytical techniques of multiple regression (zero-order, backward or stepwise elimination procedure) and path analysis. The hypothesis was tested at 0.05 level of significance. The decision was where P-value or t-value is less than or equals 0.05, reject null hypothesis, otherwise, do not reject. The proposed equation of prediction was:

$$Chemistry\ Achievement\ (CA) = a + b_1TA_1 + b_2MT_2 + b_3SE_3 + b_4SH_4 + b_5AT_5 + b_6AR_6 + b_7IT_7 + b_8EI_8 + b_9SR_9 + b_{10}ST_{10}$$

Where: $b_{1\text{-}10}$ = regression weights of the relative contributions of the predictor variables and TA = Test anxiety, MT = Motivation, SE = Self-efficacy, SH = Study habit, AT = Attitude, AR = Academic resilience, IT = Interest, EI = Emotional Intelligence, SR = Self- regulated learning skills and ST = Self-esteem.

Results

The hypothesized model shown in Figure 1 is reproduced as Figure 2 with the path coefficient and the zero-order correlation coefficients (standardized beta coefficients) and as Figure 3 with no standardized beta coefficients.

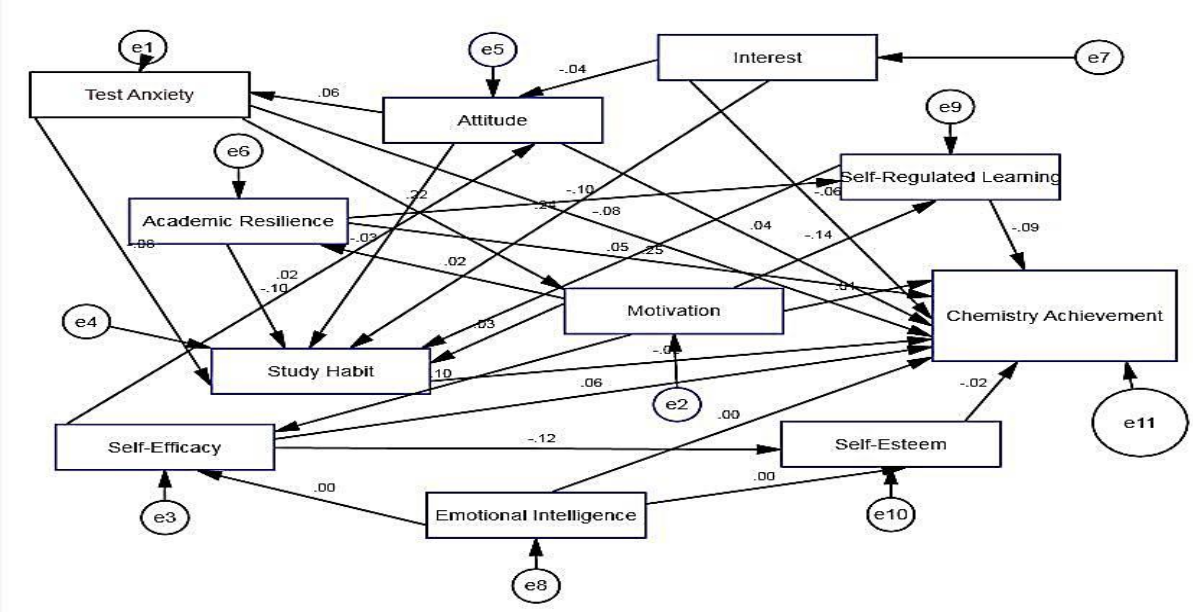


Figure 2: Just-Identified (Full, Saturated) Path Model of an 11 Variables system showing Path Weights using Standardized Beta Coefficient

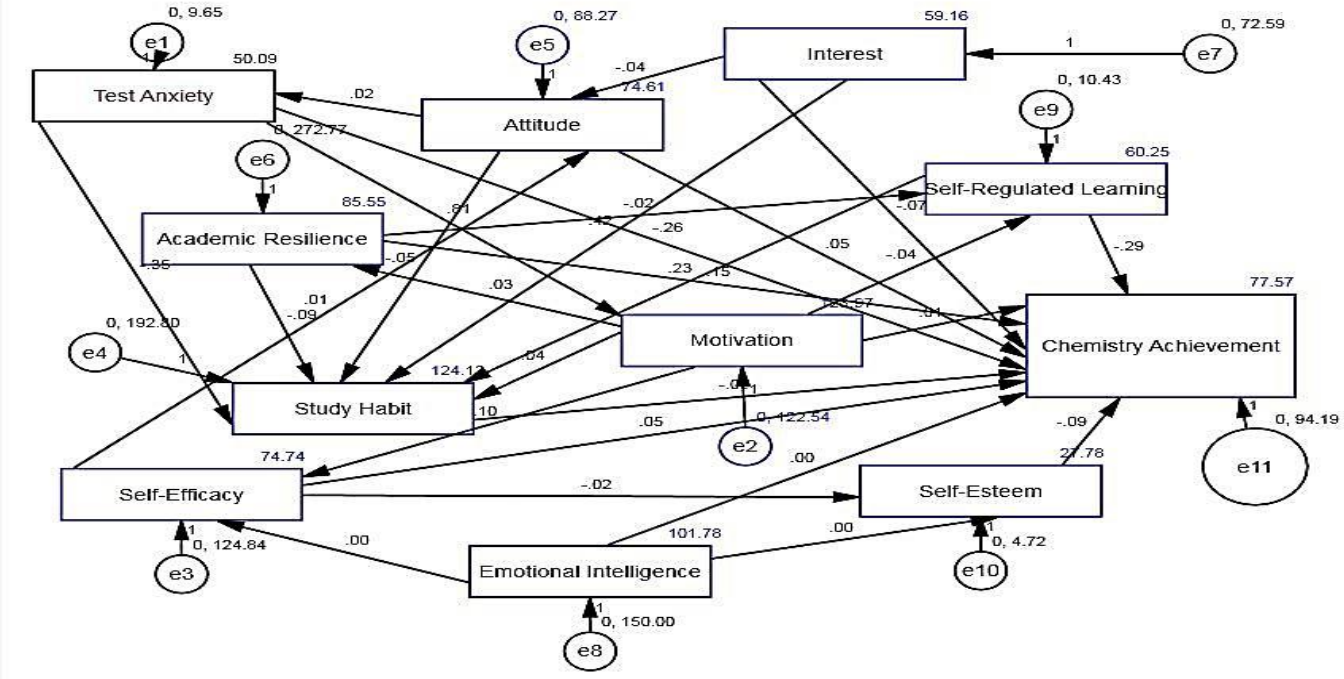


Figure 3: Just-Identified (Full, Saturated) Path Model of an 11 Variables system showing Path Weights using Non-standardized Beta Coefficient, Variances and Residual Values

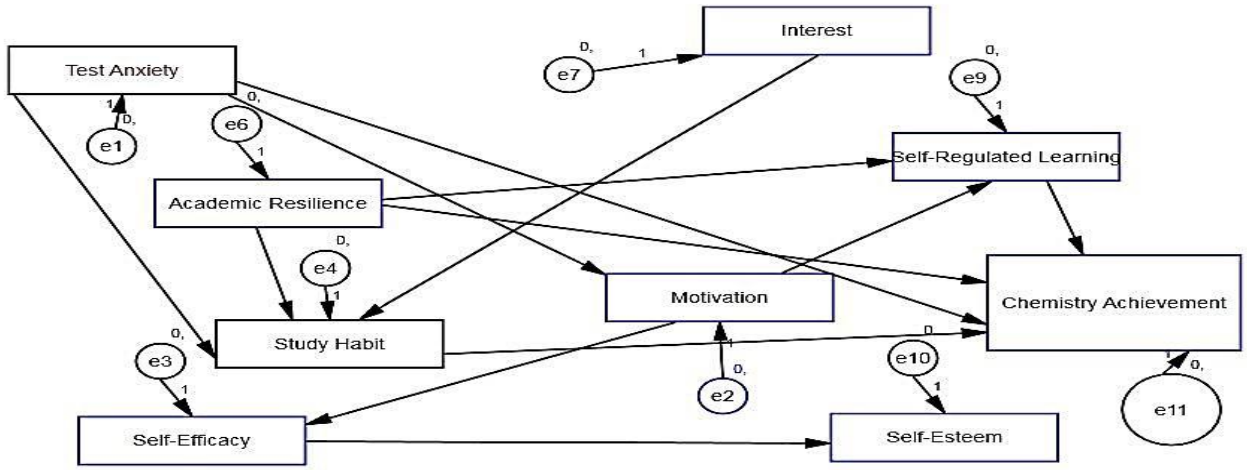


Figure 4: Over-Identified (Reduced) Path Model of 11 Vars System showing the most causal model of student-related variables affecting achievement in chemistry

Key: MS = meaningful and significant; M = Meaningful

To trim the paths in the model, paths and path coefficient are considered meaningful if path coefficient is less than 0.5 and paths are considered significant if the P value is less than 0.05. The decision for each path and their path coefficients is shown in Table 1.

Table 1: Meaningfulness and Significance of Paths and their Coefficients

S/N	Paths	Path Coefficients	P-value	Decision
1	P111	-.078	.017	MS
2	P112	.006	.931	M
3	P113	.056	.431	M
4	P114	-.048	.014	MS
5	P115	.042	.554	M
6	P116	.246	.001	MS
7	P117	-.059	.423	M
8	P118	-.002	.974	M
9	P119	-.095	.005	MS
10	P1110	-.020	.781	M
11	P103	-.118	.009	MS
12	P108	-.003	.968	M
13	P92	-.139	.046	MS
14	P96	-.104	.001	MS
15	P62	.022	.754	M
16	P53	.017	.810	M
17	P57	-.039	.579	M
18	P41	-.076	.027	MS
19	P42	.030	.671	M
20	P45	-.032	.639	M
21	P46	-.104	.008	MS
22	P47	.244	.000	MS
23	P49	.052	.454	M

24	P32	.101	.044	MS
25	P38	.001	.986	M
26	P21	.221	.001	MS
27	P15	.059	.403	M

Based on the criteria, the hypothesized path model (just-identified model) is reproduced with the 12 meaningful and significant paths in Figure 4.

Table 2: Analysis of Variance (ANOVA) of the Regression

Source of Variance	Sum of Squares	df	Mean Square	F	Sig.
Regression	1939.306	10	193.931	1.946	.041 [b]
Residual	18838.614	189	99.675		
Total	20777.920	199			

a. Dependent Variable: Achievement
b. Predictors: (Constant), ST, EI, MT, AR, AT, SR, IT, SE, TA, SH

Table 2 shows that the R^2 value of .093 obtained from the regression analysis is significant. At 10df numerator and 199df denominator, the F-value is 1.946 with a P-value of 0.41 which is less than 0.05. The null hypothesis is therefore rejected. Thus, the extent of prediction of academic achievement in chemistry by the selected factors: test anxiety, motivation, self-efficacy, study-habit, attitude, academic resilience, emotional intelligence, self-regulated learning, self-esteem and interest are significant.

Discussion

The findings of the study showed that the most meaningful causal model for predicting students' achievement in chemistry by student-related factors has 12 pathways, with discrepancies between original and reproduced correlation matrix implying that the observed data is consistent with the new model. Thus, achievement in chemistry can be predicted: directly by test anxiety but also indirectly through the pathways of motivation to self-regulated learning, study-habit; directly by academic resilience but also indirectly through self-regulated learning, study-habit; directly by study habit and self-regulated learning. It is important to know that the prediction of achievement in chemistry by self-regulated learning and study habit is because they have a common antecedent which is academic resilience, thus, their interaction is

spurious. Study habit interacts with interest, a latent exogenous variable in the model in predicting achievement in chemistry. Motivation interacts directly with self-regulated learning skills in predicting achievement in chemistry but indirectly with self-efficacy which is interacting with another latent variable, self-esteem. The interaction of motivation which is both direct and indirect with variables preceding before and proceeding after it in the model made the new path model non-recursive. The elimination of emotional intelligence and attitude from the model does not imply that they do not predict achievement in chemistry but suggests that they are highly collinear with other variables in the path model. The findings of the study show that there are four direct and eight indirect pathways representing 30% and 21.25% of the total effects of the selected variables in prediction achievement.

The findings of the study further reveals that the reproduced path model for predicting achievement in chemistry fit the data significantly. The model therefore fits the data and is considered tenable in explaining the pathways through which the selected student-related variables predict achievement in chemistry. The most meaningful pathways however, are those that have interaction with academic resilience, self-regulated learning skills, test anxiety and study habit. The findings of the study support that finding of Saddler and William (1993) whose path model for predicting achievement revealed that study habit interacted with other variables in the model while predicting achievement directly. The findings of the study also support that of Asanee (2013) whose model showed that self-regulated learning and achievement have a common antecedent.

Conclusion

The study conclude that academic resilience self-regulated learning skills, study habit and all their pathways are very keys in the achievement of chemistry students.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Academic institutions should organize orientation exercise for fresh chemistry students at the point of admission to teaching them about the need for academic resilience and well-formed study pattern. Such orientation should also emphasize the importance of developing a facilitating test anxiety towards assessments.
2. Diagnostic analysis of student-related variables should be carried out at the point of admission and as the student progress academically by student affair departments in colleges of education in order to find out the areas the student may need orientation, guidance or counseling.

References

Asanee, T. (2013). A Path Analysis of Relationships between factors with achievement motivation of students of private universities in Bangkok, Thailand. *Procedia - Social and Behavioural Sciences, 88,* 229 – 238.

Bajwa, N., Gujjar, A., Shaheen, G.H. & Ramzan, M. A. (2011). Comparative study habits of the students from formal and non-formal systems of education in Pakistan. *International Journal of Business and Social Science, 2*(14),175-178.

Chukwu, L.O. (2014). *Relationship among test anxiety, academic achievement and interest of senior secondary school students in Geometry in Enugu state.* (Unpublished Master Thesis), University of Nigeria, Nsukka.

Gordon, V. (2002). *A guidebook and readings for new students.* Scotland: Gordon's University Survey.

Hattie, J. A. C. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. London: Routledge.

Jassem, G.M. (2014). Students attitudes towards chemistry: An examination of choices and preferences. *American Journal of Educational Research, 4(*2),351-356.

Kocakaya, C. & Gonen, K. (2012). Effect of the demographic characteristics on students' achievement. *International Journal on New Trends in Education and Their Implications, 3*(4), 16-31.

Maruff, A. O. (2010). *A path-analytic study of socio-psychological variables and academic performance of distance learners in Nigerian Universities*. Retrieved from https://www.researchgate.net/publication/306353300

Mayer, J.D., Salovey, P. & Caruso, D. (2004). *Mayer-Salovey- Caruso Emotional Intelligence Test (MSCEIT) User's Manual.* Toronto, Canada: Multi-Health System.

Mohamed, Z.G.A., Mustafa, M., Abdullah, M.L. & Hamdan, A.M. (2013). Path analysis of the factors influencing students' achievement in mathematics. *Australian Journal of Basic and Applied Sciences, 7*(4), 437-442.

Myra, K. (2006). *Chemistry Attitude Survey: 42 likert scale item.* Retrieved from http://www.dl.ulis.ac.jp/ISDL97/proceedings/gmo/gmo.html

Niemczyk, A. (2014). The application of path modelling in the analysis of consumer behaviour in the cultural tourism market. *Economics & Sociology*, *7*(1), 204-216.

Njiru, J. N. (2003). *Measuring academic motivation to achieve for high school students using a Rasch measurement model.* Retrieved from http://ro.ecu.edu.au/theses/1320.

Okwaraji, F.E., Nduanya, C.U., Obiechina, K.I., Onyebueke, G.C. & Okorie, A.N. (2018). Locus of control, self-esteem and depression in a sample of school going adolescent in two Nigerian rural communities. *The Journal of Medical Research, 4*(2),106-110.

Rosenberg, M. (1965). *Society and the adolescent self-image.* Princeton, NJ: Princeton University Press.

Saddler, C.D. & William, O.B. (1993). *Path analysis of factors affecting University students' academic achievement.* Paper presented at the annual convention of the Western and Rocky Mountain Psychological Associations, Phoenix, Arizona.

Webb-Williams, J. (2006). *Self-efficacy in the primary classroom: An investigation into the relationship with performance.* Paper presented at the British Educational Research Association New Researchers/Student Conference, University of Warwick.

Wuensch, K. L. (2016). *An introduction to path analysis*. Retrieved from http://core.ecu.edu/psyc/wuenschk/MV/SEM/Path.pdf

Development and Validation of Geo-TAN Instructional Software Package for Teaching Geometry in Senior Secondary School

Njoku, C.
Harvard Wilson College of Education, Aba, Abia State, Nigeria
chikacelebration2013@gmail.com

&

Okigbo, E. C.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
ec.okigbo@unizik.edu.ng

Abstract

Students have consistently showed significant weakness in geometry. Majority of the candidates in the senior secondary school examination avoid questions drawn from geometry, specifically questions based on chord properties, circle theorems and tangent to a circle. Teaching of Mathematics in secondary schools in Nigeria is mostly done using conventional expository method which has been identified as a major cause of students' poor performance in Mathematics especially in geometry. In this 21st century, teaching and learning of many topics in Mathematics require the use of computer and this entails that relevant instructional software packages that teach specific lessons especially the difficult and abstract concepts such as geometry should be developed. In this study GeoTAN Instructional Software Package (GISP) was developed, validated for teaching geometry in secondary schools in Nigeria. GISP was developed for use in the following application software namely; Cinema 4D, Macromedia Flash 8, Macromedia Fireworks 8, Microsoft Word and Adobe Audition. The software development models that were adopted in the development of GISP are Gerlach and Ely; and ADDIE models. A three-stage validation process was used in validating GISP. Educational Software Package Rating Scale (ESPRS) was used by seven Mathematics educators for content validation of GISP. Kendall's Coefficient of Concordance was used to analyse the rating scores in order to determine the agreement or concordance among the raters and reliability of the GISP. The result revealed Kendall's W of 0.82 which indicated that there is agreement among Mathematics educators that the subject matter contents of the developed GISP sufficiently covered the required areas of geometry in senior secondary school two (SS2) Mathematics curriculum. The result showed also that Mathematics educators rated GISP independently and it is reliable for instructional purposes. From the findings of this study, it was recommended among others that GISP should be used by Mathematics teachers in teaching geometry concepts to SS 2 students.

Keywords: Development, GeoTAN instructional software, Geometry

Introduction

Science education is the platform that conveys scientific and technological information and knowledge to the recipients. In science education, Mathematics occupies central and invaluable place such that other science subjects namely Chemistry, Physics, Biology, Agricultural science including social science subject like economics cannot be effectively understood without recourse to Mathematics. Mathematics is a discipline that trains the human mind to understand the world by symbolically and systematically performing reasoning and computation on abstract structures (Joshua, 2016). The importance of Mathematics to human life was succinctly captured by Akinsola and Popoola in Akor (2015) who stated that Mathematics fosters intellectual skills needed to analyse complex problems; recognizes logical relations between interdependent factors as well as formulates general laws on their interrelationship in achieving precision in expression.

Sequel to the foregoing, predicated upon the invaluable role of Mathematics, Federal Republic of Nigeria (FRN, 2013) in the National Policy on Education was apparently motivated to list Mathematics as one of the core and compulsory subjects to be offered by all secondary school students in Nigeria. This implies that all secondary school students in Nigeria must study Mathematics from junior secondary school one to senior secondary school three. Hence, every student is required to obtain at least a credit pass in Mathematics before such student is admitted into higher institution in Nigeria.

The obvious importance of Mathematics notwithstanding, the achievement of secondary school students in Mathematics in public examinations is poor and appalling. The evidence of the poor achievement in Mathematics is predicated on the annual reports of West African Examination Council (WAEC) between 2010 and 2018 which indicated a discouraging performance of students in the subject. The analysis of the performance of students in May/June

West African Senior School Certificate Examination (WASSCE) in Nigeria (WAEC, 2010-2018) shows that the percentage of students who passed at credit level and above (A1–C6) was less than 50% over a period of nine years with the exception of the year 2016 and 2017 where performance was a little above 50%. In a similar development, Fabiyi, (2017) reported that chord property, circle theorem and tangent to a circle were among the concepts in geometry students perceived difficult to learn.

Geometry is one of the five themes in senior secondary school Mathematics curriculum (Nigerian Educational Research & Development Council (NERDC), 2007). Ntshengedzeni (2015) defined geometry as the branch of Mathematics that is concerned with the study of properties, relations of point, lines, surface, solid shape, relative arrangement of the parts, position of objects, movement of objects and the space around the objects which improve learners' spatial imagination. Geometry enhances logical and deductive reasoning for modelling abstract problems and is widely applied in various areas of life such as Computer Aided Design (CAD), modelling, robotics, medical imaging, computer animation and visual presentation (Jacob, Decl, Bolaji, Kajuru & Musa, 2017). Irrespective of the usefulness of geometry to human, the achievement of students in geometry particularly chord properties, circle theorems and tangent to a circle is very poor. This assertion is predicated on the report of WAEC Chief Examiners which revealed that candidates have consistently showed significant weakness in geometry and majority of the candidates avoid questions drawn from chord properties, circle theorems and tangent to a circle (WAEC Chief Examiners' report, 2010; 2011; 2013 - 2018).

This poor achievement in geometry has been blamed on a number of factors. Notable among them is the problem of teaching method which is basically the conventional lecture method. Nworgu (2017) described conventional lecture method as that characterized by

verbalization, memorization, non-interactive, and teacher dominance. This method, however, allows for a wider coverage of content within a short period of time and enables the teaching of large number of students at the same time (Osufor & Njoku 2016). More so, more than 70 percent of science and Mathematics teachers in Nigeria is conversant with conventional lecture method since it suits their traditional pedagogic worldview. Another reason is that conventional lecture method easily interfaces with the Nigerian educational curriculum which is basically theory inclined. Notwithstanding its merits, its demerits outweigh them as it does not promote insightful learning, increase in interest and long-term retention of some concepts (Ahmed & Abimbola, 2011).

In view of the importance of geometry, paying much attention to the methods cum strategies used in its teaching and learning in secondary schools becomes inevitable and desirable. This was**,** therefore, why NERDC (2007) succinctly stated in senior secondary education curriculum in Mathematics that the computerized nature of the global world has led to the intensification of the use of computer in teaching many of the topics in Mathematics. Hence, a lot of Computer Assisted Instruction (CAI) materials are recommended for the teaching and learning of various topics. The Association for Educational Communications and Technology (AECT) (2015) defined CAI as an instructional programme in which the computer is used to instruct the student and where the computer contains the instruction which is designed to teach, guide and test the students until a desired level of proficiency is attained. To this end, the use of CAI **in teaching and learning of Mathematics implies that relevant instructional software packages that teach specific lessons especially the difficult and abstract concepts such as geometry should be developed i**nstructional software package is a combination of one or more files that necessitate the execution of a computer program for the purpose of communicating learning activities, skills and knowledge that are narrowed down to specific

content areas to the learners in an interactive manner (Akukwe & Njoku, 2014). According to Okorie (2015), instructional software package engages learners through the screen instructions from the computer and makes provision for appropriate responses through the attached keyboards; restructures learning environment and makes provision for individual differences of the learners. The point being stressed here is that the instructional software package has the capacity to drill each student and at the same time allows each student to work privately and at the individual student pace. Therefore, adopting teaching approach that is student-centred becomes imperative hence, the development of GeoTAN Instructional Software Package (GISP).

Etymologically, GeoTAN is derived from four words, namely; Geometry, Text, Animation and Narration. GeoTAN Instructional Software Package(GISP) is an instructional software that can be used to teach geometric concepts specifically **chord properties, circle theorems and tangent to a circle** using text, animation and narration simultaneously to the learners **in such a way that it will help** *learners* **build mental representations and construct knowledge by themselves.** In other words, GISP is an instructional software package **that runs on computer system which can be used to teach chord properties, circle theorems and tangent to a circle in an interactive manner which** can help a learner to see the learning experience as text on the computer screen, hears it as it is described in words (narration) and sees the animation that shows illustration of how angles are formed and the position of angles in the diagram. GISP has the capacity to drill each student and at the same time and allows each student to work independently. Furthermore, GISP helps students to access the worked example as a guide to solve some practice questions. It has also a virtual assistant that encourages students with motivational expressions when they pass or fail any practice question.

GISP is in line with the modern teaching approach which involves the use of various activities that make room for the active participation of learners to enhance meaningful understanding of the lesson (Nworgu, 2017). Therefore, GISP **is a student-centred approach that** allows the active participation of learners by **presenting instructional activities in stages and in an interactive manner to students.** In each lesson, the stages of presentation involve introduction, list of lessons, specific objectives of each lesson, test on previous knowledge, explanation of the learning activities both in text, narration(voicing) and animation; students' activities for evaluation and summary of the lesson. GISP has interactive features in that it shows the leaner whether the option selected is right or wrong. It also allows every student to navigate from one link to another using Home, Next, Back and Exit buttons. Against this background, GISP was developed and validated for teaching geometry in secondary schools. The problem of this study was: would the developed and validated GISP sufficiently cover the required area of geometry based on SS2 Mathematics curriculum?

Purpose of the Study

The purpose of the study was to develop and validate GeoTAN Instructional Software Package (GISP) for the teaching and learning of geometry by senior secondary school students using the following topics in geometry namely, chord property, circle theorem and tangent to a circle. Specifically, this study sought to find out if the developed GISP sufficiently and appropriately covered the chosen content of geometry.

Research Questions

The research question that guided the conduct of the study is; what are the mean ratings of Mathematics educators on GISP content?

Hypotheses

The hypothesis tested at 0.05 levels of significance is; there is no significant difference in the mean ratings of Mathematics educators on the content of GISP.

Method

The research design adopted in this study is instrumentation. Ali (2006) defined instrumentation design as that which is geared towards the development and validation of measurement instrument or the investigation and introduction of new techniques for use in educational practice. The International Centre for Educational Evaluation in Okorie (2014) defined instrumentation design as one which aimed at the development of new or modification of content, procedure, technology or instrument of educational practice. Going by these definitions therefore, instrumentation design is said to be the development of measurement instrument or new technologically based technique such as instructional software and strategies for use in educational practice. The purpose of the present study fits into the definition of instrumentation design. Hence, its adoption in this study is because GISP was developed and validated by the researchers.

Developmental Procedure of GISP

Requirement specification: This involves defining in specific terms what was to be learned. In the case of this study, it was Mathematics and specifically topics in geometry namely, chord property, circle theorem and tangent to a circle.

Design: This has to do with the process of specifying how geometry is to be learned. The Lesson Plan on Geometry (LPG) in this study was designed by the instructional designer – the researcher. Afterwards, LPG was used in the preparation of developmental plan of GISP.

Coding: At this stage, the content of the developmental plan was coded into the computer with the use of the following application software namely; Cinema 4D, Macromedia Flash 8,

Macromedia Fireworks 8, Microsoft Word and Adobe Audition**.** Cinema 4D was used to create the 3-dimentional images. Macromedia Fireworks 8 was used to create 2-dimentional images. This is because it allows very tiny file size compared to other graphic application software. Macromedia Flash 8 enabled the assemblage and embedment of graphics, text, interactive features and audio in the software. In fact, Macromedia Flash 8 was used as the overall platform. Microsoft Word was used for formatting the text. Lastly, the a**dobe audition was used for recording voice over.** The GISP development was perfected through the assistance of professional computer programmer.

Integration: This entails creation of slides, addition of animation effects and narration to the slides in the instruction. The following four steps were taken:

Step 1: Transition: the movement of the slides in the instruction was controlled using next and backward button.

Step 2: Animation: this was used to create 2-dimensional and 3-dimensional images used for examples and illustrations in the instruction.

Step 3: Adding voice or narration to the slides in the instruction.

Step 4: Saving the instruction into a storage medium

Software development model: The software development models that were adopted in the development of GISP are Gerlach and Ely; and ADDIE models for instructional software package.

Software development technique: Software development technique that was employed was the combination of Tutorial, and Drill and Practice.

Usage: The following mode and technique were adopted in the usage:

Mode of Environment: The mode of environment employed was hybrid environment. Hybrid environment is a learning environment where the students received instruction both from the

teacher and computer. In other words, it involves guiding the students and making necessary explanation to the students as they learn geometry using the GISP.

Implementation Technique: The implementation technique was synchronous implementation which involves a situation where all students in a particular location are exposed to the same learning experiences and materials at the same time. That is, GISP was installed in the computer systems in computer laboratories such that all the students were exposed to the same learning experiences and materials at the same time.

Test Instrument Used for Evaluation in GISP

The instrument used for evaluation in GISP was researchers-adopted Geometry Achievement Test. It consists of 70 multiple choice objective items adopted from past question papers of West African Examination Council (WAEC, May/June, 1988-2018, Nov/Dec, 2010-2017, Jan/Feb, 2018). Two questions were used to test previous knowledge of students in each lesson while five questions were used for evaluation in each lesson. The items were validated by Mathematics teachers and; measurement and evaluation experts. It was tested for reliability using 30 randomly selected SS3 students. A reliability coefficient of 0.87 was obtained using the Kudar Richardson (KR-20) which was considered reliable for the research study.

Validation of Instrument

The Educational Software Package Rating Scale (ESPRS) adapted from Educational Software Evaluation Consortium (Bitter & Wighton, 1987) was used to validate GISP. It contains 14 item evaluation criteria. The criteria are correctness of presentation; content presentation; integration into classroom use; ease of use and curriculum congruence. Others are user control program; teacher documentation; colour, sound, graphic, and animation features; reliability; and content bias. It is structured on a 4-point rating scale of Excellent, Good, Fair and Poor. The 4-point rating scale of the items were assigned numerical values of

4,3,2 and 1 respectively. The ESPRS was validated by two professional secondary school Mathematics teachers and three Mathematics educators. After the validation, the reliability coefficient of ESPRS was established. To establish the reliability coefficient of ESPRS, the instrument was giving to 20 specialists (eight Mathematics educators, seven computer experts and five educational technologists) for rating. Cronbach Alpha reliability coefficient was thereafter used in analysing the rating scores in order to determine the internal consistency coefficient of the ESPRS. The internal consistency reliability coefficient of 0.85 was obtained after the computation. The instrument was therefore judged reliable.

The Validation of the GISP

In validation of GISP, two types of validation were used – the face and content validations. This was done in three stages namely expert validation comprising of educational technologists and computer programmers; content validation comprising of Mathematics specialists and field validation comprising of SS2 students.

Stage one: Expert validation

The GISP was face validated by three computer programmers and three educational technologists. First, the three computer programmers were given the research title, purpose of the study and GISP. The researchers requested them to assess the GISP in terms of the following: language, legibility, durability, animations, interactivity, interface, navigation, voice over and packaging. Their suggestions were used to modify the package. Second, three educational technologists were given the research title, purpose of the study and GISP. The researchers requested them to determine the appropriateness of GISP in terms of suitability for instruction, emphasis on key concepts, use of examples and illustrations, moving from known to unknown, unity of colour, animation, text and voice, curriculum congruence, and lesson evaluation, thereafter, their corrections were used to improve GISP.

Stage two: Content validation

The content validation was done in two stages. In the first stage, the developmental plan of GISP written by the researchers was given to Mathematics specialists for validation. They were given the lesson blueprint, scheme of work and senior secondary school Mathematics curriculum, the research title and purpose of the study; and requested them to validate the developmental plan of GISP in terms of finding out if the content of the developmental plan of GISP adequately and sufficiently covered the Nigerian secondary school Mathematics curriculum. Thereafter, the comments of the specialists were used to correct some mistakes whereas their suggestions were used to improve the developmental plan of GISP. The second stage of content validation came after the development of GISP. The developed GISP was given to five Mathematics educators and two instructional software package designers (who are also mathematics educators) for validation. The Mathematics educators were given the research title, purpose of the study and ESPRS. They were requested to carry out the content validation of the GISP by ensuring that it was in line with the 14 criteria in ESPRS. Their comments were the rating scores in the ESPRS. The Kendall's Coefficient of Concordance was used to analyse the rating scores in order to determine the agreement or concordance among the raters and reliability of the GISP.

Stage three: Field validation

Afterwards, a pilot study was carried out with GISP. For this reason, GISP was administered to 20 SS2 students. In the school selected for the pilot study, the research assistants (regular Mathematics teachers) helped the researchers to ensure that the computers were in good working condition. Projectors were properly set and computers booted by researchers. During the first 40-minute lesson, students were given a short introduction on how to use GISP. That is familiarizing the students with GISP. The researchers directed students to boot their own computers systems. After that, researchers inserted the CD in the CD drive and

students also inserted CD in the CD drive. Teachers guided the students to perform the following functions in computer systems:

1. Click to open the folder to view the file.
2. Select the GISP and click open with Macromedia Flash 8 to open the lessons.
3. Select lesson one and click to open it
4. Listen to the narrative instructions and follow it.
5. Attempt the questions drawn from previous knowledge. The package is designed in such a way that the learner can go to the next step even if the correct answer is not gotten.
6. Thereafter, click the Next button to get to the next step and listen to the narration
7. Continue clicking Next button to read and listen to narration until they get to evaluation.
8. Attempt the question for evaluation and listen to the narration.
9. Clicking Next button to go to summary of the lesson
10. Interact with the computer and learning material while the researchers watched and intervened where and when necessary.
11. Click to close the file.
12. Remove the CD from the CD drive and keep CD safe for other lesson during the next mathematics period.
13. Finally, shut down the computer.
    Thereafter, their observations were used to improve GISP.

Results

Table1: Mean ranks of Mathematics educators

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean Ranks	9.4	9.4	8.4	8.4	9.4	9.4	9.4	8.4	9.4	8.4	8.4	2.4	2.4	2.4

Data on Table 1 show that items of the instrument had mean ranks 9.4, 9.4, 8.4, 8.4, 9.4, 9.4, 9.4, 8.4, 9.4, 8.4, 8.4, 2.4, 2.4, and 2.4 respectively.

Table 2: Summary of Kendall's W Test Statistics on Rating of Mathematics Educators of GISP

N	Kendall's W[a]	Chi-Square	df	Asymp. Sig.
7	0.817	74.315	13	.0005

a. Kendall's Coefficient of Concordance

The result in Table 2 shows that Kendall's Coefficient of Concordance is 0.817. The coefficient of 0.817 implies that Mathematics educators had a high agreement. The null hypothesis was therefore rejected showing that there is significant agreement among Mathematics educators on the content of GISP. Hence, GISP sufficiently and appropriately covered the chosen content of geometry.

Discussion

The finding revealed that there is agreement among Mathematics educators that the contents of the developed GISP sufficiently covered the required areas of geometry based on senior secondary school (SS2) Mathematics curriculum. The result shows also that Mathematics educators rated GISP independently. It therefore means that GISP is reliable for instructional purposes. The reason could be that the procedure adopted in the development of GISP met the required standard of developing instructional software package. The finding of this study agrees with the finding of Isiaka and Mudasiru (2014) that developed and validated computer instructional package for learning Physics which produced a very good performance when used for Physics instruction. The finding of this study is also in consonance with the finding of Okorie (2014) who developed and validated the CBISP in Chemistry. The finding of this study further agrees with the finding of Usman, Wishishi, Gambari, and Olayinka (2017) who developed and validated instructional software package *in Hausa Language forteaching and learning of geometry at junior secondary school level.*

Conclusion

In this study, it was concluded that the contents of the developed GISP sufficiently covered the required areas of geometry in appropriate and sequential manner.

Recommendations

From the findings of this study, the following recommendations are made:

1. The use of GISP should be used by Mathematics teachers in teaching geometry concepts to students.
2. Computers should be provided by government agencies such as State Governments, and Federal Ministry of Education for effective utilization in teaching/learning at the secondary schools.
3. Mathematics teachers should be made to become computer literate so that they can develop appropriate instructional software package.
4. The development and validation procedures adopted in this study could be used as a model on development and validation of instructional software packages by teacher training institutions for training and retraining teachers.

References

Akor, A.E. P (2015). *Effect of achievement motivational instructional approach on primary six pupils' numerical aptitude and retention in Mathematics* (Unpublished doctoral dissertation) University of Nigeria, Nsukka.

Akukwe A. C.& Njoku, J.I (2014*). Introduction to computer studies.* Owerri: Onii Publishing House.

Association for Educational Communications and Technology (AECT, 2015). *Educational technology definition and glossary of terms.* Washington, DC: Association for Educational Communications and Technology.

Fabiyi, T.R. (2017). Geometry concepts in Mathematics perceived difficult to learn by senior secondary school students in Ekiti State. *IOSR Journal of Research & Method in Education (IOSR-JRME), 7* (1), 83-90.

Federal Republic of Nigeria (2013). *National policy on education* (5th Ed.). Lagos: NERDC Press.

Isiaka, A. G. & Mudasiru O. Y (2014). The development and validation of computer instructional package on physics for secondary schools in Nigeria. *Educational Research International,3*(1) 112-130.

Jacob, T. A, Decl, C. Bolaji, Y. K., Kajuru, M. M, & Musa, K. B. (2017). Effect of concrete manipulative approach on attitude, retention and performance in geometry among junior secondary school students in Benue State. *IOSR Journal of Research & Method in Education*,*7*(6), 80-175.

Joshua, M.T (2016). *Communication technologies and Science, Technology, Engineering and Mathematics (STEM) education*. Keynote address presented at the 57th annual national conference of Science Teachers Association of Nigeria from 15th-20th August, Government College, Ado Ekiti.

Nigerian Educational Research and Development Council, (NERDC, 2007). *New senior secondary education structure at a glance*. Lagos: NERDC Press.

Ntshengedzeni, R. M. (2015). *Enhancement of learners' performance in geometry at secondary schools in Vhembe District of Limpopo Province*. (Unpublished doctoral dissertation), University of Venda, Venda.

Nworgu, B. G. (2017). *Modern teaching approach*. Paper presented at the one day stakeholders' forum on e-curriculum. Nigerian Educational Research & Development Council (NERDC). Retrieved from https://www.facebook.com/NERDC

Okorie, E. U. (2014). Development and validation of teacher-made instructional software package for teaching chemical bonding in secondary schools. *Journal of Education and Practice*. 5 (22), 28 – 33.

Okorie, E. U. (2015). Effects of instructional software package method of teaching on students' interest and achievement in chemical bonding. *Scientific & Academic Publishing*; 5(6): 158-165.

Usman, B. A., Wishishi, D. I., Gambari, A. I. & Olayinka, O. (2017). Effect of developed web-based instructional package in Hausa language on academic achievement of upper basic students in geometry in Niger State. *ATBU, Journal of Science, Technology & Education (JOTE)*, 5(2), 109-118.

Vanguard, Newspapers (November 21, 2018). *Waec-releases-2018- wassce-results for private candidates recording 60% failure/*. Retrieve from https://www.vanguardngr.com

West African Examination Council (WAEC) (2008 – 2018). *Chief Examiners' Reports.* Yaba: Lagos State.

Industry-Related Mathematics Skills Acquisition for Job Performance by Senior Secondary School Students in Anambra State, Nigeria

Nkanyimo, C. I. [1] **& Okeke, S. O. C.** [2]

[1,2] *Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria*
[1] ic.nkanyimo@unizik.edu.ng [2] soc.okeke@unizik.edu.ng

Abstract

The industry-related mathematics skills acquisition for job performance by senior secondary school students in Anambra State, Nigeria was determined. Descriptive survey design was adopted. Three research questions guided the study and two hypotheses were tested at 0.05 level of significance. The study was carried out in in the State. Sample comprised 2,495 senior secondary schools three (SS3) mathematics students drawn from a population of 42,002 in the state through stratified random sampling technique. The Industrial Mathematics Skills Acquisition Test (IMSAT) was used as instrument for data collection. The IMSAT was validated by three experts and Kuder-Richardson Formula 20 was used to establish its reliability which yielded a reliability index of 0.89. The IMSAT was administered to students from the sampled schools. The research questions were answered using aggregate score, mean and standard deviation while hypotheses were tested using t-test. Findings of the study indicated that: majority of the students irrespective of gender and school location had good acquisition of industry-related mathematics skills for job performance; there was no significant difference between male and female, urban and rural students on industry-related mathematics skills acquisition. It was concluded that in Anambra State senior secondary schools, students were sufficiently exposed to industry-related mathematics skills for gainful employment in industries. Based on the findings, it was recommended among others that; mathematics teachers should continue to teach mathematics in such a way that the students' good acquisition of industry-related mathematics skills will be sustained.

Keywords: Industry-related mathematics, Skills acquisition, Job performance.

Introduction

Unemployment remains one of the most critical problems facing African nations today. Nigeria which is the most populous nation in Africa and second largest economy in the continent with a population of over 180 million is endowed with diverse human and material resources. The Nigerian Bureau of Statistics (NBS, 2018) recently put the number of unemployed as at the 3rd quarter of 2018 at 90.5 million and the underemployed at 18 million. From this unemployed population, the youths constitute about 38 percent. As a direct response to this challenge, millions of these youths brave the risk of voluntary enslavement in other countries in their search for greener pastures. Some of them travel through the risky

Mediterranean Sea on their way to Europe and many have died in the process. Moreover, most graduates have been recruited into the rank of armed robbers, kidnappers, terrorists, herdsmen and insurgents. Though the Nigerian government had made efforts to create jobs, it must be realized that to reduce unemployment in any country, all hands must be on deck, individuals, private sectors and government at all levels.

In line with this view, Ogbe (2006) stated that job creation acquired through youth empowerment is expected to reverse the structural weakness and imbalance in the economy by providing strategic focus and direction in the youths. Job creation is defined as the provision of new opportunities for paid employment, especially for those who are unemployed. To meet up with these challenges facing the youths, the governments had embarked on the youth empowerment programmes. Youth empowerment according to Jimba (2006) involves different ways the youths can be facilitated to cause changes in their lifestyle. It encompasses different ways youths can be exposed to different trades that may help them to engage in sustainable paid and self-employment. In an attempt to reduce unemployment among youths, different skills acquisition programmes have been initiated by the Federal and State governments. All these efforts do not seem to have yielded desired results.

Form research on developing entrepreneurial skills in secondary school students through effective mathematics education, Uka (2015) found that both students and teachers need knowledge of mathematics skills to be good entrepreneurs. This means that there is strong positive relationship between mathematics skills and industrial skills acquisition. This has lent anchorage to the research on industry-related mathematics skills acquisition for job performance by senior secondary school students in Anambra State. Industry-related mathematics is a combination of two concepts: industry and mathematics. Industry is defined as a process of making products by using machinery and factories or a group of business that provide a particular product or services (Webster, 2014). Mathematics skills are defined as

necessary and appropriate skills a mathematician should acquire that can be transferable to job. Enhancing the young person's employability through sound mathematics skills helps business gain more from the work experiences (Kilpatrick, Swafford & Findell, 2001). Industry-related mathematics skills therefore, are the basic mathematics skills that industries are willing to pay for that will engender job performance

Job performance is defined by Natasha, et al (2018) as all the behaviours employees engage in while at work. Salas, Rosen, Held and Weissmuller (2009) contributed that job performance is essentially a person's behaviour in the context of doing a task. Performance is determined by the amount of skills that the learner has acquired. The acquisition of industry-related mathematics skills by senior secondary school students may be related to gender and location. Gender can be classified into masculine and feminine. It is defined by Bravo-Bauman (2000) as the social construction of male and female identity. Hyde, Lindberry, Linn, Ellis and Williams (2008) found that when it comes to mathematics skills, girls and boys are similarly capable. They reported that in children from grades two to eleven, there was no gender difference for mathematics skills.

Hyde and Mertz (2009) added that while more boys than girls score at the highest level in mathematics, gender gap has been closing over time. In fact, they reported that the gap is smaller in countries with greater gender equality. Offiah and Egolum (2007) revealed that male students are academically superior to their female counterpart in mathematics skills. Adesina, Adigun, Irunokhali, Onihuna and Sada (2015) also reported no significant difference between mathematics skills acquisition and gender. On location Ugwuanyi (2016) and Oredein (2016) showed that; school location has a significant effect on students' skills acquision in sciences. Also Unodiaku (2013) found that there was a significant difference in the mean errors made by urban and rural SSI entrants as measured by MATHRET. He suggested therefore that location is a significant factor that influences the degree of readiness of JS3 students achieving from

junior secondary school level to senior secondary school level to acquire higher mathematics skills.

Skills acquisition is the bane of Nigeria's industrialization. Multinational Corporations (MNCs) have often preferred foreign to local labour in Nigeria due to the unskilled nature of the Nigerian labour force. It is in this context that unskilled labour force has remained a serious setback to Nigerian's industrialization and its growth and development. This has made the present study relevant which seeks to determine the industry-related mathematics skills acquisition by secondary school students that will make them competent workers in industries. This is a means of ensuring a sufficient level of industrial skills acquisition required for a fast pace of curbing unemployment in Nigeria. The problem of the study is 'What industry-related mathematics skills acquisition have senior secondary school students for job performance in Anambra State?'

Purpose of the Study

The purpose of the study was to determine the industry-related mathematics skills acquisition for job performance by senior secondary school three (SS3) students in Anambra State.

Specifically, this study sought to determine the:

1. Industry-related mathematics skills acquisition by SS3 students in Anambra State.
2. Industry-related mathematics skills acquisition by SS3 male and female students.
3. Industry-related mathematics skills acquisition by SS3 students from urban and rural schools.

Research Questions

1. What is the aggregate score of industry-related mathematics skills acquisition of senior secondary school year three (SS3) students in Anambra State?
2. What are the industry-related mathematics skills acquisition mean scores of male and female secondary school students?
3. What are the industry-related mathematics skills acquisition mean scores of urban and rural secondary school students?

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean scores of male and female SS3 secondary school students on industry-related mathematics skills acquisition.
2. There is no significant difference between the mean scores of urban and rural SS3 secondary school students on industry-related mathematics skills acquisition.

Method

The study adopted a descriptive survey design. The study was carried out in secondary schools in Anambra State. The population for the study was 42,002(34,105 private and 7,894 public) students. The sample for the study comprised 2,495 SS3 students in Anambra State. The sample was composed using multistage sampling technique. One instrument tagged Industrial Mathematics Skills Acquisition Test (IMSAT) was used to collect data for the study. Three experts from the Departments of Science Education, Educational Foundations and Guidance and Counselling in Nnamdi Azikiwe University, Awka validated the instrument. Reliability of IMSAT was established using Kuder-Richardson 20 Formula. The reliability coefficient of 0.89 was obtained. The IMSAT was administered to 2,495 SS3 students from the sampled schools. Aggregate score was used to answer research question one. Mean and standard deviation were used to answer research questions two and three while t-test was used

to test the null hypotheses at 0.05 alpha level. The benchmark is if mean ≥50, it means good acquisition but if mean< 50, it is poor acquisition for the research questions. In testing the hypotheses, the decision is to reject the null hypothesis if the P-value is less than the significant value of 0.05, otherwise, do not reject the null hypothesis.

Results

Research Question 1:

What aggregate score of industry-related mathematics skills acquisition have senior secondary school year three (SS3) students in Anambra State?

Table 1: Aggregate score placed in range of Industry-Related Mathematics Skills Acquisition by SS3 Students in Anambra State.

Range of Scores	N	%	Remark
0-49	640	29.7	Poor Acquisition
50-100	1514	70.3	Good Acquisition

Table 1 shows that 70.3% of the students with the scores ranging from 50 to 100 had good acquisition of industry-related mathematics skills, while 29.7% of the students who scored between 0 to 49 had poor acquisition of the industry-related mathematics skills.

Research Question 2:

What are the industry-related mathematics skills acquisition mean scores of male and female secondary school students?

Table 2: Mean Scores on the Industry-Related Mathematics Skills Acquisition of Male and Female Secondary School Students.

Group	N	Mean	SD	Remark
Male	861	57.25	14.20	Good Acquisition
Female	1293	56.77	14.10	Good Acquisition

Table 2 indicates that males have mean score = 57.25 (SD=14.20) while females have mean score = 56.77 (SD=14.10). Since both males and females had scores which are greater than the criterion score of 50, they were considered to have good industry-related mathematics skills acquisition in secondary schools.

Research Question 3:

What are the industry-related mathematics skills acquisition mean scores of urban and rural secondary school students?

Table 3: Mean Score on the Industry-Related Mathematics Skills Acquisition of Urban and Rural Secondary School Students.

Group	N	Mean	SD	Remark
Urban	994	57.29	13.54	Good Acquisition
Rural	1160	56.68	14.60	Good Acquisition

Table 3 shows that urban had mean score = 57.29 (SD=13.54) while rural had mean score = 56.68 (SD=14.60). Since both urban and rural secondary school students had scores which are greater than the criterion score of 50, they were considered to have good industry-related mathematics skills acquisition in secondary schools.

Hypotheses 1:

There is no significant difference between the mean score of female and male SS3 school students in industry-related mathematics skills acquisition.

Table 4: t-Test of Significant Difference between the Mean Scores of Male and Female Students on the Industry -Related Mathematics Skills Acquisition.

Group	N	X	SD	df	Cal.t	Crit.t	Decision
Male	861	57.25	14.20	2152	0.773	1.96	Not sig
Female	1293	56.77	14.10				

Table 4 shows that males had mean=57.25 (SD =14.20) while females had mean score = 56.77 (SD=14.10). This has yielded t value=0.77 with critical t=1.96 at df =2125. Now since the calculated t is less than the critical t value, the calculated t value of 0.77 was considered to be non-significant at 0.05 level of significance. This has warranted the non-rejection of the null hypotheses which states that there is no significant difference between the mean scores of males and female SS3 secondary schools student on industry-related mathematics skills acquisition.

Hypotheses 2:

There is no significant difference between the mean scores of urban and rural SS3 secondary school students on industry-related mathematics skills acquisition.

Table 5: t-Test of Significant Difference between the Mean Scores of Urban and Rural Students on the Industry-Related Mathematics Skills Acquisition.

Group	N	Mean	SD	df	Cal. t	Crit t	Decision
Rural	994	57.29	13.57	2152	1.00	1.96	Not sig
Urban	1160	56.68	14.60				

Table 5 reveals that rural had mean score = 57.29 (SD = 13.57) while urban had mean score = 56.68 (SD = 14.60). This has yielded t-value = 1.00 while the critical t = 1.96 at df = 2152. Now, since the calculated t-value is less than the critical t-value, calculated t-value of 1.00 was considered to be non-significant at 0.05 alpha level. Thus, the null hypothesis is not rejected which states that there is no significant difference between the mean score of urban and rural SS3 secondary school students on industry-related mathematics skills acquisition.

Discussion

The finding revealed that majority of the students had good acquisition of industry-related mathematics skills. This finding was consistent with that of Nwokolo (2009) that senior secondary school graduates needed 22 skills functions for jobs in industries. Uka (2015) also aligned with the finding of this study who found that both students and teachers need knowledge of mathematical skilled to be good entrepreneurs and there is strong positive relationship between mathematics skills and industrial skills. Finding of Ogan, Ibibio and Francis (2017) also confirmed the result of the present study. Ogan, et al found that students of high mathematic ability have greater mean percentage gain of 41.17% while those of low mathematical ability have 36.93%. This finding has come much as a surprise. This is because of the common global dread for mathematics. It is well known that all over the world people are scared of figures. However, a reasonable explanation of this phenomenon is that gainful

employment in industries is uppermost in the minds of the students considering the high rate of unemployment and the reluctance of Nigerians to work on farms. Hence, students across board were able to learn mathematics skills that can enable them function effectively in industries.

Results of from the study further showed that both male and female students had good industry-related mathematics skills acquisition in secondary schools. There was no significant difference between the mean scores of the male and female SS3 secondary school students on industry-related mathematics skills acquisition. These findings were in agreement with the finding of Benbow, Lubinski, Shea and Eftekhari- Sanjani (2000) that both sexes become exceptionally skillful and perceived themselves as such. Contrary to these findings were the studies by the Else-Quest, Hyde and Linn (2010) that despite overall similarities in mathematics skills, boys felt more confident in their abilities than girls did. Also, findings by Halpern, Benhow, Geary, Gur and Gernsbacher (2013) disagree with this finding. Halpern et al found that males are more variable on most measures of mathematics skills and visual spatial ability. The difference in the males and females acquisition of mathematics skills may be explicated by the fact that history of mathematics education shows that gender skills acquisition gap is due to the social construction of gender roles in society not because women are unwilling or unable to learn mathematics (Doer, 2011). That the present study shows no gender difference may be because the girl child no longer finds comfort in the kitchen. The girl child's psyche had changed overtime. They also aspire to work outside the home.

The results also indicated that both urban and rural students had good industry related mathematics skills acquisition in secondary schools. There was significant difference between the mean scores of urban and rural SS3 secondary school students on industry-related mathematics skills acquisition. The findings were not akin to the findings of Smither and Robinson (2006) that the location of the school had a significant effect upon students' skills

acquisition in mathematics, that students attending rural schools are not as skilful as students from urban schools. Tayaba (2012) found that rural and urban students had comparable levels of skills acquisition yet some rural students out-skilled their urban counterparts in some provinces. Also, Khanal (2016) found that there was significant difference in the use of mathematics skills learning strategies between urban and rural school students. These findings all disagree with the findings of this study. These contrary findings may be because schools in the rural areas suffer dearth of teaching and learning facilities. Most teachers posted to rural locations abscond and reject their postings thereby leaving the rural schools and their students with insufficient or no teaching staff.

That industry-related mathematics did not distinguish between urban and rural school in this study could be explicated in terms of high levels of aspiration of rural students to acquire good skills in the subject which would facilitate their migration to the cities in search of lucrative jobs in industries. Another plausible explanation for this is that rural areas usually lack basic social amenities which often distract the students in urban schools from their studies. Therefore, it follows a corollary that the rural students' lack of social amenities is compensated adequately by their devotion to their studies.

Conclusion

Based on the findings of the study, it was concluded that in Anambra state senior secondary school, students were sufficiently exposed to industry-related mathematics skills for gainful employment in industries. This is premised on the fact that both male and female students from urban and rural public and private school had good acquisition of industry-related mathematics skills.

Recommendations

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

1. Mathematics teachers should continue to teach mathematics in such a way that the students' good acquisition of industry-related mathematics skills will be sustained.
2. Industry related mathematics should be used by mathematics teachers to enhance gender equity in acquisition of all students in industrial skills.
3. Managers of schools should ensure equal exposure of urban and rural students to industry-related mathematic skills by maintaining equity in positing and transferring mathematics teachers to both locations.

References

Adesina, O, Adigun, J, Irunokhali, E, Ondure, J.E, Sada, Y. (2015). Effect of gender on students' academic performance in computer studies in secondary school in New Bussa, Borgu L.G.A of Niger State**,** *Journal of Education and Practice,* 6(33), 60-63.

Benbow, C. P., Lubinski, D., Shea, D. L., & Eftekhari-Sanjani, H. (2000). Sex differences in mathematical reasoning ability at age 13: their status 20 years later. *Psychological science*, *11*(6), 474–480. https://doi.org/10.1111/1467-9280.00291

Bravo-Baumann, H. (2000). *Capitalization on the experiences on the contribution of livestock projects to gender issues: Working document.* Bern Swiss: Agency for Development and cooperation.

Else-Quest N.M.; Hyde J.S. & Linn M.C. (2010). *Cross national patterns of gender differences in mathematics:* A meta-analysis. Retrieved from *https://www.ncbi.nlm.nih.gov*

Halpern, D.F. Benhow, C.P. Geary, D.C. Gur, R.C. Hyde, J.S, & Gernsbacher, M.A. (2013) The science of sex difference in science and mathematics https://www.ncbi.nlm.nih.gov/pubmed/25530726

Hyde, J.S. Lindbery, S.M. Linn, M.C. Ellis A.B. Williams, C.C. (2008). Gender similarities characterize mathematics performance. *Science, 321* (2), 491-495.

Hyde, J.S. & Mert, J.E. (2009). Gender, culture and mathematics performance. *Proceeding of National Academy of Science, 106*(22), 8801-8807.

Jimba, D. (2006). Youth empowerment for sustainable development. In contemporary issues and challenges for sustainable development in the new millennium The Nigeria Experience. *A book of reading school of arts and social science.* KSCOE: Akpa.

Khanal, B. (2016) Learning strategies used by urban and rural school students. Retrieved from https://www.researchgate.net/publication/309406644

Kilpatrick, J: Swafford, J & Findell. B. (2001) Adding it up: Helping Children learn mathematics, Washington: National Academy Press, 461

Natasha, F: Mariano, C.B: Rego, M.C; Campos, M; Ladilucy, P.A. & Franciso A.C. (2018) Job Performance analysis: Scientific studies. Journal of Management and Psychology from 2006-2015 https://doi.org/10.1002/pig 21248

Nwokolo, H. (2009) *Survey of mathematical concepts and skills needed by senior secondary school graduates to perform optimally at jobs in instries.* Unpublished Dissertation. Nnamdi Azikiwe University, Awka.

Offiah, F. C. & Egolum, E.O. (2017). Effects of prior knowledge of some relevant mathematical concepts on students achievement in stoichemistry. *Journal of Science Engineering and Technology,6* (149), 7676-7685.

Ogan, C; Ibibio, G. & Francis, O.I. (2017). Effects of mathematics knowledge on physics students performance in electromagnetism, Retrieved from *https://creativecommons.org/licenses/by/4.0*

Ogbe, N. E. (2006). The current state of Nigerian economy. *Bullion, Abuja: Central bank of Nigeria,10* (1), 17-23.

Salas, E; Rosen, M.A; held, J.D. & Weissmuller, J.J. (2009). Performance measurement in simulation-based training. A review and best practices. *Simulation of Gaming,* 40(3), 328-376.

Smither, A. & Robinson, P. (2006). *The paradox of single-sex and co-educational schooling,* Buckingham: Carmichael press

Tayaba, S. (2012) Rural-urban gaps in academic achievement, schooling, conditions, students, and teachers' characteristics in Pakistan. *International Journal of Educational Management.* Retrieved from *https://www-emeraldinsight.com/doi/abs/10.1108/09513554121119*

Ugwuanyi, A. A. (2016). *Science process skills acquired by senior secondary school chemistry students in Enugu Education Zone.* An unpublished Master Thesis, University of Nigeria, Nsukka.

Uka, N.K. (2015) Developing entrepreneurial skills in secondary school students, through effective mathematics education in Aba, Nigeria. *International journal of Education Learning and Development, 3* (7), 1-11.

Unodiaku, S.S. (2013). Influence of sex and ability level on students mathematics readiness in Enugu State. *Journal of Education and Practice, 4*(14). 222-228.

Webster Dictionary (2014) Industry (definition). Retrieved from http://www.merriam-webster.com/disturary/industry

Gender and Academic Retention of Secondary School Students Taught Electrostatics with Computer Animated Instructional Package in Awka Education Zone

[1]Nwoye, A. N., [2]Okeke, S. O. C. & [3]Nwosu, F. C.
[1, 2]Department of Science Education, Nnamdi Azikiwe University Awka, Anambra State, Nigeria
[3]Department of Electrical/Electronic Engineering, Federal Polytechnic Oko, Anambra State, Nigeria
[1] an.nwoye@unizik.edu.ng [2] soc.okeke@unizik.edu.ng [3] jirebus@gmail.com

Abstract

Several researchers had investigated how multi-media could be used to improve understanding of difficult and abstract topics in physics yet; a few studies have been conducted to investigate the gender differences in students' learning retention through multi-media use. This paper determined gender differences in students' academic retention in electrostatics through computer animated instructional package (CAIP)in Awka Education Zone. of Anambra state, Nigeria. One research questions guided the study and two null hypotheses were tested at 0.05 level of significance. Quasi-experimental non-equivalent control group design was adopted for the study. Population was 3,438 senior secondary one (SS I) students from government owned co-educational secondary schools in the area. A sample of 68SS I from Awka south and Dunukofia Local Government Areas was selected through multistage sampling. The students were exposed CAIP produced by the researchers which is based on the content of the SS I physics scheme of work. Instrument for data collection was Electric Charge Electric Field Achievement Retention Test (ECEFART) validated by three experts with a reliability index of 0.89 using KR-20 formula. Mean and Analysis of covariance were used for data analysis. Findings revealed that; gender had no significant influence on students' retention in electrostatics when taught with CAIP; there was no significant interaction effect of treatment and gender on students' academic retention. Based on the findings, it was recommended among others that since computer animated package enhances retention in physics, teachers should embrace its usage in classroom.

Keywords: Gender, retention, electrostatics, Computer assisted instruction

Introduction

The importance of education across gender has led to the intensified research on the performance of both male and female students in academics in addition to the need to ensure an equal performance of both genders on both science and art subjects. It has also called for the need to identify the factors leading to the differences in their academic performance where

there is any. Several authors have noted the influences of teacher's competence, family background of the students, school environment, the society where the school exists and the impact of government on the retention and performance of students on science subjects such as Physics (Akiri & Ugborugbo, 2014; Ayodele & Adebiyi, 2013; Okoro, 2004). However, Adigun et al (2015) identified that gender is a strong influencing factor in the retention and performance of students in science subjects and their understanding of difficult science concepts. According to the authors, a student's gender comprises the physical, mental, biological features of an individual including the behaviours that make the male and the female population distinct. The need for the study of the effect of gender on the student's academic retention is underpinned by the socio-cultural dissimilarities between both genders. For instance, some science/technological professions such as carpentry, engineering, craft are classified as men's professions while some professions such as catering, nursing, and home economics are classified as a female course based on the socio-cultural perspectives of the individual.

To enable students' understanding of the teaching and learning process and to increase students' retention in perceived difficult science concepts such as Electrostatics, computer technology is applied to facilitate students' understanding. Electrostatic is a concept in physics which studied charges at rest. The realization that this aspect of physics is among those that is treated as a difficult and abstract concept with little practical implications has over time dampened interest of the learner hence retarding their retention of the concept which equally affects their performance in physics. Yusuf and Afolabi (2010) noted that the Computer Animated Instructional Package (CAIP) arouses the interest of the students thereby enhancing retention and serves as a motivation to the students irrespective of their gender. Through the CAIP lessons are provided for better understanding through, animation, games, drill and practice, visual imagery, and tutorial (Mayer, 2009; Scot, 2004). Students' ease in

understanding a lesson serves as a driver for their sustained attention and retention in the subject and the subsequent adoption of the subject as a career choice because of the simple method the lessons are presented through the CAIP.

Several studies have been carried out to ascertain the effect of gender on the understanding, performance, and retention of the student in some science subjects such as Mathematics, Computer, and Physics using computer-animated instruction package, however, Yusuf and Afolabi (2010) identified that there has not been any success recorded as the link between the instructional model and the performance of either male or female gender, but the authors believed that attitude to the model, access, computer use, and career choice is not the same across genders. This has called for the concern of parents, policymakers, practitioners, and stakeholders in education on ensuring equal perception of the importance of advanced technology, because of its future position in human activities such as teaching and learning. Scholars such as Danmole (1998) and Stephen (2010) were of the view that male students outperform female students in a science subject such as Physics while other study carried out by Atadoga, Zaria, Mari,and Danjuma (2016) made a contrary revelation stating that female students perform better than their male counterparts.

On the use of the CAIP, Collazos, Guerrero, Llana, and Oetzel (2020) identified that computer-animated instructional model improves collaborative learning which also ensures students' performance and retention in some perceived difficult subjects such as Physics. The authors identified that a greater number of females in a collaborative learning group have a higher index of collaboration when compared with a group with few numbers of women. Research across genders failed to establish the gender-differences across on the retention of male and female students. Authors such as Kirkpatrick and Cuban (1998) and Yusuf and Afolabi (2010) stated that findings have revealed a similar record across genders when male

and female students are exposed to the same level of learning experience using the CAIP, therefore a similar level of impact is recorded in students-subject retention across gender.

Purpose of the Study

The main purpose of the study is to investigate on the influence of gender on the academic retention of secondary school students taught electrostatics with Computer Animated Instructional Package (CAIP). Specifically, the study sought to;

1. investigate the difference in mean retention scores of male and female students taught electrostatics using CAIP.
2. find out the interaction effect of the package and gender on students' retention in electrostatics.

Research Question

1. What is the difference in mean retention scores of male and female students taught electrostatics using CAI package?

Hypotheses

The following hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the mean retention scores of male and female students taught electrostatics.
2. There is no significant interaction effect of package and gender on students' retention in electrostatics.

Method

Quasi-experimental design was used for this study, specifically, non-equivalent control group design. The population is total of 3,438 SS 1 students from all the state government owned co – educational secondary schools in Awka Education Zone of Anambra state. Co-educational secondary schools were chosen in order to create the same study environmental

condition for both genders. While SS 1 students were chosen because SS 1 is the foundation class for science students and if captured at that level the students might likely study physics in SS 2 and SS 3. The sample was made of 68 (37 males and 31 females) SSI students. This was selected through multistage sampling. 30 items of multiple-choice questions (MCQ) on electric charge and electric field were used as data collection tool. Prior to the classroom exercise, teachers who acted as research assistants had been adequately briefed and had demonstrated competence in the successful implementation of the instructions, pre-test was applied on groups a week before the actual teaching of the electric charge and electric field concepts. Experimental groups were taught using CAIP. Conventional lecture method was used for groups which are known as control groups. Post-tests were administered to both groups one week after the treatments. In analysis of data, descriptive and inferential statistics were used. ANCOVA was used for testing the hypotheses. In this case, post-test scores serve as covariate measures. In this study, steps below were observed with control and experimental groups in 5 weeks of process. At the end of pre-test, subjects of electric field, types of charge, charge and charge interaction, charge as a quantity and production of charges were taught to both groups by their class teachers who served as research assistants in line with the lesson plan prepared by the researchers. Control groups were exposed to the physics concepts using conventional method. Experimental groups were taught using CAIP produced by the researchers from the same field with the lesson plan. The package adopted the tutorial modes of Computer Assisted Instruction (CAI). After the treatment has been made, the same instrument was reshuffled and used as delayed post-test.

Results

Table 1: Mean and Standard Deviation Scores of Students' Retention Scores by Gender

Gender	N	Post-test Mean	SD	Test for Retention Mean	SD	Gain in mean
Male	37	73.00	10.21	74.92	8.54	1.92
Female	31	70.10	10.87	75.23	12.56	5.13
Mean Difference		2.90		-0.31		-3.21

Table 1 presents the mean retention scores of male and female students exposed to CAIP in electrostatics. Male students had a mean retention score of 74.92 while their female counterpart had 75.23. From the table 1, it is obvious that female students with mean gain of 5.13 retained more than male student with mean gain of 1.92.

Table 2: ANCOVA Test of Significant Difference between the Mean Retention Scores of Students by Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	1590.331[a]	2	795.165	8.962	.000	
Intercept	2424.523	1	2424.523	27.325	.000	
Post-test	1588.742	1	1588.742	17.905	.000	S
Gender	45.690	1	45.690	.515	.476	NS
Treatment*Gender	351.790	1	351.790	3.019	.084	NS
Error	5767.434	65	88.730			
Total	390458.000	68				
Corrected Total	7357.765	67				

S= Significant at 0.05 probability level NS= Not Significant at 0.05 probability level

Table 2 reveals that the value of significant of F (0.515) on the mean retention scores of students based on gender (Treatment*Gender) is 0.476 which is greater than the alpha level of $p<0.05$. The null hypothesis that there is no significant difference between the mean retention scores of male and female students taught electrostatics through CAIP is therefore upheld. This implies that the effect of CAIP on students' retention does in no way influenced by whether the student is a male or female.

From Table 2, it can be observe that the significant of F (3.019) for the interaction (Treatment*Gender) is 0.084 against $p<0.05$. Facts emerging from the table show that there is

no significant interaction effect between method of instruction and gender on students' retention. Thus, the null hypothesis 2 is upheld. That means the male and female students are in the same retention level when exposed to CAIP.

Discussion

The findings of this study revealed that there is no variance in the delay post ECEFAT scores of male and female students exposed to CAIP. This is an indication that male and female students benefitted. Table 2 also confirms that gender is not a significant factor in students' retention in physics concept taught. This is in agreement with the earlier findings of Aminu (2015); Stephen (2010) which revealed no significant difference in the academic retention of male and female students exposed to animated-media strategy. The present study further reveal that CAIP used in the course of this study could be used to improve students' retention in physics irrespective of gender.

Hypothesis two predicted that there would be no significant interaction effect of the package and gender on students' academic retention in electrostatics. But the result of the analysis of covariance on retention presented on Table 2 showed that the significance of F in the two-way interaction is higher than the significant level of alpha set at $p<0.05$. It implies that there is no significant interaction effect of method of instruction and gender on students' retention in physics concept (electrostatics). This means that the group difference is not sensitive of gender.

From the findings of this study, CAIP has proved to be useful in teaching and learning of physics in Awka Education zone, Anambra state, Nigeria just as in developed countries of the world like; USA, UK and so on. The realization that physics is treated as a difficult and abstract subject with little practical implications has over time dampened interest in the learning of physics thereby hampering students' retention in physics. However, with the emergence of ICT as an important tool in teaching and learning of science which physics is one of the science

subject, teaching and learning of difficult and so to say abstract subjects like physics has proven not to be inherently boring. Looking at it from another angle, it can be said that the problem lies in the fact that teachers are usually not equipped with the skillset and tools to make the teaching and learning of physics more interesting. This concur the expression of Aina (3013) that the proliferation of educational software aimed at explaining the complex aspects of physics have served to trigger interest in the subject. With the students' interest aroused in any educational environment, there retention will automatically be enhanced. Hence with the use of computer software (CAIP, CAD, CAI, among others) in classroom activities, teaching and learning of not only physics but other difficult subjects' concept will become more interesting, simplify and meaningful thereby enhancing retention of learners.

Conclusion

Based on the findings of this study, the following conclusions were made. The result of this study provide empirical evidence that female students exposed to CAIP retained slightly more than their male counterparts, though their mean retention scores were not significant.

Recommendations

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

1. Students irrespective of gender should have equal opportunity and the level of motivation to learn.
2. Since the use of computer animated instructional package enhances retention in physics concept (electrostatics), the physics teachers should embrace its usage in classroom.

References

Abimbade, A. (1997). *Principle and practice of educational technology*. Ibadan: International Publishers Ltd.

Adigun, J., Onihunwa, J., Irunokhai, E., Sada, Y. and Adesina, O. (2015). Effect of gender on students' academic performance in computer studies in secondary schools in New Bussa, Borgu Local Government of Niger State. *Journal of Education and Practice, 6(33),* 1-7.

Aina, J. K. (2013). Effective teaching and learning in science education through ICT. *IOSR-JRME, 2(5),* 43-47

Akiri A. A. and Ugborugbo, N. M. (2009). Teachers' effectiveness and students' academic performance in public secondary schools in Delta State, Nigeria. *Stud Home Comm Sci, 3(2),*107-113.

Atadoga, M.M, Zaria, A.B, Mari, J.S & Danjuma, A.B (2016). Effects of CAI on academic achievement of Nigeria certificate in education physics students in Niger state, Nigeria. *Report and opinion, 8 (1),* 39 – 46.

Ayodele, C.S & Adebiyi, D.R (2013). Study habits as influence of academic performance of university undergraduates in Nigeria. *Research Journal in Organizational Psychology & Educational Studies, 2(3),*72-75.

César A. Collazos, C. A., Guerrero, L.A., Llaña, M. & Oetzel, J. (2020). Gender: An influencing factor in the collaborative work process in computer-mediated communication. Retrieved from*:* *https://www.researchgate.net/publication/255628731_Gender_An_influence_factor_in_the_collaborative_work_process_in_computer-mediated_communication*.

Danmole, B. T. (1998). The influence of teacher preparation and use of instructional materials on primary school pupils' performance in integrated science. *Ilorin Journal of Education, 12,* 56 - 64

Kelly, A (1978). *Girls and science.* International Association for Evaluation of Educational Achievement Monograph (9). Stockholm: Almguist and Wilksell.

Kirkpatrick, H. & Cuban, L. (1998). Should we be worried? What the research says about gender differences in access, use, attitudes, and achievement with computers. *Educational Technology, 38 (4),* 56 – 60.

Novak, J. D. & Mosunda, D. (1991). A twelve-year longitudinal study of science concept learning. *Americana Research Journal, (28),* 117 - 153

Okoro, C. N. (2004). *School environment and teacher competency variable as correlates of learning outcomes of integrated science students with hearing impairment.* Unpublished Ph.D. Thesis University of Ibadan, Ibadan.

S.A. Awoniyi, (2004). Sex differences in academic performance. *Nigerian Journal of Gender and Development,1(1&2)* 35.

Scott, M. (*2004*). *Wordsmith Tools 4*, Oxford: Oxford University Press.

Wonzencreft, M. (1963). Sex comparism of certain abilities. *Journal of Educational Research 57, 21 – 22*

Yusuf, M. O. & Afolabi. A. O. (2010). Effects of computer assisted instruction (CAI) on secondary school students' performance in biology. *Turkish Online Journal of Educational Technology, 9(1), Retrieved from: www.tojet.com*.

Yusuf, O. M. & Afolabi, O. A. (2010). Effects of computer assisted Instruction (CAI) on secondary school students' performance in Biology. *The Turkish Online Journal of Educational Technology, 9(1),* 62-69.

Effect of Group Instruction Technique on Secondary School Students' Interest in Civic Education in Anambra State, Nigeria

Unachukwu, G. C.[1] & Okoli, O. K.[2]

[1,2] Department of Educational Foundations, Nnamdi Azikiwe University Awka, Anambra State, Nigeria

Abstract

The persistent poor students' interest in Civic education is a major concern and there is need to ameliorate it. This study examined the effect of group instruction technique (GIT) on secondary school students' interest in civic education in Anambra State. Two research questions guided the study and three null hypotheses were tested at 0.05 level of significance. The study employed quasi-experimental design. Multi-stage sampling procedure was used to select 193 Senior Secondary two (SS2) students from six intact classes. The experimental group was 92 (48 males and 44 females) while the control group was 101 (54 males and 47 females). Civic Interest Scale (CIS) was used as instrument for data collection. Validation of the instrument was established by experts in the field of civic education and measurement and evaluation, while Cronbach Alpha reliability coefficient was used to establish the reliability of CIS at r = .82. Experimental and control groups were taught Civic education for six weeks using GIT and Lecture method respectively. Mean and Standard deviation were used to analyse data to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses using SPSS version 23.0.Findings revealed that the use of GIT significantly enhanced SS 2 students' interest in Civic education more than the Lecture method. Gender was a significant factor on the effect of GIT on students' interest in civic education among other findings. Based on the findings, it was concluded that GIT is a good alternative teaching technique to improve students' interest in civic education. It is therefore recommended among others that, GIT should be formally adopted by secondary school teachers for effective teaching of Civic education to improve students' interest in the subject.

Keywords: Civic Education, Instruction Technique, Interest

Introduction

Civic education aims at empowering the learners to be well-informed active citizens and gives them the opportunity to change the world around them. Civic education as an integral part of general education was one of the core subjects introduced into the secondary schools of Nigeria by the Nigerian Educational Research and Development Council (NERDC, 2007). It is aimed at implementing value reorientation, political participation and good citizenship traits. Civic education as studied in Nigerian secondary schools is that aspect of learning about

nationhood, the workings of democratic system of government and the responsibility of the citizens in that democratic setting (Falade & Adeyemi, 2015).

Despite these important components of civic education built ideally to inculcate the spirit of nationalism in the students; it is worrisome that the behaviour the students towards civic duties as well as their interest in civic education are becoming less satisfactory by day. The situation has become worrisome to stakeholders and the society at large prompting studies into the causes. Civic education as one of the subjects taught in the Nigerian secondary schools has some problems affecting students' interest.

Interest is an important variable in learning because when one becomes interested in an activity, one is more likely to be more deeply involved in the activity and thus achieve more (Okeke, 2008). Interest goes hand in hand as factors that promote effective learning. Rowey (2009) posited that interest is subjective feeling of concentration and curiosity over something. Interest in this study portends eagerness to learn a set out task/activity for positive and near mastery of knowledge and skills related to the activity which was measured in this study using civic interest scale.

One of the major causes of students' low interests in civic education as reported by Bennions and Drill (2013) is the instructional technique used by the teacher. This resonates withMeziobi in Ukaegbu's (2011) assertion that the content and methods of delivery of civic education curriculum needs to be revisited and re-packaged in order to drive home the aim of teaching civic education in our schools.Levinson (2007) also found that civic education teachers mostly used the conventional lecture techniques which centers on teacher, textbooks, chalk and black board.

The lecture method involves a process of teaching where the teachers are seen as sources of all knowledge and organizers of classroom activities with the learners as passive followers. It is also the subject matter approach and the teacher centered method of teaching

where the lesson is focused on covering the subject matter during a special period of time without allowing the learner to join in the construction of knowledge or participate in the gathering, organizing and internalization of it. The central issue in lecture method is transfer of information by means of facts. Teachers using lecture method have very limited concern about students' ideas and reasoning when they prepare their lessons. Teacher's attention during lecture method is usually on students' cognitive domain (knowledge) and not constructive aptitudes; the lecture method teachers seem not to use guided inquiry method and group knowledge construction to elicit information from the learners; yet, the use of lecture method is still currently patronized by classroom teachers despite its limitations.

The lecture method of teaching has been largely criticized for stifling interest and creativity in students. Parveen, Yousuf and Mustapha (2017) criticized the lecture method used by teachers in classrooms as being incapable of ushering in a classroom where activity, inquiry, and interactions would bring about desired learning outcomes in both males and females. These views may suggest that the method of teaching civic education may be responsible for a situation where students fail to neither manifest high interest rating nor score high in academic tests.

To enhance civic education interest of learners in the senior secondary schools, there is the need to try out other techniques of teaching the subject. This becomes imperative to see if the aim of teaching civic education curriculum could be achieved in the learners. The emerging trend in methodological approaches to civic education instruction is the use of a variety of stimulating instructional techniques such as group instruction using brainstorming and cooperation to facilitate interest in learners as it encourages in student spirit of self-learning, guided inquiry and resourced based constructive learning (Bennion & Drill, 2013). To this end, the civic education curriculum for senior secondary education as developed by NERDC (2007) which recommended the use of a variety of methods that facilitate students' ability to learn

more, retain more and apply what is learned by engaging in significant and appealing activities. One of such methods is the group instruction technique (GIT).

Group instruction technique (GIT), according to Lopez and Kirby (2007) is teacher–directed; students'-focused learning strategy aimed at actively involving students, first individually and in group in knowledge construction by providing information or developing step-by-step skills for purposeful learning. It also helps to assess and monitor learning progress, the author added GIT is a broad concept which embraces approaches such as; brainstorming, co-operative, interactive, experimental and independent study. Additionally, this study will investigate the effect of GIT on students' interest across gender.

Gender being socio-biological classification of people as either males or females is denoted in this study is how males' and females' interest in civic education depend on the teaching and learning technique. Okoli (2010) asserted that instruction technique could have gender effect on subject interest among students. There is existing gaps in study designs of previous studies attempting to establish the efficacy of different instruction techniques in improving students' interest in civic education using quasi-experimental design. Therefore, this study intends to fill the gap created by this neglect.

Research Questions

1. What are the mean interest ratings (scores) of students taught civic education with Group Instruction Technique (GIT) and those taught with Lecture Method (LM)?
2. What are the post-test mean interest scores of male and female students taught civic education with GIT?

Hypotheses

Three null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the mean interest ratings of students taught civic education with GIT and those taught with the LM.

2. There is no significant difference between the mean interest scores of male and female students taught civic education with GIT.
3. There is no interaction effect of instruction techniques and gender on students' interest scores in civic education.

Method

The design of this study was non-randomized control group, pre-test, post-test quasi-experimental design. The design involved the use of two groups; the control group and the experimental group evaluated on the pre-test and post-test basis using approved treatment for the study. The study was carried out in Anambra State of Nigeria. The issue of proximity and easy accessibility of the schools to the researcher for effective coordination of the experiment also informed the choice of the study area. The population of the study consisted of 8,656 (4,362 male students and 4,294 female students) senior secondary two (SS 2) students in the 193 co-educational secondary schools in Anambra State. The choice of co-educational secondary schools is informed by the desire to study the population in a near natural learning habitat without the influence or bias which may be associated by typical Boys or Girls school setting. The sample size of the study comprised 193 secondary school students; the experimental group was 48 males and 44 females totalling 92 SS 2 students. The control group was 54 males and 47 females totalling 101 SS 2 students which sum up the sample for the study thus: 92+101= 193. The sampling technique for the study was multi-stage sampling technique which involved the use of different but appropriate sampling techniques at every stage of the selection. The instrument used for data collection in this study was Civic Interest Scale (CIS) constructed by the researcher. The CIS was validated by experts in measurement and evaluation and curriculum studies, from Nnamdi Azikiwe University Awka; and expert in civic education from Nwafor Orizu College of Education, Nsugbe who is a team leader in WASSCE civic education marking exercise. The reliability

of CIS scale was established using Cronbach's alpha reliability coefficient. Experimental procedures involved the training of research assistants, pre-test, post-test and control of extraneous variables such as effect of pre-test, post-test, initial group difference, class interaction, Hawthorn effect and experimenter bias. Data collected from the pre-test and post-test were analysed using mean and standard deviation to provide answers to the research questions. Analysis of covariance (ANCOVA) was used to test the significance of the differences at 0.05 alpha levels. In taking decision, accept the null hypothesis (Ho) if calculated F is less than F-critical value. Hence reject the null hypothesis (Ho) if calculated F is greater than the F-critical value.

Results

Table 1: Mean interest ratings (scores) of students taught civic education with GIT and those taught with LM

Source of Variance	N	Pre-test Mean	SD	Post-test Mean	SD	Mean Difference	Remark
Experimental Group	92	56.88	11.0	68.40	9.85	11.52	Effective
Control Group	101	55.97	8.71	56.06	8.54	0.09	Not Effective

Data in Table 1 reveal the pre-test mean interest scores of students taught civic education with Group Instruction Technique (experimental group) as 56.88 while pre-test mean interest scores of those taught with Lecture Method (control group) was 55.97. At the end of the experiment, the post-test mean interest scores of students taught civic education with Group Instruction Technique (experimental group) increased to 68.40 whereas that of those taught with Lecture Method (LM) was 56.06. This finding is indicative that the experimental group gained 11.52 post-test mean interest on civic education whereas the control group gained only 0.09 post-test mean interest on civic education. This shows that GIT which was used for the experimental group accounted for the difference in civic interest than the LM which was used in the control group.

Table 2: Mean interest scores of male and female students taught Civic education with GIT

Source of Variance	N	Pre-test LM	GIT	SD	N	Post-test LM	GIT	SD	Mean Difference	Remark
Male	54	57.4	54.4	9.79	48	57.0	66.8	9.3	9.8	Effective
Female	47	54.3	59.5	11.7	44	54.9	70.1	10.1	15.2	Effective
Mean difference		3.1	5.1			2.1	3.3			Effective

Data in Table 2 reveal the post-test mean interest scores of male and female students taught civic education with GIT were 66.8 for males and 70.1 for females. The data is indicative that in the post-test GIT, females had higher interest in civic education than males with a mean difference of 3.3. The finding implies that there is gender effect in the civic education interest between males and females taught with GIT.

Table 3: ANCOVA on mean interest scores of students taught civic education with Group Instruction Technique (GIT) and those taught with Lecture method (LM)

Source	Type I Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	7322.847[a]	1	7322.847	86.633	.000
Intercept	740652.518	1	740652.518	8762.331	.000
Instruction Technique	7322.847	1	7322.847	86.633	.003
Error	16144.634	191	84.527		
Total	764120.000	193			
Corrected Total	23467.482	192			

a. R Squared = .412 (Adjusted R Squared = .408)

Data in Table 3 reveal that the mean interest scores of students taught civic education with GIT and those taught with Lecture method were ascertained at $F(1, 193) = 86.6$, $p < .05$. The p-value ($p \leq .003$) is less than 0.05 and adjusted R^2 indicated that the observed difference contributed .408 (40.8%) understanding of the effects of instruction technique on civic interest. Thus, null hypothesis II is rejected.

Table 4: ANCOVA on mean interest scores of male and female students taught Civic education with GIT.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7334.873[a]	2	3667.437	43.193	.000	.313
Intercept	75280.016	1	75280.016	886.602	.000	.824
Gender	12.026	1	12.026	.142	.707	.001
Instruction Technique	7313.959	1	7313.959	86.139	.000	.312
Error	16132.609	190	84.908			
Total	764120.000	193				
Corrected Total	23467.482	192				

a. R Squared = .313 (Adjusted R Squared = .305)

Data in Table 4 also reveal that the mean interest scores of male and female students taught civic education with Group Instruction Technique (GIT) was ascertained at F(1, 193) = .142, p > .05. The p-value (p > .707) is greater than 0.05 and adjusted R^2 indicated that the observed difference contributed .305 (30.5%) understanding of the effects of instruction technique on civic interest. Thus, null hypothesis IV was confirmed.

Table 5: Interaction effect of instruction technique and gender on students' interest scores in civic education

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7685.147[a]	3	2561.716	30.678	.000	.327
Intercept	743473.753	1	743473.753	8903.406	.000	.979
Instruction Tech	7470.646	1	7470.646	89.464	.000	.321
Gender	18.574	1	18.574	.222	.638	.001
Instruction Tech * Gender	350.274	1	350.274	4.195	.042	.022
Error	15782.335	189	83.504			
Total	764120.000	193				
Corrected Total	23467.482	192				

a. R Squared = .327 (Adjusted R Squared = .317)

Data in Table 5 reveal the interaction effect of instruction technique and gender on students' interest scores in civic education at F (1,193) = 4.1, p > .05. The p-value (p > .042) is less than 0.05 and adjusted R^2 indicated that the observed interaction contributed .317 (31.7%) understanding of the combined effects of instruction technique and gender on students' interest in civic education. Thus, null hypothesis VIII was not confirmed. This

implies that instruction technique and gender significantly affected students' interest in civic education since there were significant differences in the civic interest scores among students taught with different techniques and across gender.

Discussion

The result of research question one as presented in Table 1 showed that there is a mean difference on the interest scores of students taught civic education with Group Instruction Technique (GIT) and those taught with Lecture Method (LM). From the result, the experimental group (GIT) had a mean gain of 11.52 while the control group had a mean gain of 0.09. This gives mean difference of 11.43 in favour of the experimental group which further indicates that greater effectiveness was achieved with group instruction technique than the lecture method. Comparing the result of research question one with hypothesis one in Table 3, hypothesis two is rejected since the experimental group taught civic education with GIT had higher interest than the control group taught civic education with LM as evidenced in the mean difference. This means that students' interest in civic education is higher when taught with Group Instruction Technique than Lecture Method. This finding is supported by the findings of Nweke and Uba(2011) which revealed that higher interest to civic education were recorded among students with group projects than those with individual projects; hence, method of learning was responsible for increased interest among the students and thus is connected to the findings of the current study. The finding is further supported by the finding made by Agbodike (2010) on citizenship education which identified that students' poor attitude towards civic education can be improved through curriculum delivery method in which group instruction technique has been identified as one of the delivery methods to enhance students' interest as found in the current study.

The result of research question two as presented in Table 2 showed that there is a mean difference on the interest scores of male and female students taught civic education

with GIT and those taught with Lecture Method (LM). From the result, males in the experimental group taught civic education with GIT have a mean difference of 9.8 when compared with civic interest scores of males in control group taught civic education with LM. Also, females in the experimental group taught civic education with GIT had a mean difference of 15.2 when compared with civic interest scores of females in control group taught civic education with LM. However, comparing the data in Table 4, the observed difference in the mean did not reach significant proportions hence, hypothesis two is confirmed since interest scores of both males and females in experimental group taught civic education with GIT were similar with the interest scores of males and females in control group taught civic education with LM. From the findings, instruction technique did not affect male and female interest on civic education since there is no significant difference between the mean interest scores of male and female students taught civic education with GIT and those taught with Lecture method (LM). Although, the finding is not in congruence with some studies which have suggested that instruction technique could have gender effects on subject interest among students such as in the works of Okoli (2010), there may be other unexplained variables which may influence the interest of such students. Such unexplained variables may be responsible for the current findings which did not find significant difference between the mean interest scores of male and female students taught civic education with GIT and Lecture method. This finding is also in contrast to the findings made by Nweke and Uba (2011) on the "effect of individual project and group project methods on students' interest and achievement in teaching and learning of civic education in junior secondary schools' which found that students' higher interest in civic education were associated with students with group projects than those with individual projects.

Conclusion

Based on the foregoing, the study concludes that group instruction technique (brainstorming and cooperation) improved students' civic interest more than the conventional lecture method.

Recommendations

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

1. Group instruction technique should be adopted in problematic subjects in secondary schools in Anambra State in order to improve students' interest in the subjects.
2. Teachers who are experiencing abysmal failures of their students' performance in certain subjects should in collaboration with their management authorities experiment the effectiveness of other instruction techniques rather than sticking to the conventional method of instruction such as the lecture method.

References

Agbodike, A.; Megwalu, O.; Onuegbunam, G. & Obakwueche (2010), *Citizenship education: A panacea for moral decadence in Oyi Local Government Area, of Anambra State.* Unpublished essay in citizenship education. Nwafor Orizu College of Education, Nsugbe.

Bennion, E. A., & Dill, H. (2013). Civic engagement research in political science journals: An overview of assessment techniques. In A. R. M. McCartney, E. A. Bennion, & D. Simpson (Eds.), *Teaching civic engagement: From student to active citizen*, 423–435. Washington, DC: American Political Science Association.

Davila, A., & Mora, M. T. (2007a). *Do gender and ethnicity affect civic engagement and academic progress? Part II of an assessment of civic engagement and academic progress*. The center for information and Research on Civic Learning and Engagement working paper, 53, 1-25.

Falade, D. A., & Adeyemi, B. A. (2015). Civic education in Nigeria's one hundred years of existence problems and prospects. *Journal of Emerging Trends in Educational Research and Policy Studies*, *6*(1), 113-118.

Levinson, M. (2007). The Civic Achievement gap. The center for information and Research on Civic Learning and Engagement, *Working Paper*, 51.

Lopez, M. H. & Kirby, E. H. (2007). U.S. Civics instruction: content and teaching Strategies. CIRCLE. The Centre for information and Research on Civic Learning and Engagement 1-9.

NERDC (2007). *9-Year basic education curriculum: Civic education for JS 1-3*. Lagos: UBEC.

Okeke, N. F. (2008). *The effect of activity centered teaching approach using low cost learning kits in facilitating students' achievement and interest in mathematics*. Unpublished Master's Thesis, Faculty of Education, Nnamdi Azikiwe University, Awka.

Okoli, O. K. (2010). *Relevant secondary school history content for achievement of national unity in Nigeria*. Unpublished Master's Thesis, Faculty of Education, Nnamdi Azikiwe University, Awka, Anambra State.

Parveen, Q., Yousuf, M. I., & Mustafa, S. (2017). An experimental study on the effect of cooperative learning on students' academic achievement and students' perceptions towards cooperative learning. *The Anthropologist*, *27*(1-3), 69-76.

Ukegbu (2011). *Basic civic education for senior secondary schools SS1 NERDC approved curriculum*. Owerri: Alphabet Nigeria.

Extent of Integration of Practical Work in the Teaching of Chemistry by Secondary Schools Teachers in Taraba State

Adamu, S.
Government Secondary School Karim, Karim Lamido Local Government Area, Taraba State, Nigeria
&
Achufusi-Aka, N. N.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
nn.achufusi@unizik.edu.ng

Abstract

This study investigated the extent of integration of practical work in the teaching of chemistry by secondary school teachers in Taraba State, Nigeria. It was guided by three research questions and three null hypotheses. The study adopted descriptive survey design. Stratified random sampling was used to select 45 out of 76 chemistry teachers in the 76 secondary schools. A questionnaire constructed by the researcher which consists of 22 items, drawn on five-point scale was used to collect data for the study. Validation of the research instrument was carried out by three experts from the Department of Science Education and reliability established using Cronbach Alpha which yielded a coefficient value of 0.81. Data for the research were collected through self-administered questionnaire by the researchers and the two assistants. The analysis of the data was done using mean and standard deviation to answer the research questions while the null hypotheses were tested at 0.05 alpha levels with One-way analysis of variance. The findings revealed that the extent of integration of practical work in the teaching of Chemistry by secondary schools teachers in Taraba State is low and this was influenced by teachers' qualification. The study recommended among others that chemistry teachers should ensure frequent integration of practical work in the teaching of topics in chemistry using appropriate methods.

Key words: Integration, Practical work, Teaching, Chemistry**.**

Introduction

Chemistry deals with the composition, properties and uses of matter. It probes into the principle governing the change that matter undergoes. Our world is made up of matter (anything that has mass and can occupy space) thus we study chemistry to acquire knowledge about matter and perform experiments to learn, observe, record and make intelligent inferences. Studying chemistry gives us training in the scientific method. Chemistry has become one of the most important science disciplines in the secondary school curriculum. At secondary school

level, chemistry is taught through theory as well as practical which involve experimentation and demonstration to explain concepts. The study of chemistry as a science subject in senior secondary schools entails the exposure of learners to both theoretical and practical aspects of learning experiences. The methods of instruction vary depending on the nature of the content. Some content involves theory work while others involve practical work.

The conventional method of teaching chemistry in the secondary schools entail that theory aspect is taught in the classroom while practical aspect is taught in the laboratory. However, this method gives more priority to theory aspect and also it might seem difficult for students to relate or transfer the knowledge obtained in a theoretical class to a practical class or vice-versa. Ejedike and Oyelana (2015) found out that practical work is handled negligently or based on chemistry teachers' conveniences. This neglect, according to Adesoji and Arowosegbe (2015) makes chemistry difficult for learners and consequently, they perceive chemistry as a difficult and abstract subject. Njoku (2007) equally attributed descending differential achievement of students in chemistry in quantitative analysis, qualitative and theory of practical questions to wrong way and manner teachers teach practical chemistry. For proper understanding of the chemistry as a subject there is a need for integration of practical work in the teaching of chemistry by teachers. Integration is the act of bringing together smaller components into a single system that functions as one (Rouse, 2015). It can be seen as an act of combination, inclusion or bringing in of practical work into the teaching and learning of chemistry for better understanding of the phenomena or concepts that seems to be abstract to students. To remove the abstract nature of chemistry, integration of practical work is necessary in the secondary school syllabus of chemistry.

The West African Examination Council Syllabus (WAEC, 2016) recommended that the teaching of chemistry should be practical-based and that students should: have the understanding of basic chemistry concepts, acquire laboratory skills, be aware of the inter-

relationship between chemistry and other disciplines and be aware of the linkage between chemistry and industry/ environment /everyday life in terms of benefits and hazards; and skills of critical and logical thinking. This is to demonstrate the importance of practical work in chemistry. The practical experience constitutes an integral part of chemistry because the subject consists of many topics that can be verified experimentally with an objective to create an enabling environment to stimulate students learning about chemistry that is commonly presumed as abstract, quantitative and boring (Read & Kable, 2007). When practical work is not properly integrated in the teaching of chemistry, it will surely show in their academic performances. The Chief Examiner's report on practical chemistry (2015) indicated that the inadequacies in students' performance was attributed to the following weaknesses; non-adherence to rubric, arithmetical errors in volume of acid-used, averaging non-concordant value, poor mathematical skills; poor knowledge of S.I units of mass concentration and molar concentration, tests of solids instead of solutions among others. These weaknesses may be as result of negligence of teachers to integrate practical work or the integration of practical work is done by teachers that are not professionally qualified to teach chemistry.

Abe and Adu (2013) opined that teacher's qualification / teaching qualification, is one of a number of academic and professional degrees that enable a person to become a registered teacher in primary or secondary school. Such qualification includes but not limited to the postgraduate diploma in education (PGDE), professional diploma in education (PDE), Bachelor of Education (B.Ed.), Bachelor of Science Education (B.Sc. Ed), Bachelor of Art Education (B.A. Ed) and national certificate in education (NCE). In Taraba State teachers who are academically qualified or are professionally qualified are engaged to carry out instructional process. Academically qualified teachers refer to those who have academic training as a result of enrolment into educational institution and obtained qualification such as HND, B.Sc., B.A, M.A, and so on while professionally qualified teachers are those who got professional training

that gave them professional knowledge, skills, technique, aptitude as different from the general education (Edu & Kalu, 2012). A teacher is someone who has been exposed to a good measure of training in a teaching subject areas as well as professional education. One thing is to be well grounded in the conceptual understanding of a subject; another thing is to be well equipped with the best method to pass the concepts across to the learners for proper comprehension. A professional teacher would be desirable in this regard.

According to Ikeobi (2010), it is the teacher who organizes the interactions between the subject (learner) and the object (learning materials). It is the teacher who ensures that equipment and materials are properly used by the learner to achieve the expected objectives. All these point to the fact that teacher is a very significant factor when the learners failed to exhibit the expected mastery in a science subject like chemistry. Owalobi (2012) found out that students' perform better when taught by professional teacher than when taught by non-professional. Many other researchers such as Akinsolu (2010), Ouma (2011) and Njoku (2015) also found out that teacher's qualifications influence students' academic performance.

The Chemistry Chief Examiner's report (2015) revealed that there is an increase in lack of understanding, comprehension and assimilation of chemistry as a science subject. This may be as a result of who teaches chemistry and how has it been taught. For the in-depth understanding of the subject as majority of the concept in chemistry seem to be abstract, students require practical classes organized by professionally qualified teacher that will help the students to visualize what they have been taught in a theoretical class. Many factors have been identified as responsible for lack of understanding and poor performance of students in chemistry; these are inadequate resources both human and material, curriculum related impediment and lack of laboratory work among others. In view of the several suspected factors mentioned as the reasons responsible for the continued students' poor performance in

chemistry, this study sought to investigate extent of integration of practical work in the teaching of chemistry by secondary schools in Taraba state.

Research Questions

1. To what extent are topics integrated into practical work by secondary school teachers in teaching of chemistry based on their qualification?
2. What types of instructional methods are used in integration of practical work in the teaching of chemistry by secondary school teachers based on their qualification?
3. What is the frequency at which these practical works are integrated in the teaching of chemistry by secondary school teachers based on their qualification?

Hypotheses

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

1. There is no significant difference in the topics integrated into practical work by secondary school teachers based on their qualifications.
2. There is no significant difference in the extent of instructional methods used in practical work integration by secondary school teachers based on their qualifications.
3. There is no significant difference in the frequency at which these practical works are integrated in the teaching of chemistry by secondary school teachers based on their qualifications.

Method

The study adopted descriptive survey as research design. The population of the study comprised all chemistry teachers in all public secondary schools in Taraba State, Nigeria. There are 76 chemistry teachers in public secondary schools in Taraba State. The sample for this study consists of 45 chemistry teachers selected from 45 out of 76 schools in Taraba state. The stratified random sampling was adopted to select 45 secondary schools and 45 chemistry

teachers of the state. Data for the research study were collected through self-administered questionnaires to ensure fairness, objectivity, and for explanation on unclear issues in the questionnaire. The instrument was validated by experts in Department of Science Education from Nnamdi Azikiwe University Awka. To test for reliability, a trial study was carried out in two secondary schools in Adamawa state which were not part of the sample used. The researcher administered the questionnaire to six (6) chemistry teachers in three secondary schools. The reliability coefficient was 0.81 using Cronbach Alpha.

The data related to research questions were analysed using mean and standard deviation. A mean rating of 3.00 and above was indicated agreement with the item while a mean rating below 3.00 indicated disagreement with the item. The null hypotheses were tested at 0.05 levels of significance using one-way ANOVA.

Results

Table 1: Mean Ratings of Teachers on the Extent Topics are Integrated into Practical Work in the Teaching of Chemistry based Qualification

S/N	Topics	NCE (N=24)		Graduate (N=14)		Postgraduate (N=7)		Total (N=45)		Decision
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1.	Standard separation technique	4.92	.27	3.92	1.42	3.92	1.12	4.39	1.14	Agree
2.	Solution of acids and base	4.84	.37	4.21	1.51	4.44	.53	4.43	1.15	Agree
3.	Water of crystallization	2.14	.41	2.10	.52	2.81	1.41	2.11	.37	Disagree
4.	Solubility of acids and bases	2.84	.54	3.42	1.20	3.52	1.02	3.68	.97	Agree
5.	Percentage purity	2.41	.78	2.10	.50	2.53	.70	2.21	.66	Disagree
6.	Stoichiometry reaction	2.52	.85	2.24	.82	2.42	.48	2.32	.84	Disagree
7.	Redox reaction	2.44	.84	2.82	1.12	4.73	.37	3.11	1.05	Agree
8.	Halogens displacement	2.39	.85	2.43	1.01	3.72	.36	2.59	.93	Disagree
9.	Gases and functional grps	2.64	1.0	2.45	1.42	2.64	.37	2.53	1.29	Disagree
10.	Rxn of acids on solid or aqueous solution	4.45	.94	3.83	1.51	4.13	.70	4.14	1.29	Agree
11.	Rxn of cation with base & alkali	4.25	.44	3.52	1.42	4.52	.37	3.87	1.10	Agree
12.	Determination of PH, rates of rxn and eqll. Constant	2.29	1.1	3.51	1.35	4.61	1.01	3.85	1.91	Agree
13.	Measurement of mass & vol., heat of neutralization	4.13	1.0	3.44	1.43	4.32	.37	3.74	1.32	Agree
14.	Use of indicators to determine conc	4.92	.27	4.12	1.61	5.10	.48	4.46	1.21	Agree

Table 1 indicates that from the fourteen topics selected for this study in which practical work are supposed to be integrated while teaching the topics, NCE holders integrate practical work in six topics with mean rating above 3.00 points and do not integrate practical work in eight topics with mean rating below 3.00. Graduates integrate practical work in eight topics and do not integrate practical work in six topics against postgraduates that integrate practical work in ten topics and do not integrate in four topics. Generally, secondary school teachers under this study integrate practical work in teaching only nine topics with mean rating above 3.00 and neglected integration of practical work in teaching five topics with mean rating below 3.00 regardless of their qualification.

Table 2: Mean Ratings of Teachers on the type of Instructional Methods used in Practical Work Integration in the Teaching of Chemistry Based on Teachers Qualification

SN	Methods	NCE (N=24)		Graduate (N=14)		Postgraduate (N=7)		Total (N=45)		Decision
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
15.	Teacher demonstration	4.17	1.03	13.9	1.53	4..81	.37	4.09	1.21	Agree
16.	Group method	3.98	1.52	4.06	.49	4.19	.37	4.04	1.52	Agree
17.	Individualized method	1.41	.49	2.64	1.31	3.24	1,32	2.17	1.23	Disagree

Table 2 reveals that most of NCE holders and graduates prefer teacher's demonstration and group methods in performing practical work with mean rating above 3.00 as against individualized method which has mean rating below 3.00 but postgraduates uses all the three instructional methods. However, teacher demonstration and group methods are generally used as a method of integration of practical work among secondary school teachers irrespective of their qualifications with mean rating above 3.00 as against individualized method with mean of only 2.07. This implies that acquiring of practical skills may be difficult for students under the study area since teachers give more emphasis on only two instructional methods as against three.

Table 3: Mean Ratings of Teachers on the Frequency at which Practical work are integrated in the Teaching of Chemistry based on Teachers' qualification.

S/N	Frequency	NCE (N=24)		Graduate (N= 14)		Postgraduate (N=7)		Total (N=45)		Decision
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
18.	I never perform practical work	1.62	.51	1.07	.00	1.25	.50	1.37	.48	Disagree
19	I rarely perform practical work	1.62	.51	1.07	.00	1.25	.50	1.37	.48	Disagree
20	I occasionally perform practical work	4.14	.89	4.05	.94	3.81	.96	4.02	.89	Agree
21	I often perform practical work	1.81	.81	3.76	.92	3.06	.04	2.74	1.2	Disagree
22	I always perform practical work	1.71	.70	3.05	.47	3.07	.05	2.33	.87	Disagree

Table 3 indicates that all secondary school teachers regardless of their qualifications disagree with the statement that they never or rarely perform practical work while teaching chemistry with mean ratings below 3.00. All respondents perform practical work occasionally while teaching chemistry with mean above 3.00 but only Graduates and Postgraduates do perform practical work often and always. However, the total means of often and always performs practical work among secondary school teachers is below 3.00 suggesting that practical work is perform occasionally among secondary school teachers.

Table 4: One-way Analysis of Variance of Difference between Mean Ratings of Teachers on the Topics of Integration and Teachers' Qualification

	Sum of Squares	Df	Mean Square	F	P-value	Dec
Between Groups	138.163	2	69.081	13.661	.000	Sig
Within Groups	136.538	42	5.057			
Total	**274.700**	**44**				

Table 4 reveals that the difference between topics of integration of practical work and the teachers' qualification is significant since the p-value is less than 0.05 hence the null hypothesis is rejected. This implies that teacher qualification plays a significant role on the choice of topics to integrate practical work in the teaching of chemistry.

Table 5: One-way Analysis of Variance of Difference between Mean Ratings of Teachers on the type of Instructional Methods used in Practical Work Integration and Teachers' Qualification.

	SS	Df	Mean Square	F	P-value	Decision
Between Groups	21.317	2	10.658	25.609	.000	Sig
Within Groups	25.530	42	.939			
Total	**46.667**	**44**				

Table 5 indicates that the p-value is less than 0.05 therefore there is a significant difference in the type of instructional methods used in practical work integration and teachers qualification, so the null hypothesis is rejected.

Table 6: One-way Analysis of Variance of Difference between Mean Ratings of Teachers on the Frequency of Integration and Teachers' Qualifications

	Sum of Squares	Df	Mean Square	F	P-value	Remark
Between Groups	41.131	2	20.566	31.222	.000	Significant
Within Groups	182.455	42	.659			
Total	**223.586**	**29**				

In Table 6, the result shows that there is a significant difference between the frequency at which practical work is integrated in the teaching of chemistry and the teachers' qualification seeing that the p-value is less than 0.05. Therefore, the null hypothesis is rejected.

Discussion

The result of the findings for research question one revealed that there is a significant difference between teachers' qualification and the topics of integration of practical work in the teaching of chemistry. As shown in Table 1 where NCE holders integrate practical work in only six topics out of fourteen, graduates integrate practical work in only eight topics and postgraduate integrate practical work in ten topics. It was also revealed that teachers generally integrate practical work in only nine of the fourteen topics. This however will have effect on the students because the topics have been taught half way, and according to Adesoji and

Arowosegbe (2015), it will make chemistry difficult for learners and consequently they will perceive chemistry as a difficult and abstract subject.

This finding is in line with the findings of Owolabi (2012) who found out that students performed better when taught by professional teachers than when taught by non-professional. This implies that to be academically qualified is not enough reason for somebody to teach chemistry but to be professionally qualified can give someone knowledge and skills to teach. This is because further probing shows that most of these graduates do not have teaching qualification but academic qualifications and so the knowledge required to integrate practical work in all the stated topics might not be there. Likewise, Akinsolu (2010) found out that teacher qualification was significantly related to students' academic performance.

The findings for research question two revealed that teachers' qualification has great influence on the type of instructional methods used in practical work integration in the teaching of chemistry. Indication showed that NCE and Graduates prefer teachers' demonstration and group methods as against all the three methods used by postgraduates. This was established by Njoka (2015) that the main activities observed in the laboratories by many teachers were teacher demonstrations. Though Njoka believed that when group practical are used, the number of students per group is unusually big, therefore the individual practical will not be possible in the large class size. The use of various instructional methods in integrating practical work helps to develop students' practical skills and improve their performance as discovered by Ouma (2011) who found teaching methods as one of the factors that influences student performance positively.

Though, the least popular, individualized methods are the best because it gives the students an opportunity to have hands on experience with the apparatus and chemicals. It also gives them confidence and exposure. This is very important because in the final exam they do

the practical individually. Millar (2004) observed that the students must play an active role in the learning process if he has to make sense of ideas and concepts presented during the lesson. This is inevitable for any practical lesson to be meaningful.

Other studies that agree with the finding include Njoku (2007), Adesoji and Oluwatobosun (2008). Although, majority of the practical work should be individualized method, the general usefulness of demonstrations and group methods must be stressed, for they are effective and economical in supplying knowledge, and they are particularly valuable in coordinating a series of facts, or in repeating a well-known historical experiment, and time must be allowed for their inclusion

The findings of research question three revealed that there is a significant difference between the teacher qualification and frequency of integration of practical work in the teaching of chemistry by teachers. From the result, all NCE holders disagree with the statement that they never or rarely perform practical work while teaching chemistry with a mean rating below 3.00 but all of the agree that they occasionally perform practical work and disagree that they often or always perform practical work while teaching chemistry. Graduates and postgraduate disagree with the statement that they never or rarely perform practical work but agree that they occasionally, often times and always perform practical work. However, even though all the teachers disagree that they never or rarely perform practical work while chemistry, but generally agree that practical work is occasionally being performed in the teaching of chemistry. Therefore, it implies that the frequency of integration of practical work is low. Ojelade (2015) found out that frequent practical lessons help develop practical skills in the leaner, makes chemistry more meaningful to the learner, promotes systematic reasoning and predictive ability in students and makes the learners to see the practical use of chemistry theories in everyday life. Based on the finding of Ojelade, students in Taraba State are liable

of having limited knowledge of chemistry since the frequency of integrating practical work is low.

Conclusion

Based on the findings of the study, it was concluded that the issue of personnel is important in integrating practical work in the teaching of chemistry as most of the teachers handling the subject are not professional on the job, though they are graduates. Some of the teachers teaching chemistry in secondary schools will not be as effective as a specialist in the subject itself due to inappropriate educational qualification to teach the subject and this is what operates in most of the schools under study.

Recommendations

Based on the findings of this study, some recommendations were made for effective integration of practical work in the teaching of chemistry which includes:

1. Chemistry teachers should try as much as possible to integrate practical work in topics taught in theoretical class for better understanding of the concepts.
2. Chemistry teachers should ensure that students are taught practical using different methods especially individualized and/or group methods. Teacher demonstration should be used only when the experiment is dangerous, apparatus are expensive and complicated for the learner, or when the time and apparatus are limited.
3. Chemistry teachers should frequently integrate practical work in their teaching of chemistry to remove the abstract nature of chemistry concepts/theories and as well develop student's practical skills.

References

Abe. T.O. & Adu, E.I (2013). Influence of qualification on development and assessment of computer programme and instructional package on energy concept in upper basic technology in Ekiti State. *Journal of Science and Technology*, *3*(6), 611-618.

Adesoji, F.A. & Arowosegbe, O. (2015). Isolation of factors in teachers' perception of secondary school chemistry practical in Nigeria.

Akinsolu, A.O. (2010). Teachers and students' academic performance in Nigerian secondary schools: Implication for planning, *Florida Journal of Educational Administration & Policy, 3*(2), 86-103.

Edu, D.O: Edu, G.O& Kalu, I.M (2012). Influence of academic qualification on gender and teacher perception of difficult concept in primary science in Ikom educational zone Cross River State. *Greene and Journal of educational Research, 2*(2). Retrieved from https://www.gjournals.org

Ejedike, I.P. & Oyelana, A.A. (2015). Factors influence effective teaching of chemistry. *International Journal of Education Science, 8*(3), 605-617

Ikeobi, I.O. (2010). *Beyond the stereotype: Thoughts and reflection on Education*. Lagos: The CIBN Press Ltd.

Millar, R. (2004). The role of practical work in the teaching and learning of science. A paper prepare for meeting: High school science laboratories: Role and vision. Washington DC. National Academy of sciences.

Njoku, Z.C. (2007). Comparison of students' achievement in the three categories of questions in SSCE practical chemistry examination. *Journal of the Science Teachers Association of Nigeria, 42*(1&2), 67-72.

Njoka, E.M. (2015). *Extent of utilization of laboratories in teaching chemistry in public schools in Meru south district, Kenya*. Unpublished M.Ed. thesis, Kenyatta University, Nairobi.

Ojelade, I.A. (2015). Impact of integrating practical classes into teaching of chemistry in public secondary schools. *Advance in Social Sciences Research Journal, 2*(3), 140-146. Retrieved from https://doi.org/10.14738/assrj.23.951

Ouma, C.O. (2011). *Factors influences performance of students in chemistry in public secondary school Kajiado north district Kenya*. Unpublished M.Ed. thesis, University of Nairobi.

Owolabi, O.T., & Adedayo, J. O. (2012). Effect of teachers' qualification on the performance of senior secondary school physics students: Implication on technology in Nigeria. Retrieved from URL: http://dx.doi.org/10.5539/elt.v5n6p72

Rouse, M. (2015). Definition of integration. Retrieved from *http://searchcrm.techtarget.com.definition/integration*

West African Examination Council. (2015). Chief Examiner's report on the May/June chemistry paper 3. Retrieved from *www.waeconline.org.ng*

West African Examination Council. (2016). Regulation and syllabus for senior secondary school certificates examination, Nigeria, Lagos: Author

Effect of Use of Combined Physical and Inquiry Virtual Laboratories on Secondary School Students' Achievement in Physics in Enugu State

Onuh, C. C.
Department of Science Education, Peaceland College of Education, Enugu, Enugu State, Nigeria
onuhchris2000@yahoo.com
&
Okigbo, E. C.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
ec.okigbo@unizik.edu.ng

Abstract

There had been poor enrolment and poor achievement of secondary school students in Physics over the years in Enugu state. Thus, the researchers were motivated to investigate the effect of use of combined physical and inquiry virtual laboratories (CPIVL) on achievement of senior secondary two (SS2) students in Physics in Enugu State, Nigeria. Two research questions guided the study and three null hypotheses were tested at 0.05 alpha level. The research adopted a non-equivalent control group quasi experimental design. The population of the size was 3, 206 SS2 students. Two hundred and twenty (220) SS2 physics students (120 males and 100 females) formed the sample size. The sample was composed using two stage sampling procedure. The research instrument used was Electricity Achievement Test (EAT). The EAT and lesson plan were validated by three experts. The reliability index was established using, the Kudar Richardson Formula 20 which yielded reliability coefficient of 0.77. Experimental group was taught using CPIVL while the Control group was taught using physical laboratory only. Data were collected by administering EAT to the participants as pre-test and post-test. The data analysis was carried out using mean, standard deviation and analysis of covariance. The findings showed that the use of combined Physical and Inquiry Virtual Laboratories had more positive effect on students' achievement when compared to the use of only physical lab. The use of CPIVL enhanced the achievement of male physics students more than their female counterparts taught the same way. Based on the findings it was recommended that teachers should expose physics students to virtual lab activities so as to promote meaningful learning, discovery learning and learning by experience among students. Also teachers should make teaching and learning of physics gender friendly by adopting the use of CPIVL in teaching physics concepts.

Keywords: Physical laboratory, Inquiry virtual laboratory, Physics achievement.

Introduction

The goal of Science Education is to help students develop a deep conceptual understanding of abstract scientific concepts. Yet, most research in Science Education showed that the achievement and attitude of students in science particularly physics are not geared

towards realizing this goal. Science has been regarded as the bedrock of modern-day technological breakthrough (Oladejo, Olusunde, Ojebisi & Isiola, 2011). Countries of the world, especially the developing ones like Nigeria, are striving hard to develop technologically and scientifically since the world is turning scientific and proper functioning of life depends greatly on science, science has become an integral part of the world's culture; even the remotest villages on earth are not devoid of the impact of science.

Ogunleye (2011) defined science as dynamic human activity concerned with understanding the working of our world. In all areas of human endeavour, the individual comes in contact with various forms of scientific equipment and contraptions that demands basic scientific skills and knowledge for proper handling and manipulation. The understanding of science helps man to know more about the nature of the universe so as to be able to fit into today's world. The emergence of a highly competitive and integrated economy, rapid scientific and technological innovations, and an explosion of knowledge will continue to have a great impact on our lives. In order to meet the challenges posed by these changes, physics, like other science subjects, provides a platform for developing scientific literacy and for building up essential scientific knowledge and skills for life-long training and knowledge acquisition in science and technology. Science comprises of basic disciplines such as physics, chemistry, biology and mathematics. Essentially, science and technology will be incomplete without physics.

Physics is the study of the basic principles that govern the physical world around us. Physics has proven its benefits to mankind as almost every human activity and virtually every profession involves some element of physics (Gambari, 2010). It is one of the most fundamental natural sciences that involve the study of universal laws, the behaviours and relationships among a wide range of physical phenomena. Through the learning of Physics, students acquire conceptual and procedural knowledge relevant to their day to day activities.

In addition, to the relevance and intrinsic beauty of physics, its study also helps students to develop an understanding of its practical application to wide variety of fields associated with scientific and technological development.

In spite of the importance of physics to technological development and as a requirement for many specialized science and engineering courses at the universities and other tertiary institutions, a large number of students still perform poorly in physics at Senior School Certificate Examination (SSCE) in Nigeria. Students' performance in SSCE physics conducted by West Africa Examination Council in Nigeria from 2012 – 2016 revealed that only 43.19% of the students that sat for SSCE physics in 2012, 48.26% in 2013, 47.83% in 2014, 51.27% in 2015 and 63.94in 2016 got at least credit pass in the subject. Gambari and Yusuf (2014) attributed poor performance of students in science, particularly in physics to lack of qualified teachers, poor instructional strategies, poor infrastructure and non-availability of school laboratory and poor utilization of instructional materials. This must have resulted to students' poor achievement in physics.

Agboola and Oloyede (2012) opined that one of the objectives of science education is to develop students 'interest in science and technology. Contrary to this, research reports such as John and Muhammed (2009); Hasret and Oladejo et al. (2011) showed that in most Physics classrooms, the expository methods were adopted. Despite the development of these lofty instructional strategies in theory, one would wonder why Nigeria Physics teachers are convenient with the traditional expository method regardless of its attendant effect on level of achievement of students in Physics. This probably maybe that the transmission is said to be effective but the reception is negligible. For example, Adesoji (2010) suggested the need for change from the current method of teaching physics to learner- centred instructional approach such as inquiry method that will enable students carry out experiments within the laboratory.

Laboratory is described as a room or building or a place where experimental studies are carried out. In the laboratory, students are engaged in a human enterprise of examining and explaining natural phenomena in a practical way (Glasson, 2009). Laboratory activities have played a special and central role in science education for a long time, and science educators believe that engaging students in laboratory activities has many benefits. These include: stimulate creativity, curiosity and critical thinking, promote students' engagement with the scientific methods and encourage active learning and problem-solving approach among others. Students need practical experiences to enable them understand some abstracts concepts in physics, therefore, effective use of laboratory equipment and facilities may improve the mastery of physics concepts. However, most of the public secondary schools in Nigeria are faced with insufficient of laboratory and equipment which limits the teacher to perform just simple laboratory activity (Adejoh & Ityokyaa, 2009). In other words, Physical experiments are rarely performed in some public secondary schools in Nigeria due to lack of equipment, facilities and other logistic problems (Adekunle & Hussaini, 2011). In most public secondary schools, the laboratory activities are carried out in scripted, pre-determined fashion under direct supervision of the instruction. In such environments, students are not allowed to deviate from the prescribed procedures as to minimize time waste, injury, equipment damage and material waste. Such approach may be problematic because it does not provide opportunities for students to truly explore the limitations of the equipment, materials and theory they are trying to validate. Nor does it provide opportunities for students to create their own understanding of the phenomena they are investigating. When taking these challenges into consideration, looking for appropriate alternatives is inevitable, hence, the use of virtual laboratory in supporting the traditional laboratory method or in the absence of physical laboratory can be a logical one.

Inquiry virtual laboratory (IVL) is an interactive environment without real laboratory tools meant for creating and conducting simulated experiments (Babateen, 2011; Harry & Edward, 2005). According to Babteen, IVL provides students with tools and materials set on computer in order to perform experiments saved on CDs or on web site. IVL is a learning environment in which students convert their theoretical knowledge into practical knowledge by conducting experiments (Woodfield, 2005). Inquiry virtual laboratory makes students become active in their learning, provide opportunities for students to construct and understand difficult concepts more easily. Flint and Stewart (2010) reported that inquiry virtual laboratory was less expensive and ten times faster than a traditional laboratory exercise, yet achieved the same learning outcomes for students who were already familiar with laboratory techniques. This could promote improved achievement of learner towards the study of physics.

Anekwe (2011) sees achievement as a test for the measurement and comparison of skills in various fields of academic study. Hence, achievement could be described as a task which has been accomplished successfully, especially by means of exertion, skill practice or perseverance. Aronson (2012) explained academic achievement as the degree of attainment by student in schools, colleges and universities either in class, laboratory, library, project or field work in which the student is sufficiently exposed to. Academic achievement enables teacher to obtain information on the extent to which a student has attained the criterion performance. In this study academic achievement will be measured using electricity achievement test (EAT). Academic achievement enables the teacher to determine the relative position or rank of individual student with respect to their performance irrespective of their gender (Etuk, Koko & Eno, 2011).

Gender refers to the roles and responsibilities of men and women that are created in families, societies and cultures. The concept of gender is the expectations held about the characteristics, attitudes and likely behaviour of both men and women (masculinity and

femininity) in the society (Ezeh, 2013). Gender issues have been linked with performance of students in academic tasks in several studies but without any definite conclusion. Some studies revealed that male students performed better than the female in science courses. For instance, Kost, Pollock and Finkelstein (2009) found that male students performed better than female in interactive physics, while Anagbogu and Ezeliora (2013) found that girls performed better than boys in physics using science process skills method of teaching. However, Adeyemi (2008), Orabi (2009) and Gambari (2010) reported that gender had no influence on academic performance of students. Therefore, the present study would examine the students' exposure to the same amount and types of experiences in physics lesson using combined physical and inquiry virtual laboratory in order to determine the influence of gender on students' achievement in electricity (physics).

The observation that the acquisition of conceptual understanding of electricity in expository approach curricular is problematic suggests that this combination of textbook-based instruction and practical lesson does not provide students with optimal conditions for acquiring proper conceptual understanding of electricity which could improve their achievement in physics. If expository approach is less able in fostering improved achievement in electricity, adding learning opportunities that will foster conceptual understanding of electricity to the physics curriculum seems to be a logical next step. It is against this background that the researcher is motivated to investigate effect of use of combined physical lab and IVL for teaching and learning of electricity in secondary schools in Enugu State, Nigeria.

Research Questions

1. What is the difference between the mean achievement scores of SS 2 students taught electricity using CPIVL and those taught using only physical laboratory?
2. What is the difference between the mean achievement scores of SS 2 male and female students taught electricity using CPIVL?

Hypotheses

The following null Hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores of SS 2 students taught electricity using CPIVL and those taught using physical lab only.
2. There is no significant difference between the mean achievement scores of male and female SS 2 students taught electricity using CPIVL.
3. There is no interaction effect of teaching approaches and gender on the mean achievement scores of secondary school students in electricity

Method

The design for this study is quasi-experimental. Specifically, pre-test, post-test non-equivalent control group design was used. The population for this study consists of all senior secondary year two (SS2) physics students in all the 30 public senior secondary schools in Enugu Education Zone of Enugu State out of which 20 are co-educational. The population is 3,206 SS 2 physics students. This population comprises 1,648 males and 1,558 females. The sample for the study comprised 220 SS 2 physics students. For the selection, a two-stage sampling was adopted. First, a purposive sampling was used to obtain two secondary schools out of the 20 co-educational public schools in Enugu Education Zone. The schools was sampled based on equivalence in (laboratory facilities and manpower), school location (urban area, Enugu metropolis), school type (coeducational schools), and equipped computer laboratories under the school net programme (students and teachers' exposure to the use of computer in their schools). All the students offering physics in each of the two schools were used for the study.

The instrument for data collection was Electricity Achievement Test (EAT). The EAT was used to collect data on student achievement in physics. The EAT consists of 25 items.

The EAT was subjected to face and content validation. The face and content validation was done by submitting the instrument together with the purpose of the study, scope, research questions and hypotheses to three experts. Trial testing of the EAT was done by administering the instrument to 30 SS2 physics students in Comprehensive Secondary School Akpasha, Nkanu West Local Government Area of Enugu State (school not in Enugu Education Zone). The data were used to estimate the reliability of the instrument using Kuder-Richardson Formula 20 (K-R 20). An internal consistency reliability of 0.77 was determined and this was considered high enough for the instrument to be used for data collection.

The research instruments developed for this study was: Electricity Achievement Test. The EAT were given to the students by their regular physics class teacher before the commencement of the lesson and after the lesson, the EAT were collected back from the students by their class teacher and the scores were used for data analysis. The data gathered from the administration of research instruments were analysed using quantitative statistics. The research questions were answered using mean and standard deviation. The null hypotheses for the study were tested at 0.05 alpha level using Analysis of Covariance (ANCOVA). In taking decision, reject the null hypothesis if the P-value is less than or equal to the significant value of 0.05 (P< 0, 05), otherwise do not reject the null hypothesis

Results

Table 1: Mean achievement scores of physics student exposed to combine use of physical and inquiry virtual laboratories.

Group	N	Mean Pre-test	SD Pre-test	Mean Post-test	SD Post-test	Mean gain
Experimental	116	42.28	11.76	75.05	16.38	32.77
Control	104	42.20	12.88	66.56	17.92	24.36
Mean Diff.		**0.08**		**8.49**		**8.41**

The results presented in Table 1 show that students taught physics using combined physical and inquiry virtual laboratories achieve higher in physics achievement test than their counterparts exposed to physical lab only.

Table 2: Mean achievement scores of male and female physics student exposed to combined use of physical and inquiry virtual laboratories.

Group	N	Mean Pre-test	SD Pre-test	Mean Post-test	SD Post-test	Mean Gain
Male	64	43.41	10.46	77.59	16.96	34.18
Female	52	40.88	13.16	71.92	15.21	31.04
Mean Diff.		**2.53**		**5.67**		**3.14**

The results in Table 2 show that male students exposed to treatment perform better in physics achievement test than their female counterparts exposed to the same treatment.

Table 3: Summary of ANCOVA test of significant difference in physics achievement scores of the treatment groups.

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	post-test achievement	40090.648[b]	5	8018.130	70.076	.001
Intercept	post-test achievement	7450.276	1	7450.276	65.113	.001
	post-test achievement	11305.537	1	11305.537	98.806	.001
Pre-achievement	post-test achievement	26254.803	1	26254.803	229.457	.001
Method	post-test achievement	873.394	1	873.394	7.633	.006
Sex	post-test achievement	467.930	1	467.930	4.090	.044
method * sex	post-test achievement	.360	1	.360	.003	.955
Error	post-test achievement	24486.152	214	114.421		
Total	post-test achievement	1249840.000	220			
Corrected Total	post-test achievement	64576.800	219			

From Table 3, F (1,214) = 0.003; P =0.95 > 0.05. Hypothesis six is not rejected. It was concluded that there was no interaction effect of teaching methods and gender on achievement of students in physics. From Table 3, F (1,214) = 7.633; P =0.006< 0.05. Therefore, the null hypothesis is rejected. Thus, there is significant difference in the mean physics achievement scores of students exposed to CPIVL and those exposed to physical lab. This is in favour of the CPIVL group. From Table 3 also, F (1,214) = 4.090; P = 0.044 < 0.05. Hypothesis four is rejected. The study concluded that there is significant difference in the mean achievement scores of male and female students exposed to the CPIVL. Thus, male students exposed to

CPIVL perform better in physics achievement test than their female counterparts exposed to the same treatment.

Discussion

The results of hypothesis one reveals that students exposed to use of combined physical and inquiry virtual laboratories performed better than those taught with conventional laboratory method. This finding agrees with the earlier findings of Van-LeJeune (2002), Alkazemi (2003), Karamustafaoglu, Aydin and Ozmen (2005), Tuysuz (2010), Tatli and Ayas (2012) and Shegog; Lazarus; Murray; Diamond; Sessions and Zsigmond (2012), who established that students exposed to virtual laboratory did better than those in conventional laboratory method.

Findings of the study on the influence of gender on the achievement scores of students in physics showed that male students performed better than their female counterparts in CPIVL. The finding supports the finding of Afolabi and Akinyemi (2009), Cengiz (2010) and Suleyman (2011) who found out in their respective studies that male students perform better than their female counterpart in science subjects. On interaction effect of teaching methods and gender on mean attitude rating and achievement scores, the finding of this study showed that there was no significant interaction effect of teaching methods and gender on students' mean attitude rating and achievement scores in physics. From the findings, it can be deduced that use of combined physical and inquiry virtual laboratories produced more positive effect on students learning outcomes. It is gender friendly and improves students' achievement in physics practical. This package is therefore better approach for teaching practical physics at senior secondary schools in Nigeria.

Conclusion

The study conclude that through the use of combined physical and inquiry virtual laboratories, practical content can be delivered in simplest, motivating and interactive manners. This could reduce the age long poor performance in physics practical in Enugu State.

Recommendation

Based on the findings, it was recommended that physics teachers should be trained on how best to involve students in the use of combined physical and inquiry virtual group laboratories activity during physics practical instructions so as to facilitate students' achievement in the lesson. This could be achieved through seminars and workshops for teachers in secondary schools.

References

Abiodun, O. (2004). Influence of gender and classroom climate on secondary school students' achievement in mathematics related subjects in Ekiti State. *Journal of Science Education. 2* (2), 25-32.

Adejoh, M. J. & Ityokyaa, F. M. (2009). Availability and adequacy of laboratory and workshop resources in secondary schools in Benue State, Nigeria. *Journal of Research in Curriculum and Teaching, 4*(1),304-311.

Adesoji, F. A. (2010). Modern strategies in the teaching of integrated science. In S.O. Ayodele (Ed.), *Teaching strategies for Nigeria secondary school*. Ibadan: Power House Press Publishers.

Adeyemi, B. A. (2008). Effects of cooperative learning and problem-solving strategies on junior secondary school students' achievement in social studies. *Electronic Journal of Research in educational Psychology, 6*(3), 691–708. Retrieved February 13, from *http://www.springerlink.com/content/c19u25816754q5j5/*

Anagbogu, M. A. and Ezeliora, B. (2013). Sex differences and scientific performance. *Women Journal of Science and Technology, 4*, 10-20.

Anekwe, J. U. (2011). Effect of constructivist-based instructional model on students' interest and academic achievement in French in Anambra state. *Unpublished Ph.D Thesis* University of Port Harcourt.

Aronson, J. (2012). *Improving academic achievement: Impact on psychological factors on education*. New York: Elsevier Inc,

Etuk, N., Koko, G. & Eno, U. (2011). Constructivist instructional strategy and pupils' achievement and attitude towards primary science. *Bulgarian Journal of Science and Educational Policy (BJSEP), 5*(1), 225-230.

Ezeh, D.N. (2013). Science without women a paradox. *The 75th inaugural lecture* (May, 30th), University of Nigeria, Nsukka.

Flint, S, & Stewart, T. (2010). Food microbiology-design and testing of a virtual laboratory exercise. *Journal of Food Science Education, 9*(4), 84-89.

Gambari, I. A. (2010). *Effect of computer-supported cooperative learning strategies on the performance of senior secondary students in physics, in Minna, Nigeria*. Unpublished PhD thesis, University of Ilorin, Ilorin, Nigeria.

Gambari, A. I. & Yusuf, M. O. (2014). Attitude of Nigerian secondary school students towards cooperative learning strategies. *Delsu Journal of Educational Research and Development*, *12*(1), 100 - 131.

Glasson, G. E. (2009). The effect of hand-on and teacher demonstration laboratory method on science achievement in relation to reasoning ability and prior knowledge. *Journal of Research in Science Teaching, 26* (2), 121-131.

Kost, L. E., Pollock, S. J. & Finkelstein, N. D. (2009). Characterizing the gender gap in introductory physics. *Physics Education Research, 5*(1) 1-14.

Nwosu, E. N. (2011). Gender differences in the utilization of information and communication technology (ICT) among undergraduate students. *Journal of CUDIMAC University of Nigeria Nsukka, 3*(1), 272-280.

Okoh, B. E., Iwuozor, C. & Obioma, J. (2011). Gender differences in computational problems in chemistry among senior secondary school students in selected location government area of Delta state. *Journal of Research and Development,2*(1), 14-22.

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O. & Isola, O. M. (2011). Instructional materials and students' academic achievement in physics: Some policy implications. *European Journal of Humanities and Social Sciences, 2 (1),* Retrieved from *http://www.journalsbank.com/ejhst.htm*

Ogunleye, B. O. & Babajide, V. F. (2011). Commitment to science and gender as determinants of students' achievement and practical skills in Physics. *Journal of the Science Teachers Association of Nigeria, 46*(1), 125-135.

Suleyman, A. (2011). Effect of cooperative learning and traditional methods on students' achievement and identification of laboratory equipment in science and technology laboratory course. *Journal of Educational Research, 6* (9), 639-644.

Secondary School Students' Learning Style, Achievement Motivation and Gender as Predictors of Mathematics Achievement in Imo State

Duru, D. C.
Anambra Imo River Basin Development Authority, Owerri, Imo State, Nigeria
dcduru@gmail.com

&

Okeke, S. O. C.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
soc.okeke@unizik.edu.ng

Abstract

The learning style, achievement motivation and gender as predictors of mathematics achievement were examined. Four research questions guided the study and four null hypotheses were tested. The study adopted a correlation survey design. A total of 882 (486 males and 396 females) senior secondary 2 students from 14 out of 124 secondary schools in Owerri Education Zone of Imo State were involved in the study. The researchers used simple random sampling technique to draw the sample. The instruments used for data collection were Barsch Learning Style Inventory (BLSI) and Achievement Motivation Scale (AMS). The cumulative average scores of students' results were used as their academic achievement scores. The instruments were validated by experts. The reliability was established using Cronbach Alpha which was found to be 0.85 and 0.81 respectively for BLSI and AMS. The data collected were analysed using correlation coefficient and multiple regression with the aid of SPSS version 20. The findings of the study revealed that learning style significantly predicts students' achievement in mathematics irrespective of gender. The findings also showed that achievement motivation does not significantly predict female students' achievement in mathematics but significantly predicts male students' mathematics achievement. The study recommended that Mathematics teachers should be trained on the strategies which are related to the learning styles and achievement motivation and at the same time help students to belief in their own capability.

Keywords: Mathematics, Achievement, Learning style, Achievement Motivation

Introduction

As the queen and bedrock of all sciences, mathematics is a sine-qua-non for effective scientific and technological development of any society. It is a core science subject and tool for the development of any science-based discipline (Fajemidagba, Salman & Ayinla, 2012).

This fact has always created the impression that the learning of mathematics is exclusively reserved for science students. The truth remains that the need for the learning of mathematics is substantial in every field of human endeavour (social sciences, natural science, engineering, medicine and education). It predisposes scholars in these field the skills of measurement, calculation, construction, numeracy etc. without which the level of sophistry in digitalization, scientific and technological advancement that predominant trend in our society may become difficult.

An important aim of mathematics education is to develop in students' positive attitude towards mathematics and their involvement in it. Many studies have all stressed that mathematics is indispensable because it has substantial use in all human activities and in other school subjects, (Eraikhuemen & Ahunsi, 2014; Okafor &Anaduaka, 2013). Despite the importance of mathematics, students' academic achievement worsens as years go by. The West Africa Senior Secondary School Certificate Examination (WASSCE) May/June results for 2000 to 2016 show that on the average 35.04% of the students passed mathematics at credit level. The achievements of students in external and internal examinations in mathematics continue to fall below average. The poor academic achievement continues to generate much concern among parents, teachers, students and other stakeholders in the education business. This dismal situation is not in conformity with the goal and aspiration of 2030 agenda of the SDGs (Sustainable Development Goals), because for a country to attain scientific and technological advancement, excellent academic achievement of students in mathematics is essential.

In the search towards scientific and technological advancement, we need nothing short of good academic achievement in mathematics to attain the Nigeria National Development Aspiration by the year 2030 (Zalmon & Wonu, 2017). For this reason, it is important to ensure lifelong learning for all, so as to enhance socio-economic development and create a harmonious

society (Dou, 2009). To achieve this, Tigist (2013) believed that the classroom should now be learner centred instead of teacher centred. The Nigeria secondary school mathematics curriculum (NERDC, 2007) that is currently in use is learner centred. In a learner centred classroom, the teacher acts as a facilitator who helps the learners to work on a given task or project and so learn by doing (Characteristics of a 21st Century Classroom, 2008). In spite of the efforts by mathematics teachers, teacher educators and other researchers in education to improve students' achievement in mathematics, minimal attention has been paid to learning style and achievement motivation as factors that could affect students' achievement in mathematics. This has necessitated the investigation of relative contributions of secondary school students' learning style, achievement motivation and gender as predictors of their mathematics achievement.

One of the basic psychological factors (of learning) that teachers learn in their educational training is that every learner has a different learning style. This implies that every student is unique and has a unique way of solving problems. In a normal classroom, we have children of varying learning abilities. Anusiem (2006) categorized learning abilities into slow learners, fast learners or gifted learners. These learners have suitable styles they prefer to learn. Zhou (2011) defined learning style as the manner and conditions under which learners most efficiently and effectively perceive process, store and recall what they are attempting to learn. Learning style is the most suitable ways individuals prefer to learn, perceive information, solve problems and respond to the learning environment. Hence, the learners' awareness of their learning style preference may help them to optimally develop their achievement motivation which may improve their academic achievement in mathematics.

Achievement motivation is an important concept in classroom learning and it could be linked to increased levels of academic achievement. A student who is academically motivated could be the one determined to succeed in academic work. It is in this recognition that Tella

(2007) defined achievement motivation as a motive that leads to seeking success or the achievement of high standard of performance. The teachers could use teaching strategies that incorporate motivation to stimulate student's interest and enhance achievement motivation. If mathematics work is seen as too difficult, students may not attempt their work or may give up easily because of fear of failure and low hope for success. On the other hand, perceiving mathematics as too easy is not beneficial because higher achieving students may become bored with material they feel is not challenging. This goes to show that achievement motivation in mathematics may not be unconnected to students' achievement level.

High achievement in mathematics is seemed to be associated more with males than females. This has led many people to believe that mathematics is male domain (Gappi, 2013). In contrast, people who hold this view roughly equate mathematics achievement with gender. Gender is a set of characteristic distinguishing between male and female. Gender in this context refers to male and female secondary school students who offer mathematics. Thus gender related issues in mathematics achievement have continued to receive serious attention judging from the number of studies done to that effect (Ajai&Imoko, 2015; Gappi, 2013). Hence, one sees that the issues of gender have not yet been resolved particularly in relation to students learning style and achievement motivation.

Studies have shown that some personality and learning variables such as learning style, self-regulated learning, achievement motivation, gender, and achievement level may have influence on students' achievement in mathematics (Bosman & Schulze, 2018; Metussin, 2016). However, there have been conflicting research reports as to the relative and combined contributions of these variables on students' achievement (Mutua, 2015; Mutweleli, 2014). These contradicting reports coupled with the noticeable consistent poor academic achievement of students in secondary school mathematics has necessitated a further investigation of the relative contributions of the two predicator variables, learning style and achievement

motivation to male and female students' achievement in secondary school mathematics. Hence this study is poised to find out the predictive values of learning style and achievement motivation on students' mathematics achievement with respect to gender.

Research Questions

1. To what extent does learning style predict male students' achievement in mathematics?
2. To what extent does learning style predict female students' achievement in mathematics?
3. To what extent does achievement motivation predict male students' achievement in mathematics?
4. To what extent does achievement motivation predict female students' achievement in mathematics?

Hypotheses

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

1. Learning style does not significantly predict male students' achievement in mathematics.
2. Learning style does not significantly predict female students' achievement in mathematics.
3. Achievement motivation does not significantly predict male students' achievement in mathematics.
4. Achievement motivation does not significantly predict male students' achievement in mathematics.

Method

The study adopted a correlation survey research design. The population is made up of 17,637 (8,878 males and 8,759 females) senior secondary school two (SS 2) students 2017/2018 in the government public secondary schools in Owerri Education Zone of Imo State, Nigeria. A total of 882 (486 males and 396 females) SS 2 students from 14 out of 124 secondary schools in the zone were involved in the study. The researchers adopted simple random sampling technique to draw the sample. Selection of male and female was done by proportion of their population. The instruments used for data collection were Barsch Learning Style Inventory (BLSI), and Achievement Motivation Scale (AMS). The cumulative average scores of students' results were used as their academic achievement scores. The instruments were validated by experts. The reliability was established using Cronbach Alpha which were found to be 0.85 and 0.81 respectively for BLSI and AMS. The administration of instruments was done by the researcher with the help of research assistants and this facilitated easier administration and retrieval of the instruments. Only valid (876 correctly filled; 483 males and 393 females, approximately 99.3%) instruments were used for analysis. The data collected were analysed using correlation coefficient for research question and multiple regression analysis for null hypotheses at 0.05 alpha level with the aid of (SPSS) version 20.

Results

Table 1: Analysis of correlation coefficient for males

Variables	N	R	R^2	Predictive value (%)
Learning style	483	.099	.010	1.0
Achievement motivation	483	.098	.010	1.0
Mathematics Achievement	483			

The result in Table 1 reveals that learning style predicts 1.0% to the variance observed in male students' achievement in mathematics. Achievement motivation predicts 1.0% to the variance observed in male students' achievement in mathematics. This shows that an

improvement in learning style and achievement motivation would lead to small increase in both male and female students' mathematics achievement.

Table 2: Analysis of correlation coefficient for females

Variables	N	R	R^2	Predictive value (%)
Learning style	393	.202	.041	4.1
Achievement motivation	393	.059	.003	0.3
Mathematics Achievement	393			

The result in Table 2 reveals that learning style predicts 4.1% to the variance observed in female students' achievement in mathematics. Achievement motivation predicts 0.3% to the variance observed in female students' achievement in mathematics. This is an indication that an improvement in learning style would lead to small increase in both male and female students' mathematics achievement.

Table 3: Regression analysis of predictive significant for males

Variables	N	R	R^2	F	Sig.
Learning style	483	.099	.010	4.773	.029
Achievement motivation	483	.098	.010	4.638	.032
Mathematics Achievement	483				

From the result of the regression analysis as shown in Table 3, the statement of hypothesis 1 and 3 are rejected; implying that learning style significantly predicts male students' achievement in mathematics. This is because the p-value (Sig. = 0.029) is less than the 0.05 level of significance.

Table 4: Regression analysis of predictive significant for females

Variables	N	R	R^2	F	Sig.
Learning style	393	.202	.041	16.603	.000
Achievement motivation	393	.059	.003	1.370	.243
Mathematics Achievement	393				

From the result of the regression analysis as shown in Table 4, the statement of hypothesis 2 is rejected while hypothesis 4 is accepted thus, learning style significantly predicts

female students' achievement in mathematics but academic achievement insignificantly predicts their mathematics achievement.

Discussion

The finding revealed that learning style predicts 1.0% to a variance observed and positive relationship between learning style of secondary school male students and their mathematics achievement. This shows that an improvement in learning style would lead to small increase in male students' mathematics achievement. The result revealed that that learning style predicts 4.1% to a variance observed and a positive relationship between learning style of secondary school female students and their mathematics achievement. This shows that an improvement in learning style would lead to large increase in female students' mathematics achievement. This relationship is significant as attested to by the regression analysis irrespective of gender. This implies that there is a significant prediction of learning style to students' achievement in mathematics with regard to male and female students'. The result revealed that achievement motivation predicts 1.0% to the variance observed and a positive relationship between achievement motivation of secondary school male students and their mathematics achievement. This shows that an increase in achievement motivation would lead to small increase in male students' mathematics achievement. However, achievement motivation predicts 0.3% to the variance observed and a positive relationship exists between achievement motivation of secondary school female students and their mathematics achievement. This shows that an increase in achievement motivation would lead to small increase in female students' mathematics achievement. This relationship is not significant as attested to by the regression analysis. This implies that achievement motivation significantly predicts male students' achievement in mathematics but not the female students.

The study established that an improvement in learning style and achievement motivation would lead to significant increase in students' mathematics achievement

irrespective of students' gender. This means that learning style and achievement motivation of both male and female students are good predictor of their mathematics achievement. However, learning style has a significant relationship with students' achievement in mathematics irrespective of students' gender. Hence, the relationships between learning style, achievement motivation and students' mathematics achievement are not gender selective. This is in agreement with previous studies of Mutweleli (2014) and Mutua (2015) who found similar results. Rahman and Ahmar (2017) examined the relationship between learning styles and learning outcomes by gender. The results of this study showed that the learning styles of visual and auditory learning styles is dominated by women; and there was no relationship between the variables of learning styles, genders and interaction of learning styles with genders to learning achievement.

Study by Abidin, Rezaee, Abdullah, and Singh, (2011) identified each student's learning style to determine strengths for academic achievement. They further observed that the students in their study possessed multiple learning styles or a combination of different learning styles, thus, they are able to learn effectively. They indicated that learning styles make an impact on the students' overall achievement. This is also in line with the findings of Bosman and Schulze (2018) reported that an individual learning style correlated the highest with mathematics performance. In a similar study, Ogbonna (2017) investigated learning styles as predictors of students' academic achievement. The result of the study revealed that learning styles are statistically significant predictors of academic achievement of students. The findings of the study revealed that an increase in achievement motivation would lead to increased students' mathematics achievement. This is because of the fact that achievement motivation is self determination to succeed in whatever activities one engages in, be it academic work, professional work, sporting activities among others. Furthermore, achievement motivation is a learned motive to compete and strive for success.

Gesinde (2000) observed that, achievement motivated students want and expect to succeed; when they fail, they redouble their effort until they do succeed. Achievement motivation is also based on reaching success and achieving some aspirations in life. This by implication goes to show that achievement motivation has little to contribute to students' achievement in mathematics. This could also mean that one cannot use knowledge of students' achievement motivation to predict what their achievement in mathematics would likely be. This also collaborates with the findings of Mutweleli (2014) who reported that academic achievement is unpredicted of achievement motivation. This goes to show that even though achievement motivation related positively with students' achievement in mathematics, the relationship is not significant. The fact that these variables related and predicted positively to students' achievement in mathematics indicates that there is need to help secondary school students overcome every problem associated with the variables. This will go a long way to increasing students' achievement in mathematics and at the same time help students to reduce the stress caused by failure.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. There should be continuous public enlightenment campaign on the importance of learning styles as well as achievement motivation. This enlightenment campaign should be carried out at all the government levels; Federal, State and LGA.
2. Mathematics teachers should be trained on the strategies which are related to the learning styles and achievement motivation and at the same time help students to belief in their own capability.

References

Abidin, M. J., Rezaee, A. A., Abdullah, H. N., & Singh, K. K. (2011). Learning styles and overall academic achievement in a specific educational system. *International Journal of Humanities and Social Science, 1*(10), 143-153.

Ajai, J.T. & Imoko, B.I. (2015). Gender differences in mathematics achievement and retention scores: A case of problem-based learning method. *International Journal of Research in Education and Science, 1*(1), 45- 50.

Anusiem, A. U. (2006). *Processes in human learning (revised edition).* Owerri, Nigeria: Divine Mercy publishers.

Bosman, A. & Schulze, S. (2018). Learning style preferences and mathematics achievement of secondary school learners. *South Africa Journal of Education, 38*(1),1-8

Characteristics of a 21st Century Classroom. (2008*)*. Retrieved from *http://nsdcff.wikispaces.com/file/view/Characteristics*

Dou, X. (2009). *Trying to establish a lifelong learning system and a learning society in the first two decades of the 21st century in China.* http://www.dpu.dk/fileadmin/www.dpu.dk/asemeducationandresearchhubforlifel166onglearning/conferences/rigapresentations/resources_2591.pdf

Eraikhuemen, L. & Ahunsi, J. O. (2014). An analysis of correlates of achievement in mathematics at senior school certificate examination. *International Journal of Research, 1*(11), 1160-1170.

.

Fajemidagba, M., Salman, M. & Ayinla, J. (2012). Effect of teachers' instructional strategy pattern on senior school students' performance in mathematics world problem in Ondo. Nigeria. *Journal of Education and Practice, 3*(7), 159-168

Gappi, L. L. (2013). Relationships between learning style preference and academic performance of students. *International Journal of Educational Research and Technology, 4*(2), 70-76.

Gesinde, A. M. (2000). *Motivation. In Z.A.A. Omideyi (Ed): Fundamental of guidance and counselling.* Ibadan: Kanead Publishers.

Metussin, H. (2016). Exploring the learning styles and study strategies used by Brunei high mathematics achievers. Mediterranean *Journal of Social Sciences, 7*(1), 435-443

Mutua, M. N. (2015). A correlation study between learning styles and academic achievement among secondary school students in Kenya. Unpublished M.Ed. Thesis, *University of Nairobi.*

Mutweleli S. M. (2014) Academic motivation and self-regulated learning as predictors of academic achievement of students in public secondary schools in Nairobi, Kenya. Unpublished doctoral dissertation. *Kenyatta University.*

NERDC (2007): *New senior secondary education curriculum*. Lagos, Nigeria: NERDC Press.

Ogbonna K. I. (2017). Learning styles as predictors of students' academic achievement in Rivers State. *International Journal of Novel Research in Education and Learning, 4* (6), 60-67

Okafor, C.F & Anaduaka U.S. (2013). Nigerian school children and mathematics phobia: how the mathematics teacher can help. *American Journal of Educational Research, 1*(7), 247-251.

Rahman, A & Ahmar, A. S. (2017). Relationship between learning styles and learning achievement in mathematics based on genders. *World Transactions on Engineering and Technology Education. 15*(1), 74-77

Sikhwari, T.D. (2014): A study of the relationship between motivation self- concept and academic achievement of students at a University of Limpopo Province, South Africa. *International Journal of Educational Science, 6(1), 19-25.*

Tella, A. (2007). The impact of motivation on students' academic achievement and learning of mathematics among secondary school students' in Nigeria. *Eurasia Journal if Mathematics, Science and Technology Education, 2007, 3*(2), 149-156.

Tigist, M. (2013). The relationship between parenting style and self-regulated learning and academic achievement in selected primary schools in Ethiopia. Unpublished doctoral dissertation, *University of South Africa.*

West African Examination Council (2016). *Chief examiner's report.* Lagos: WAEC.

Zalmon, I. G. & Wonu, N. (2017). Comparative analysis of student mathematics achievement in West African Senior Secondary Certificate Examination in Nigeria. *European Journal of Research and Reflection in Educational Science, 5* (1), 24-37

Zhou, M. (2011). Learning styles and teaching styles in college English teaching. *International Education Studies, 4*(1), 73-77.

Effects of Computer Assisted Instruction and Demonstration Method on Secondary School Students' Achievement in Computer Studies in Ogidi Education Zone

Egbo, F. N.
faithokoh@yahoo.com

Offiah, F. C.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
fc.offiah@unizik.edu.ng

Nweke, N. M.
nkirumaureen40@gmail.com

&
Anusiuba, I. O.
Department of Computer Science, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
oi.anusiuba@unizki.edu.ng

Abstract

The study investigated the effects of computer assisted instruction (CAI) and demonstration method on secondary school students' achievement in computer studies in Ogidi Education Zone. Two research questions guided the study and three hypotheses were tested 0.05 level of significance. Quasi-experimental design was adopted, specifically the pre-test post-test non-equivalent group design. The population for the study was 2,314 computer studies from the zone. A sample of 206 SS 2 computer studies students was involved in the study. The instrument for data collection was Computer Studies Achievement Test (CSAT) validated by two experts and one experienced computer studies teacher. The reliability of the CSAT was established using Kuder-Richardson formula 20 which yielded a coefficient value of 0.79. Data were collected by administering the instruments as pre-test and post-test before and after treatment respectively. The data obtained were analysed using mean, standard deviation to answer research questions and Analysis of Covariance to test the hypotheses. The CAI was found to be more effective in enhancing the achievement in computer studies than the demonstration method. Demonstration method however, was more effective than expository method. The findings of the study showed recommended that computer studies teachers should adopt the use of CAI and demonstration method in teaching computer studies.

Keywords: Computer-assisted instruction, demonstration, computer-studies, achievement

Introduction

Education at any level seeks to bring about change in the behaviour of learners. Appropriate instructional methods that could enhance achievement and facilitate the accomplishment of instructional objectives are indispensable for teaching and learning. The

questions about the effectiveness of teaching methods consistently raise considerable interest in the field of educational research. Research studies (Agboh, 2015; Yusuf & Afolabi, 2010) in the area of teaching methods have shown that certain teaching methods are better than others. Today, innovations in teaching methods have proven that some teaching methods are more effective for some subject areas. However, research studies on teaching methods better suited for computer studies as a relatively new subject area in secondary schools are not widely known. One cannot however do away with the role of the teacher in the learning process. Thus, computer assisted instructions which seem to do less with regards to human feelings appear to be limited in that area. This initiates the idea that traditional teaching method in the face of whatever innovations in teaching method is a necessity; they are indispensable in their own respect. There is need to ascertain the order of effectiveness of the teaching methods, cutting across the teacher-centred and student-centred teaching methods.

CAI is an automated instructional package in which a computer (electronic machine) is used to present an instructional programme to learners through an interactive process on the computer. It is learner-centred and activity oriented. There are two main types of packages in computer-based computer instruction namely: the ready off-the-shelf package and the customized, self-developed application (Anigbogu, 2000). The former refers to commercially produced educational software which has been prepared with all possible user queries in mind. These are stored in Compact Disk Read Only Memory (CD Rom). The customized self-developed application refers to the software which is developed in line with the prevailing and immediate environment that meets students' queries as obtained in the day to day classroom interaction. CAI however, requires competent manipulative skills, more time for a lesson, consumes time and may distract the learners who are not familiar with computer operations. Thus, a second method, namely, demonstration method is suggested.

Demonstration method is a visual approach to examining information, ideas and processes (Sambo, 2012). The students are compelled to observe carefully because they have to describe every step of the experiment accurately and draw a conclusion. After thorough questioning and cross-questioning, the class draws conclusion. The preparations necessary for an effective demonstration make it a tough and challenging method. More challenging is the task of demonstrating abstract concepts without confusing students, in which case, the students may either lose interest or achieve better with the traditional methods such as an expository method.

Expository teaching is a lecture presentation or telling strategy used during instruction (Ibe, 2013). The teacher is in control of presenting the subject matter and directs the students through the lesson. Generally, expository teaching begins with an introduction and overview of the topic before providing more specific information and detail. Although the expository method has been castigated in most recent studies as ineffective, it is useful for covering large content areas, teaching a large number of students forms an excellent blend with other methods and sometimes proves more beneficial than individualized instruction (Clark, 2007).

The merits and demerits of each teaching method make it all the more difficult to make a good choice of what method to employ when teaching subject areas like computer studies. This is because computer studies deal with basic computer systems, its applications and operation and it practical oriented. In the light of this challenge, studies are required to determine the teaching method that will be most suitable for teaching computer studies. Such studies as the present one will guide and inform school authorities of learner demands and subject contents for the usage of such instructional approach and vice versa. When this is achieved, computer studies students may then learn meaningfully. Meaningful learning implies that the learner must be ready to comprehend and relate what is being presented rather than to

memorize it verbatim. Meaningful learning is expected to enhance students' achievement in computer studies.

Achievement, according to Ali (2004) is anything that somebody has done successfully especially using one's own efforts and skills. Effective instructional methods can be used to positively enhance academic achievement irrespective of gender. Genders as a factor in students' achievement in computer studies have received research attention over the years. Nzewi (2005) found that gender is not a significant factor in students' achievement whereas Maduabum (2006) identified sex-role stereotyping and masculine image of science as factors influencing students' choice and achievement in science subjects generally. Hence, this study sought to investigate the method that could be used to enhance the students' achievement in computer studies regardless of their gender.

Purpose of the Study

The purpose of the study was to investigate the effects of CAI and demonstration methods on students' achievement in computer studies. Specifically, the study determined the:

1. The mean achievement scores of students taught computer studies using CAI, demonstration method and those taught with expository method Influence of gender on the achievement of students taught computer studies.
2. Interaction effect of teaching methods and gender on students' achievement in computer studies.

Research Questions

1. What is the difference in the mean achievement scores of students taught computer studies using CAI, demonstration method and those taught with expository method?
2. What is the difference between the mean achievement scores of male and female students taught computer studies?

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 students taught computer studies using CAI, demonstration method and those taught with expository method.
2. There is no significant difference between the mean achievement scores of male and female students in computer studies.
3. There is no interaction effect of teaching methods and gender on students' achievement in computer studies.

Method

The design of the study is quasi-experimental. Specifically, the pre-test post-test non-equivalent control group design was used. The population of the study was 2, 314 (1, 102 females and 1, 212 males) computer studies students in 24 co-educational schools in the zone. The sample for the study was 206 senior secondary school year two (SS2) students obtained using multi-stage sampling. The instrument for data collection was Computer Studies Achievement Test (CSAT). The questions were based on the computer studies concept taught. Instructional plans designed with the teaching methods on the computer concepts of word processor, system development cycle and program was also used for treatment.CAT was validated by two experts in science education and measurement and evaluation from Nnamdi Azikiwe University, Awka and one experienced computer studies teacher in secondary school. The reliability of the CSAT was established using the Kudder-Richardson formula 20. CSAT was administered to 40 students outside the study area. The generated scores were computed for reliability and the coefficient of internal consistency obtained was 0.79.

The classroom teachers used in the study were briefed for one week in each local government with three contacts of two hours per contact. The experimental groups were

exposed to computer content areas of file management and simple keyboard shortcuts. Experimental Group 1 was taught using CAI; Group II was taught using demonstration method and Group III using expository. Before the treatment, each group was administered with a pre-test and after the treatment; the CAT and CIS were reshuffled and used as post-test. After administering the pre-test, feedback as to the students' scores in the CAT and CIS were not given them. The treatments and test administration were done through the help of the computer teachers who were used as research assistants in the various schools used for the study.

For experimental group I, the teacher projected most of the concepts taught on a screen. In teaching word processing, various word applications were opened and manipulated on the projected screen to facilitate understanding. Students were allowed to engage in discussion, ask questions and perform some class exercise. In teaching the facilities available in word processors, each feature was illustrated with projected video and simulated operations of Microsoft word application and all these were projected onto a screen for the students to see. In system development cycle, each step was illustrated with a diagram and the characteristics of a good program were illustrated with videos. The students were allowed to manipulate the computer systems in the computer laboratory to familiarize them with each concept taught.

For Experimental Group II the same concepts were taught using demonstration method. All the classes were held in the computer laboratory. Each concept was demonstrated by the teacher and the students in turn attempt to imitate the teacher. For all the students to see the teacher's demonstration, a central computer screen was used for all the students to see the demonstration done on the computer desktop and thereafter, the students practiced what the teacher demonstrated at their leisure time.

In Experimental Group III, expository method was used to expose the students to the same contents as in Experimental Groups I and II. No projection was made and there was no demonstration. Only the skills of explanation and questioning were used by the teacher. The

research questions were analysed using descriptive statistics of mean. The hypotheses were tested at 0.05 levels of significance using Analysis of Covariance (ANCOVA). The decision rule for the hypothesis was as follows: reject the null hypothesis if P<0.05, otherwise do not reject the null hypothesis.

Results

Table 1: Mean Pre-test and Post-test Achievement Scores of Students taught Computer Studies using CAI, Demonstration Method and Expository Method

Source of variation	N	Pre-test Mean	Pre-test SD	Post-test mean	Post-test SD	Mean Gain
CAI	80	18.44	7.86	60.98	7.76	42.54
Demonstration	72	18.75	8.87	52.99	5.48	34.24
Expository	54	17.59	6.92	43.24	7.85	26.65

Table 1 shows that the group taught using the CAI has mean gain achievement gain score of 42.54 and the group taught using demonstration method has mean gain achievement score of 34.24 while those taught using expository method has mean gain score of 26.65.

Table 2: Mean Pre-test and Post-test Achievement Scores of Male and Female Students taught Computer Studies

Source of variation	Gender	N	Pre-test Mean	Pre-test SD	Post-test mean	Post-test SD	Mean Gain
	Male	32	19.06	7.44	68.06	6.35	49.00
CAI	Female	48	18.02	6.50	56.25	4.19	38.23
Demonstration	Male	37	18.51	8.84	54.86	3.63	36.35
	Female	35	19.00	8.77	51.00	6.39	32.00
Expository	Male	22	16.36	7.26	44.55	6.53	28.19
	Female	32	18.44	6.43	42.34	3.36	23.90

Table 2 shows that the male students taught using CAI have mean gain achievement score of 49.00, while the females had a mean gain score of 38.23. Male students taught using demonstration method have mean gain achievement score of 36.35, while the females have a

mean gain score of 32.00. Male students taught using expository method have mean gain achievement score of 28.19, while the females have a mean gain score of 23.00.

Table 3: ANCOVA on Significant difference in the mean Achievement of Students in Computer Studies taught using CAI, Demonstration and Expository

Source	SS	df	Mean Square	F	Sig.	Decision
Corrected Model	13214.688[a]	6	2202.448	85.095	.000	
Intercept	93630.320	1	93630.320	3617.545	.000	
Pre-test	31.299	1	31.299	1.209	.273	
Method	1717.522	1	1717.522	66.359	.000	S
Gender	11032.479	2	5516.239	213.128	.000	S
Method * Gender	927.135	2	463.568	17.911	.000	S
Error	5150.574	199	25.882			
Total	608738.000	206				
Corrected Total	18365.262	205				

Table 3 shows that there is a significant main effect of the treatment on the achievement scores of the students, F (2,205) = 66.359**,** P (0.000) <0.05. Thus, the null hypothesis was rejected. Therefore, there is a significant difference in the mean achievement scores of students taught computer studies using CAI, demonstration method and those taught with expository method.

Table 4: Scheffe PostHoc on differences in the Mean Achievement of Students taught using CAI, Demonstration and Expository

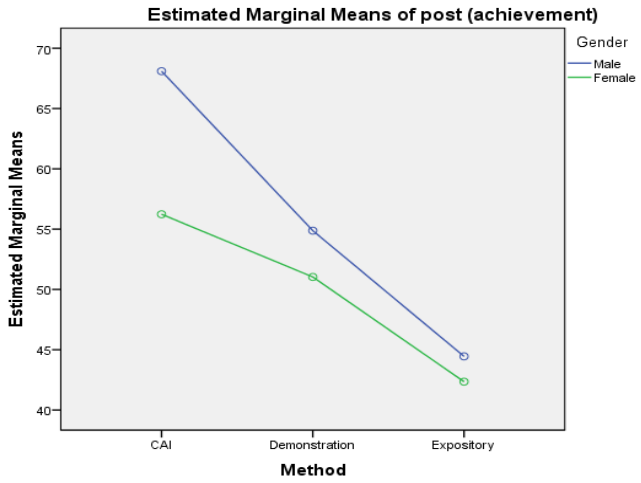
(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.[b]
CAI	Demonstration	7.977*	1.034	.000
	Expository	17.766*	1.121	.000
Demonstration	CAI	-7.977*	1.034	.000
	Expository	9.789*	1.147	.000
Expository	CAI	-17.766*	1.121	.000
	Demonstration	-9.789*	1.147	.000

Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 4 reveals that a significant difference exists between the mean achievement scores of students taught using CAI and those with demonstration in favour of those with CAI. Table 4 reveals that a significant difference exists between the mean achievement scores of

students taught with demonstration and those taught with expository in favour of those with demonstration method. Table 4 also shows that t significant difference exists between the mean achievement scores of those taught with CAI and expository in favour of CAI. Table 4 further shows that significant difference exists between the mean achievement scores of those taught with demonstration and expository in favour of demonstration.

Table 3 also shows that there is a significant main effect of gender on the achievement scores of the students, F (2,205) = 213.128**,** P (0.000) <0.05. Thus, the null hypothesis is rejected. Therefore, there is a significant difference between the achievement of male and female students. Table 3 further shows that there is a main interaction effect of teaching methods and gender on the mean achievement scores of the students, F (6,205) = 17.911**,** P (0.000) <0.05. Thus, the null hypothesis was rejected. Therefore, there is interaction effect of teaching methods and gender on students' achievement in computer studies.



Covariates appearing in the model are evaluated at the following values: pretest (achievement) = 18.33

Figure 1: Interaction Plot of teaching methods and gender on achievement in computer studies

The plot of interaction between teaching methods and gender on students' achievement in computer studies is significant and ordinal.

Discussion

The findings of the study revealed significant main effect of the treatment on achievement scores of students. CAI and demonstration method were effective, the most effective being CAI since students in the CAI treatment group had higher mean gain score than those in the demonstration treatment group.

The differences between CAI and expository is explained from the fact that CAI method enhanced students' interactivity with the learning material, teaching, fellow students and received immediate feedback, resulting in immediate learning adjustments to improve achievement. It was observed during the treatment that students in the CAI group welcomed the use of CAI during the lesson and this motivated further participation in the lesson. The treatment with CAI ensured that students are presented with materials or problems, situations, guiding students' thinking, responding to students' questions, assessing students' performances and managing students' learning. The findings of this study support the findings of Yusuf and Afolabi (2010) who found CAI whether individualized or cooperative more effective than the conventional teaching method.

The findings of the study also support that of Ahiatrogah, Madjoub, and Bervell (2013) who conducted a study on the effect of computer assisted instruction on the achievement of basic school students in pre-technical skills. Ahiatrogah, Madjoub, and Bervell found no significant difference between the CAI and Traditional groups on their achievement on aggregates, no significant difference between the CAI and traditional groups on their achievement in adhesives, and no significant difference between the CAI and Traditional groups on their achievement in finishes.

The significant difference between demonstration and expository method of teaching in favour of demonstration is because of the level of students' participation in the demonstration method. Through the demonstration by the teacher, students' understanding of

the concepts taught was made clear. Students therefore properly conceptualized the content areas that were taught. After the demonstration, students were allowed to practice what the teacher demonstrated. The students were observed carefully because they have to describe each and every step of the demonstration and therefore were actively engaged in the lesson than they were in the expository teaching method. The findings of this study supported that of Daluba (2013) reported that there was a significant difference in the mean agricultural science achievement of students taught using demonstration method and those taught using the conventional method. Yusrida (2014) reported that there was significant difference in the achievement of students taught using demonstration method and those taught using the lecture method of teaching. The findings of Allu (2014) supported the findings of this study when it reported significant difference between the achievement level of students taught keyboarding using lecture method and that taught using demonstration technique. The CAI and demonstration methods were both effective although those in the CAI had higher mean gain score than those in the demonstration method. Both methods proved effective since the students in both groups were actively engaged in the lesson.

There is significant difference in the mean achievement scores of male and female students taught computer studies using CAI, demonstration method and those taught using expository method. There was significant interaction effect of gender and teaching methods on achievement in computer studies. The findings of the study supported the findings of Agboh (2015) who reported no significant difference in the mean achievement of male and female students in the CAI group treatment. The findings however contradicted the findings of Yusuf and Afolabi (2010) who noted no significant difference in the mean achievement scores of male and female students taught using computer assisted instruction.

Conclusion

The study concluded that CAI positively improved achievement in computer studies more than demonstration and expository methods. Demonstration method however, enhances achievement more than expository method.

Recommendation

The study recommended that Computer studies teachers should adopt the use of Computer Assisted Instruction (CAI) in teaching computer studies. Computer studies teacher should be oriented by educational stakeholders on how to use computer assisted instruction.

References

Agboh, C.I. (2015). Effects of computer assisted instructional technique on students' achievement in financial accounting in colleges of education in Southeast Nigeria. *Research Journal of Finance and Accounting*, *6*(20), 31- 38.

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), 77-86.

Ajelabi, A. (2000). Essentials of educational technology. Lagos: Raytel communication Ltd.

Ali, E. (2004). *The effects of traditional learning and a learning cycle inquiry learning strategy on students' science achievement and attitudes toward elementary science (Kuwait).* (Unpublished thesis), Ohio University, USA.

Allu, S. (2014). *Effect of demonstration technique on achievement of students in keyboarding in polytechnics in Nasarawa state*. (Unpublished Master's Thesis), University of Nigeria, Nsukka.

Anigbogu, S.O. (2000). *Computer applications and Operations: A functional approach*. Awka: Optimum Press.

Clark, J. H. (2007). *The effects of expository teaching methodologies on students' achievement of suburban students in the secondary level.* (Unpublished dissertation), University of Illinois, Urbana-Champaign, United States of America.

Daluba, N.E. (2013). Effect of demonstration method of teaching on students' achievement in agricultural science. *World Journal of Education*, *3*(6), 1-7.

Ibe, H.N.N. (2013). Effects of guided-inquiry and expository teaching methods on senior secondary school students' performances in Biology in Imo State. *Journal of Education Research and Behavioral Sciences*, *2*(4), 51-57.

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.

Nzewi, U.M. (2010). It's all in the brain of gender and achievement in science and technology education. *51st Inaugural Lecture of the University of Nigeria Nsukka.* p18-32.

Sambo, A. A (2008) *Research methods in education*. Kaduna: Stirling-Horden publishers (Nig) Ltd.

Yusrida, M. S. (2014). *Effect of using demonstration method on the students' achievement in writing procedure text*. (Unpublished Master's Thesis), UNIMED school, Philippines.

Yusuf, M.O., & Afolabi, A. O. (2010). Effects of computer assisted instruction (CAI) on secondary school students' performance in biology. *Turkish Online Journal of Educational Technology*, *9*(1), 62-69.

Availability and Utilization of Cartoons for Effective Teaching of English Language in Primary Schools in Idemili South LGA

[1] Ikwuka, O. I. & [2] Ubah, C. P.

[1,2]Department of Educational Foundations, Nnamdi Azikiwe University Awka, Anambra State, Nigeria
[1] oi.ikwuka@unizik.edu.ng

Abstract

The study investigated the availability and utilization of cartoons for the effective teaching of English language in primary schools in Idemili South Local Government Area of Anambra State. Two research questions guided the study. Descriptive survey research design was adopted for the study. The population of the study comprised all the 58 English language teachers in the area. There was no sampling as the population is of manageable size. The instrument for data collection was a 20-item questionnaire developed by the researchers. The instrument was validated by three experts and was found reliable with reliability coefficient of 0.72 and 0.70 respectively for the two clusters using Chronbach Alpha technique. The data collected were analysed using percentages and mean. The findings revealed that cartoons are available and utilized for teaching English language in primary schools. Based on the findings of the study, it was recommended that teachers should use the informal, progressive and cartoon animation strategies that will develop in pupils high ordered skills needed for exploratory, experimental and creative learning in English language.

Keywords: Availability, Utilization, Cartoons, English Language, Primary Schools

Introduction

The development of any nation is hinged on a solid educational foundation for its citizenry. This pre-supposes that education is a means of effecting changes in the society in order to build a well-developed country. The objective of education includes objectivity, creativity and intellectual adventure. Education enables a child to develop physically, mentally, socially, emotionally and intellectually. In Nigeria, education takes place at different levels - primary, secondary and tertiary.

Primary education refers to the education given to children between five and 11 years. Primary education is the Nigerian child's stepping-stone to pursue higher academic and social goals. The academic block in Nigeria has a broad base at the primary stage and tapers towards the top at the tertiary stages. Therefore, pupils that are able to undergo primary education have

a better probability of continuing up to secondary school and to tertiary institution if they so desire. In doing so, a pupil can have an opportunity to find and secure a better job than a pupil that fails to attain primary education (Asodike, 2009). It is in realization of the pivotal role of primary education that effective teaching of primary school pupils has become expedient.

Effective teaching involves the use of relevant, interesting and imaginative introduction, for presentation of lessons that interest, motivate and make learning objectives clear to the pupils. Additionally, it involves the use of language and dictions that command respect from the learners, even distribution of quality questions that pose challenges or stimulate the curiosity of the learners' (Seweje, 2010). The lesson is expected to involve pupils' active participation. That is, instruction is to be more pupil-centred and less teacher-directed so that pupils can solve their problems interestingly and share information on various concepts. In addition, effective lessons help pupils gain much confidence, skills and competence to perform satisfactorily in the subjects such as English language.

English is the language of instruction and evaluation in the educational institutions (mid-primary school -primary 3 to tertiary level). Apart, it is a teaching subject in all strata of the educational system in Nigeria. Additionally, it is considered the gateway to academic excellence. This is because proficiency in English is a pre-condition for success in all other subjects. More so, English language functions as the language of government and administration in Nigeria. It is the language with which government businesses are conducted. In other words, it is the official language of the government. Both in intra and international frontiers, English language is used for communication. It is used for writing minutes of meetings, memoranda, official letters and publications.

Despite the pivotal role played by English language both in the educational society and society at large, its teaching is fraught with a lot of problems. For instance, it takes a long time to learn a new grammar system and thousands of new words. In addition, it takes a lot of

practice to develop listening, speaking and writing skills in a new language. This trend may not be unconnected to the fact that the use of educational technology is not given its pride of place in the teaching of English language in primary schools.

In the last few years, the world of educational technology has witnessed a rapid development in various audio-visual technologies which offer many possibilities for teachers to construct activities around listening to various authentic programmes, watching related videos, and holding conversations in real world. Teachers employ various tools and techniques to make the pupils learn better. A cartoon is one such material with which a teacher can provide joyful environment and also make her/his pupils to think differently and encourage them to create something on their own.

Cartoon is a visual medium with lots of humour which can be either in the form of single picture or series of pictures, captioned or non-captioned. These are seen in magazines, newspapers, books, television etc. The dialogue of cartoons is characterized by sentences that are simple and complete, and repetition is used frequently. Children, therefore, learn significant number of words from the context of cartoons that they can use in real life. Moreover, by watching cartoons, students are-highly stimulated to speak the target language (Haque, 2015).1t is known that when adopting a new language, people adopt a new personality based on the perception they have about the target culture. Adopting a personality of a cartoon character is very common in childhood, because those characters are funny, interesting and care-free. They appeal to children in the course of learning.

Use of cartoon in language learning can be helpful for initiating debate and focused group discussions in a classroom among learners as it stimulates them to engage in critical thinking in order to assess and formulate their views and opinions. Learners are given the opportunity to participate in classroom discussions, to support their own ideas and knowledge as well as identifying others conceptions of a particular topic with cartoons. This approach

helps the teachers to develop imaginative power amongst students by building proper knowledge.

English language lessons require a "positive" atmosphere, and nothing creates a more positive atmosphere than humour (Aboudan, 2013), which cartoons contain in abundance. Cartoons eliminate the pressure of being aware of learning another language. A child may repeat certain funny sentences from cartoons, and they subconsciously become ingrained in his/her mind. English language is pregnant with meaning, and the language in cartoons carries with it a set of values which children are prone to adopt more easily at that age; hence the need for availability and utilization of cartoons for its teaching in private and public primary schools.

The availability and utilization of cartoons is integral to the teaching of English language in primary schools. This is because; present primary education system demands new techniques in teaching and learning process. Today, pupils expect joyful environment in English language classroom for learning with interest and attention because media has attracted them-in very many ways with variety of fun fulfilled programmes such as cartoons. English language lessons depend on the availability and utilization of quality and relevant instructional materials such as cartoons and the skill of the teacher. This is because, cartoons can positively contribute to the learners existing knowledge and increase their participation in English language lessons. More so, cartoons make it easy for learners to follow, understand and retain content of the lesson. The argument above implies that failure to provide cartoons for use may impact on meaningful teaching and learning of English language in primary schools.

Teachers can use cartoons to teach language, human values, ethics and citizenship. The central idea of a cartoon may vary from that of simply wanting to amuse us to that of influencing our thinking (Thakur, 2015). Thakur added that the humour, empathy, and satire created in cartoons enable pupils to better understand the world. Lots of information is packed in a small picture presented with or without a short caption. Such pictures create a powerful

ground for the readers in classroom discussions, to support their own ideas and knowledge as well as identifying others conceptions of a particular topic with cartoons. This approach helps the teachers to develop imaginative power amongst pupils by building proper knowledge. The use of cartoons is one important way to ensure learner motivation and participation. An imaginative and resourceful teacher can work wonders with the help of cartoons in demystifying concepts.

Concept cartoons affects pupils' enquiry learning skill perceptions by helping students to enquire new knowledge with their existing experiences. Teaching via concept cartoons is effective in remedying misconceptions. Concepts may be from any subject of school curriculum. Among many subjects in primary school curriculum, English language is a subject full of controversial issues that provoke teachers to think differently so as to make it free from misconceptions. Cartoons eliminate the pressure of being aware of learning another language. A child may repeat certain funny sentences from cartoons, and they subconsciously become ingrained in his/her mind, as "Suggestopedia," the method of learning a foreign language by memorizing sentences in a playful atmosphere, suggests.

The development of English Language skills depends on many factors and among them is the availability and use of appropriate instructional materials. Adeogun (2010) and Makokha and Wanyonyi (2015) in their studies, observed that public schools in Nigeria are starved by both teaching and learning materials, and that teachers rely on chalk and talk method to teach language skills. They conclude that learners do not perform well in language skills development due to insufficient resources. The studies of Sofowara (2014) and Taher and Tam (2012) on the effectiveness of cartoons in teaching and learning English language in primary schools showed that Cartoon was an effective, creative and motivating method for teaching English Language. It is in view of the foregoing that the investigation into the availability and

utilization of cartoons for the effective teaching of English language in primary schools in Idemili South became expedient.

The poor performance of pupils in English Language in internal and external examinations demands intervention. This is revealed in the persistent high failure rates in the common entrance examinations in English language. This decline in standard and poor performance of pupils in the subjects can be traced to non-availability and non-utilization of instructional materials such as cartoons for teaching and learning. It is evident that there are problems facing the teaching and learning of English language in primary schools. The researchers observed that the cause could be traced to the poor foundation in spelling, reading and phonological processing sub skills in the primary schools. The absence of these skills in English Language may have an untold effect on performance of pupils. Problems faced in teaching tenses, spelling pronunciation, use of articles, summary writing, irregular verbs, punctuation, word order and conditionals are supposedly caused by the non-availability and non-utilization of instructional materials such as cartoons for teaching and learning. Consequently, low' English grades and deteriorating standards as observed in both written examinations and oral communications continue to puzzle people of all categories. This has become a matter of concern and politicians, parents, teachers, quality assurance, standard officers and the policy makers have aired their concern. It is against this backdrop that the researchers sought to investigate the availability and utilization of cartoons for the effective teaching of English language in primary schools in Idemili South Local Government Area.

Research Questions

1. What cartoons are available for the effective teaching of English language in primary schools?
2. What available cartoons are utilized for the effective teaching of English language in primary schools?

Method

The design of the study was descriptive survey. The area of study was Idemili South Local Government Area of Anambra State. All the 58 English Language teachers in the 18 primary schools in the area constituted the population of the study. The entire population was used as the sample for the study. This is because the population is small and of manageable size; therefore there was no sampling. The instruments used for data collection were two sets of questionnaire titled "Availability of Cartoons for the Teaching of English Language" (ACTEL) and "Utilization of Cartoons for the Teaching of English Language" (UCTEL). The instruments were constructed by the researchers. The ACTEL was structured on 2-point rating scale of Available (A) and Not Available (NA) for cluster one. While the UCTEL was structured on 5-point rating scale of Very High Extent (VHE), High Extent (HE), Moderate Extent (ME), Low Extent (LE) and Very Low Extent (VLE) for cluster two. The instruments were duly validated by three experts. Reliability of the instruments was established by the use of Chronbach Alpha and coefficients of 0.72 and 0.70 were obtained. The researchers considered the values high enough to be used for the study. Percentage and mean were used to answer the research questions. Mean scores from 1- 1.49 was regarded as Very Low Extent, 1.5-2.49 as Low Extent, 2.5-3.49 as Moderate Extent, 3.5-4.49 as High Extent, while above 4.49 as Very High Extent. Percentage from 0%-49% were regarded as Not available, while 50% and above were regarded as Available.

Results

Table 1: Frequencies and Percentages of available cartoons for the effective teaching of English language in primary schools

S/N	Items	Frequency	Percentage %	Remark
1	Textbook cartoons	32	55.2	Available
2	Journals cartoons	19	32.8	Not Available
3	Newspapers cartoons	35	60.3	Available
4	Graphic posters cartoons	39	67.2	Available
5	Charts cartoons	43	74.1	Available
6	Model cartoons	51	87.9	Available
7	Story boarding cartoons	44	75.9	Available
8	Encyclopaedia cartoons	27	46.6	Not Available
	Average Percentage		**62.5**	**Available**

Table 1 shows the items most available with their percentages as: model cartoons (87.9%), story boarding cartoons (75.9%), chart cartoons (74.1 %), graphic posters cartoons (67.2%), newspaper cartoons (60.3%) and textbook cartoons (55.2%) as shown in items 3, 4, 5, 6, 7. While the items least available with their percentages are encyclopaedia (46.6%) and journal cartoons (32.8%) as shown in items 2 and 8. This indicates that cartoons are available in teaching English Language in primary schools.

Table 2: Mean of available cartoons that are utilized for the effective teaching of English language in primary schools.

S/N	Items	X	Remark'
1	Textbook cartoons	3.83	High Extent
2	Journals cartoons	2.28	Low Extent
3	Newspapers cartoons	3.85	High Extent
4	Graphic posters cartoons	3.92	High Extent
5	Charts cartoons	4.06	High Extent
6	Model cartoons	4.22	High Extent
7	Story boarding cartoons	4.11	High Extent
8	Encyclopaedia cartoons	2.33	Low Extent
	Grand Mean	**3.58**	**High Extent**

Table 2 shows that majority of the cartoons such as model cartoons, story boarding cartoons, chart cartoons, graphic posters cartoons, newspaper cartoons and textbook cartoons are utilized for the teaching of English language to a high extent as shown in items 7, 6, 5, 4, 3

and 1, while journal and encyclopaedia cartoons as shown in items 2 and 8 are utilized to a low extent as they have mean scores below the cut-off mean 3.00.

Discussion

The result of the study revealed that most of the cartoons are adequately available while very few least available for effective teaching of English Language in primary schools in Idemili South Local Government Area of Anambra State. It is obvious that primary school teachers in the area are aware of the cartoon language with set of values and humours which children are prone to adopt more easily at that age. The result of this study disagrees with the view of previous researchers like Adeogun (2010) and Makokha and Wanyonyi (2015) who observed that public schools in Nigeria are starved of both teaching and learning materials and learners do not perform well in language skills development due to insufficient resources.

The result of the study also showed that most of the cartoons are utilized at high extent while very few are utilized at low extent. This could be due to the fact that cartoons have the potential of making pupils learn better because of humour, motivation and satire created in cartoons that eliminate the pressure of being aware of learning another language. This result further agrees with the views of Aboudan (2013) and Haque (2015) who observed that when used appropriately, cartoons eliminate the pressure of being aware of learning another language and that children learn significantly number of words from the context of cartoons that they can use in real life; and that by watching cartoons, children are highly stimulated to speak the target language.

Conclusion

Based on the findings of the study, it was concluded that cartoons are available, and the available cartoons are utilized for teaching English Language in primary schools to a high extent.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. School administrators should ensure that cartoons are utilized by primary school teachers in order to concretize learning in English Language.
2. Government should organize seminars and workshops to train primary school teachers on the utilization of cartoons for the effective teaching and learning of English Language.

References

Aboudan, R. (2013). Laugh and learn: Humor and learning a second language. *International Journal of Arts and Sciences, 3* (1), 90-99.

Adeogun, A.A. (2010). The principal and the financial management of public secondary schools in Osun State. *Journal of Educational System and Development,*

Asodike, J. (2009). Basic issues in primary education. *European Scientific Journal, 8* (1).

Federal Republic of Nigeria (2014). *National policy on education.* Lagos: NERDC Press.

Haque, S. (2015). *Using cartoons for English language teaching in Bangladesh: Progress, problems and - possibilities. Retrieved* from: https://www.researchgate.net/publication/318726975_Using_Cartoons_for_English_Language_Teaching_in_Bangladesh_Progress_Problems_and_Possibilities

Makokha, R.N. & Wanyonyi, K.M. (2015). The utilization of instructional resources in teaching Kiswahili poetry in secondary schools in Kenya. *International Journal of Academic Research in Business and Social Science*, 5(8), 10-18.

Seweje, R. O. (2010). The challenge of science teaching in Nigeria today. *Journal of Educational Foundations,* 1(1), 208-220.

Sofowora, O. A. (2014). Enhancing the attitude and the performance of village health workers in Osun State using interactive socio-drama learning package. *Journal of Agriculture and Rural Development,* 5 (3), 15-23.

Taher, B. & Tam, S.S. (2012). Audio-visual news, cartoons, and films as sources of authentic language input and language proficiency enhancement. *Turkish Online Journal of Educational Technology*, 11(4), 57-68.

Thakur, V. S. (2015). Engaging learners in productive learning: Some pedagogical gateways. In Z. N. Patil, S. Marathe, & A. Patil (Eds.), *Aspects of ELLT: Essays on theory, practice and experimentation in English language and literature teaching in India and elsewhere* (pp, 185-204). Hyderabad: The English and Foreign Languages University.

Relationship between Secondary School Students' Cognitive Learning Skills and Academic Achievement in Physics in Anambra State

[1] Okigbo, E. C. & [2] Nsidinanya, O. I.
[1,2] Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[1] ec.okigbo@unizik.edu.ng [2] ijomaogadinma@gmail.com

Abstract

In teaching and learning, memory processing skills of students determine how far they will gain from the learning activities. Based on this fact, this study investigated the relationship between secondary school students' cognitive learning skills and their academic achievement in physics in Anambra State. Five research questions guided the study and three null hypotheses were tested at 0.05 level of significance. The study adopted a correlation survey design. The population of the study consisted of 8,500 senior secondary school two (SS2) physics students in 258 governments owned secondary schools in the state. The sample for the study was 1000 SS 2 physics students drawn from 30 schools using multi-stage sampling. The instrument for data collection was researchers' self-developed Cognitive Learning Skills Questionnaire (CLSQ) while the students' achievement was obtained from their promotion examination results. The CLSQ was validated by three experts and its reliability established using Cronbach Alpha which gave coefficient value of 0.81. The data were collected by administering the questionnaire to the respondents. Mean, Pearson Product Moment Correlation and simple regression were used for data analysis. The findings showed that there was a high positive and significant relationship between cognitive learning skills and academic achievement of students in physics. There was also a significant positive relationship between cognitive learning skills and academic achievement of both male and female students in physics. Based on the findings, it was recommended that physics teachers should challenge students with learning materials that encourage them to constantly develop their cognitive skills towards meaningful learning.

Keywords: Cognitive learning skills, Physics achievement, Relationship, Secondary school.

Introduction

Teaching is the fundamental way through which knowledge, values, attitude and skills are transferred from one person to another. It is an age-long method by which knowledge is acquired and transferred from one generation to others. The efficacy of teaching for decades has made it a relevant tool for knowledge transfer and preservation. Teaching can be formal or informal; both are aimed at passing down relevant information, knowledge, skills, culture and

tradition from one generation of learners to another. Wang, Haertel and Walberg (1993) referred to teaching as effective classroom learning and student outcomes. Teaching and learning go together because teaching will not be judged effective if learning does not take place. For teaching and learning to be effectively carried out certain, defined pattern known as "teaching method" must be used by teachers. These methods of teaching are aimed at imparting relevant knowledge and skills learners.

Education system should center on all activities that improves the teaching and the learning processes. If attention is not adequately paid on any of the process of teaching or learning will a strike of balance in the education system of any nation will not be achieved. it becomes imperative that an effort put in place should have both the teachers and the learners fully incorporated

In Nigeria today, there has been much research on teacher-based factors that enhance learning (Okeke in Arinze, 2014). A great deal of research works had determined the effect of use of different teaching methods, aids and incentives on students' achievement. Such studies emphasized on the teaching process, yet in most cases, even when the methods are effective, students still come short of the expected achievement. This is why Arinze noted that learning is not merely what happens to a learner but something the learner makes to happen by the manner the incoming information is handled and put into practice. Processing of information by students has to do with their cognitive learning skills. It is these skills that determine how knowledge is coded, what happens to the encoded information, how it is retrieved and what it can be used for. Students in a class have different cognitive abilities and learning styles and, therefore, implore high cognitive skills that will enable them achieve their learning goals.

Cognitive learning skills are those skills employed by learners which promote encoding and retrieval of information that are taught at the acquisition and retrieval phase of learning. Cognitive skills are the core skills, the brain uses to think, read, learn, remember, reason, and

pay attention. They work together to take incoming information and move it into the bank of knowledge used every day at school, work, and in life generally. Michelon (2006) referred to cognitive skills as brain-based skills needed to carry out any task from the simplest to the most complex. They have more to do with the mechanisms of how individuals learn, remember, solve problem and pay attention, rather than with any actual knowledge. Teaching and learning cannot be said to be effective when students are lagging in their cognitive skills. The efficacy of learning is directly determined by how students properly apply and manage their cognitive skills which determine what information is encoded and how far the information can be retrieved. When teaching is going on, it is expected that the brain encodes the information passed on by the teacher depending on the cognitive skills students can properly apply. Students' achievement in any science subject, particularly Physics demands that students properly coordinate the activities of the mind and brain. Cognitive learning skills enable students to properly harmonize activities in the teaching and learning process. The use of cognitive skills can increase the efficiency with which the learner approaches a learning task which include, but are not limited to remembering and applying information from course content (LuAnn, 2016).According to Dansereau (2013), cognitive skills can be categorized into foundational, comprehensive-direct and retrieval-direct skills. Foundational cognitive skills are made up of working memory, attention and perception. Comprehensive-direct skills are focused on the skills utilized by learners to encode new information to the existing one. Comprehensive skills include concentration, raising questions, pattern recognition, sustained attention and cognitive flexibility. Retrieval-direct skills are skills employed by learners in order to effectively produce accurate storage and reproduction of information from memory. Some of the examples are response inhibition and attention, logical thinking, organization of information, multiple simultaneous attention, rehearsal and mnemonics devices among others.

As a result of the importance of cognitive skills to students, LuAnn (2016) averred that cognitive skills used by students can significantly impact on their learning outcomes.

The need for cognitive skills in the teaching of science and physics in particular cannot be over emphasized. Science is a body of knowledge that requires logical reasoning and application of every possible cognitive skill for effective understanding. Physics is one of the core science subjects studied in secondary and tertiary institutions in Nigeria. Physics is regarded as a branch of science that deals with the study of laws which determine the structure of the universe with reference to matter and energy. It arms learners with systematic thinking, backed up with theories necessary for understanding the mechanics of how things in the natural world work. It serves as a link to other science subjects such as chemistry and biology.

Over the years, physics students have recorded poor academic achievement in both internal and external examination. In order to remedy this situation, researchers and teachers come up year after year with different teaching methods and teacher related variables (Oloriyan & Onwosewo, 2015; Otiende, Barchok & Abura, 2013). However, despite increased teaching methods, and innovations introduced every time to improve students' learning outcomes in physics, there is persistent decline in their achievement in both internal and external examinations. This raises such concern as whether actually the teaching methods are effective and targeted at the students and whether is the learning process which involves the students cognitive processing skills is directly actually in place. This is the target of this study.

Omosewo in Oloriyan and Onwosewo (2015) assert that despite the importance of physics to the development of a nation, both male and female students are still performing poorly in the subject especially at the West Africa Senior School Certificate Examination (WASSCE) level. This brings up the fact that gender plays a significant role in any teaching and learning process. Gender has been a factor in the teaching and learning of sciences as male and female students are involved in the learning of physics. Overtime, researcher has not come

to a conclusion on which gender is favoured with achievement in physics whether male or female students. Researchers such as Danmole (2008), Oboh (2008) and Okoronka and Wada (2014) have reported that achievement in physics favours male students more than female students However, Lawal (2005) reported that female students out-performed their male counterparts achievement in physics, while some others have contended that there is no significant difference in the achievement of male and female students in physics. With this trend of disparity in achievement of male and female students in physics, there is every tendency that cognitive learning skills can differ among male and female students. If cognitive learning skills have implication on the achievement of students in physics, it can also differ in its relationship among male and female students. The study therefore set out to find out the cognitive learning skills students mostly apply in learning physics and to investigate the relationship between secondary school students' cognitive learning skills and academic achievement in physics.

Research Questions

1. What are the cognitive learning skills students mostly apply in the learning of physics**?**
2. What is the relationship between cognitive learning skills scores of students and their achievement scores in physics?
3. What is the relationship between the cognitive learning skills scores of male students and their achievement scores in physics?
4. What is the relationship between the cognitive learning skills score of female students and their achievement scores in physics?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance

1. There is no significant relationship between the cognitive learning skills of students and their achievement in physics.
2. There is no significant relationship between the cognitive learning skills of male students and their achievement in physics
3. There is no significant relationship between the cognitive learning skills of female students and their achievement in physics.

Method

The study adopted a correlation survey design. Correlation survey research is used to establish relationships among two or more variables without any attempt to influence them. The study was carried out in Anambra state. The population of the study consisted of all 8,500 SS2 physics students in the 258 state governments owned secondary schools in Anambra state. A sample of 1000 students was drawn from 30 secondary schools out of the 258 secondary schools using multistage sampling which involved stratified sampling, purposive sampling and simple random sampling techniques.

The instrument used for data collection in this study was Cognitive Learning Skills Questionnaire (CLSQ) while accumulated SS2 physics result in all schools were used for students' achievement. The instrument CLSQ was made up of 25 items structured in line with the cognitive skills classification of Dansereau (2013). The instrument was face validated by three experts from Faculty of Education, Nnamdi Azikiwe University, Awka and the reliability established to be 0.81 using Cronbach alpha. The data were collected by researchers and four research assistants administering the questionnaire to the respondents. Mean was used to answer research question one. Pearson product moment correlation was used to answer

research questions two to four while simple linear regression analysis was used to test the null hypothesis at 0.05 level of significance.

Results

Table 1: Mean and Standard Deviation of the Cognitive Skills applied by Students in Studying Physics

Cognitive skills	Mean (χ)	Standard Deviation
Fundamental skill	26.74	6.64
Comprehensive-direct	21.09	5.37
Retrieval-direct	17.524.64	

Table 1 shows that the students mostly applied fundamental skill in learning of physics as it has the highest mean score of 26.74, followed by comprehensive-direct (21.09) then retrieval-direct with mean of 17.52.

Table 2: Pearson's Correlation between Students' Cognitive Skills and Academic Achievement in Physics

	Fundamental skills (r)	Comprehensive-direct skill (r)	Retrieval -direct skills (r)	Academic achievement (r)
Fundamental skills	1	0.37	0.29	0.38
Comprehensive direct skills	0.37	1	0.43	0.40
Retrieval direct skills	0.29	0.43	1	0.40
Academic achievement	0.38	0.40	0.40	1
Cognitive learning skills	---	--	--	0.52

Table 2 shows the Pearson value for achievement and cognitive skills is 0.52. This means that there is a positive relationship between cognitive skills and achievement of students in physics.

Table 3: **Pearson's Correlation between Cognitive Skills and Academic Achievement of Male Students in Physics**

Gender	Variable	N	Cognitive skills	Achievement
Male	Cognitive skills	520	1	.47
	Achievement	520	.47	1

Table 3 shows that the correlation coefficient (r) obtained is 0.47 and the relationship is linear. This implies that an increase in cognitive skills of the male students led to increase in their achievement.

Table 4: **Pearson's Correlation between Cognitive Skills and Academic Achievement of Female Students in Physics**

Gender	Variable	N	Cognitive skills	Achievement
Female	Cognitive skills	480	1	.64
	Achievement	480	.64	1

Table 4 shows that the r is 0.64. This indicates that there is a positive relationship between achievement and cognitive skills of female students in physics.

Table 5: Simple Linear Regression on the Relationship between Students' Cognitive Learning Skills and Academic Achievement in Physics

Source of variance	Sum of squares	Df	Mean square	F	P	Decision
Regression	26509.44	1	26509.44	263.92	.000	sig
Residual	72120.47	998	100.45			
Total	98629.91	999				

(R=.518, R square=.269, adjusted R square=.268)

Table 5 shows that calculated f-value at 1, 998 degree of freedom is 263.92, with p value at 0.00 less than alpha level at 0.05 ($p=0.00 < \alpha=0.05$). This means that there is significant

predictive shows that the relationship between students cognitive learning skills and their academic achievement in physics. With adjusted R square = .268, it implies that 26.8% of total change in achievement was accounted for by cognitive learning skills.

Table 6: Inter-Correlation between Cognitive Skills and Achievement of Male Students in Physics

Gender	Variable	N	Cognitive skills	Achievement	p
Male	Cognitive skills	520	1	.466*	.000
	Achievement	520	.466*	1	.000

*significant at 0.05

Table 6 shows that there is a significant relationship between the cognitive skills and achievement of male students in physics with p=0.00 which is less than α=0.05.

Table 7: Inter-Correlation between Cognitive Skills and Achievement of Female Students in Physics

Gender	Variable	N	Cognitive skills	Achievement	p
Female	Cognitive skills	480	1	.642*	.000
	achievement	480	.642*	1	.000

*significant at 0.05

Table 7 shows that the p-value is 0.00 which is less than the alpha value of 0.05 (p=0.00 < α=0.05). This indicates that there is a significant relationship between academic achievement and cognitive learning skills of female students in physics.

Discussion

The finding of the study showed that students mostly applied the fundamental cognitive learning skills in physics. Fundamental cognitive skills are the basic mental processes that will enable the students to understand the subject matter in which they are taught. Fundamental cognitive learning skill just as the name implied is necessary to lay the foundation for the memory to process knowledge. It is followed by comprehensive direct cognitive learning skills.

Used uses it to comprehend learning and further understand their learning process and function effectively in the knowledge in which they are exposed while retrieval skills are used by the students but the least in the list. This maybe because retrieval direct skills are mostly used for recall and knowledge transfer from the class to real life situation.

There is a positive relationship between the cognitive learning skills of the students and their achievement in physics. This implied that students who apply good cognitive skills in their learning of physics will have better achievement. When the students are properly developed in their cognitive learning skills in physics it will give them a good cognitive strength that will enable them function effectively in physics knowledge and classroom experiences. Therefore, the level of cognitive development that the students have will affect their achievement in physics. This find was in line with the Adeoye (2010) who found out that cognitive style of the students enables them to remember concept taught in physics.

The gender of the students has implication on the cognitive learning skills of the students and their achievement in physics. Both male and female students have a positive relationship between their academic achievement and cognitive learning skills in physic. Both male and female students have significant positive relationship between achievement and cognitive learning skills of students in physics. Either being a male or female student does not affect the way in which the brain processes the knowledge in physics. The level to which the cognitive skills of the students are properly developed will go a long way to determine their achievement in physics whether they are male or female.

Conclusion

Based on the findings the study concludes that development and use of cognitive learning skills will go a long way in improving academic achievement in physics among secondary school students irrespective of gender.

Recommendations

From the findings of the study the following recommendations were made:

1. Physics teachers should challenge the students with learning materials that will encourage them to constantly develop their cognitive skills towards a meaningful learning.
2. Physics teachers should arrange learning activities in such a way that it will help students to be self-directed in their learning which will help them apply all the cognitive learning skills and discover the ones that best work for them.
3. Students should be guided to develop a thorough study habit, master necessary cognitive skills and apply them to improve their achievement in physics.
4. Schools authorities should engage the services of guidance and counselors that will help students to know how to master their cognitive learning skills suitably apply them to achieve their learning needs.

References

Arinze, C.N (2014). Relationship between secondary school students' cognitive learning skills and their academic achievement in Anambra state. Unpublished PGDE project, Nnamdi Azikiwe University Awka.

Dansereau, D. F. (2013). Learning strategy. In J.W. Segal, S. F. Chipman & R. Glaser R (Eds.), *Thinking and learning skills.* New York: Erlbaum Hillsdate

LuAnn, J. (2016). *Cognitive strategies.* Retrieved from *http://www.specialconnections.ku.ed/?q=instruction/cognitive_strategies*

Michelon P. (2006). What are cognitive abilities and skills, and how to boost them? Retrieved from *https://sharpbrains.com/blog/2006/12/18/what-are-cognitive-abilities/*

Okoronka, U. A. & Wada, B. Z. (2014). Effects of analogy instructional strategy, cognitive style and gender on senior secondary school students' achievement in some physics concepts in Mubi Metropolis, Nigeria. *American Journal of Educational Research, 2*(*9*) 788-792. DOI:10.12691/education-2-9-13.

Olaniyan, A. O. & Omosewo, E. O. (2015). Effects of a target-task problem-solving model on senior secondary school students' performance in physics. *Science Education International*,*25*(4), 522-538.

Organization for Economic Co-operation and Development (OECD, 2009). Teaching practices, teachers' beliefs and attitudes, In Creating effective teaching and learning environments: First results from TALIS.

Otiende, N. U., Barchok, K. H. & Abura O. G. (2013). Effect of discovery method on secondary school student's achievement in Physics in Kenya. *Asian Journal of Social Sciences & Humanities*, 2(3), 351-358.

Wang, M. C., Haertel, G. D.& Walberg, H. J. (1993). Toward a knowledge base for school learning. *Review of Educational Research*, *63*(3), 249–294.

Readability of Recommended Chemistry Textbooks as Correlate of Secondary School Students' Academic Achievement in Enugu State

[1] Ekwe, B. E. & [2] Okeke, S. O. C.
[1,2] Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[2] soc.okeke@unizik.edu.ng

Abstract

This study investigated the relationship between the senior secondary school two (SS2) students' readability of recommended chemistry textbooks and their achievement in chemistry in Enugu state. Three research questions guided the study. The study adopted correlation survey research design. The population of the study consisted of seven recommended chemistry textbooks used in Enugu State and 6300 SS2 chemistry students from 254 secondary schools in the State. The sample for the study consisted of three commonly used chemistry textbooks and 376 SS2 chemistry students selected from 12 secondary schools in Enugu state. The sample comprised of 188 male and 188 female students, selected from single boys, single girls and co-educational schools using a multistage sampling procedure. The instrument used for data collection was Cloze test of readability of chemistry textbook (CTRCT). The cumulative grade scores of the students were collected from the sample schools to measure students' academic achievement. The CTRCT was validated by three experts in Science Education. The instruments were trial tested on 30 SS2 chemistry students and the data collected were used to calculate the reliability of the instrument using Kuder-Richardson 20 Formula. It yielded an index of 0.83. Mean, Standard deviation and Pearson product correlation were used to answer the research questions while t-test for correlation was used to test the hypotheses at 0.05 level of significance. The finding revealed that the readability level of the chemistry textbooks was standard for the male students and fairly difficult for the female students. Also, there was a significant relationship between the readability of chemistry textbooks and academic achievement of students in chemistry. Based on the findings, it was recommended among others, that chemistry textbooks should be revised periodically and the difficult words be replaced by the simpler words to facilitate reading comprehension for readers.

Keywords: Readability, Chemistry textbook, Academic achievement.

Introduction

Two events that hastened the widespread of knowledge were the invention of the printing press and the invention of the magnifying glass for reading. In fact, the reading glass was adjudged to be the most impactful invention of the last millennium. Most people tend to take printed materials for granted. Imagine life today if the printing press had never been invented, then books, magazines or newspapers, posters, flyers, pamphlets and mailers would not exist for use by man. The printing press allows for sharing of large amounts of information

quickly and in huge numbers. It drastically changed the way society evolved. This is why ability to read effectively can be regarded as a scale for measuring learners' level of literacy.

Reading is a way of acquiring experience through understanding of other documented experiences of lives. Students read to gain knowledge and teachers are increasingly using reading to prepare the students understand the lesson taught better. One would think that with the advancement in technology the use of textbooks would become old fashioned and decrease, but not so, reiterated Petty (2014). This is because, in an effort to save time, teachers are moving towards a new emphasis on using assignments and project work especially in science, thus forcing the need for students to refer to textbooks to check basic information. As good as reading may be, it does not guarantee learning because of possible loss of concentration. However, if a teacher has a large curriculum to cover, as is often the case with science curricula, encouraging students to read becomes a good option to make up for any deficiency.

In sciences such as chemistry, students can read for information, criticism, discussion, debate or in preparation for activities and presentation. Reading is a form of individualized learning but the book must be readable otherwise the reader can get lost and fail to understand or comprehend the content. It is sometime desirable in education to measure difficulty level of a particular text in relation to the student for which it is assigned. One such measure is readability.

Readability, according to Allen (2002) is the ability of a receiver to read and understand information from a message source. Dioch (2005) affirmed that teachers everywhere in the world are more interested in determining the readability or reading difficulty of materials presented to them by publishers. Many factors tend to influence readability which include font size, spacing and layout; readers factor such as prior knowledge, reading ability, interest and motivation of reader, vocabulary difficulty, text structure, text coherence and cohesion; and syntax.

A lot of science textbooks are published in Nigeria for secondary schools especially chemistry textbooks. The issue is that most of these textbooks are published and pushed into the market without proper evaluation by specialists (Salami, 2011). When one goes into a chemistry classroom, one observes that the main tool for instruction is one of those books. This therefore calls for a continuous evaluation of chemistry and other science textbooks to determine their readability.

Despite the prime position chemistry occupy in Nigeria educational system and efforts made by teachers and researchers to enhance achievement, students still do poorly in chemistry. Statistics have shown that in spite of the major role chemistry plays in scientific and technological advancement of a nation and students' interest in the subject, majority of them still perform poorly (Kola, 2012). Worrisome is the poor performance of students in chemistry in various external examinations in Enugu State. Enugu state government have over the years invested huge amount of money towards improvement of science education through establishment of special science schools and provision of science instructional materials yet, the academic performances of students in chemistry still remain low in the state.

Researchers over the years have blamed poor performance of students in chemistry in secondary schools on inadequate facilities, poor methods of teaching and lack of motivation for students (Aniodo, 2016). The issue of readability of chemistry textbooks as they influence the academic achievement of students had received very little attention. The fundamental question of what makes a book readable for a particular set of readers needs to be addressed. This question is important when one recognizes the strong relationship between understanding of chemistry and the reading level of the material. This study therefore sought to investigate the relationship between readability of recommended chemistry textbooks and students' achievement in chemistry.

Research Questions

1. What is the readability scores of recommended chemistry textbooks by senior secondary school two (SS2) students in Enugu State?
2. What are the academic achievement scores of SS 2 students in chemistry?
3. What is the relationship between the readability scores of recommended chemistry textbooks and academic achievement scores of SS 2 students in chemistry?

Hypothesis

1. There is no significant relationship between the readability score of recommended chemistry textbooks and academic achievement of SS 2 chemistry ($P < 0.05$).

Method

The study adopted a correlation survey research design. The study was carried out in secondary schools in Enugu State. The population of the study consisted of seven (7) recommended chemistry textbooks used in Enugu state that were approved by the Nigerian Educational Research and Development Council (NERDC) and 6,300 SS 2 chemistry students in the State (PPSMB, Enugu) (2017). The sample of the study consisted of 376 SS 2 chemistry students in Enugu State, and three commonly used recommended chemistry textbooks. The sample size was determined using the Yaro-Yamane's formula for infinite population. The researcher adapted Cloze test of readability of chemistry textbooks (CTRCT). The researcher personally collected the cumulative results of the SS2 chemistry students from the sampled school. The data collected were analysed using Bormuth mean Cloze formula. Bormuth mean cloze formula stated that DRP = (1-R) X 100 where DRP = Degrees of reading power on a 0 – 100 scale with 30 (very hard) to 100 (very easy). R = mean cloze score. The research questions were analysed using Mean, Standard deviation and Pearson product correlation. The hypotheses were tested using t-test for correlation at 0.05 level of significance.

The Mean readability score of the students was calculated and interpreted based on guideline provided by Bormuth (1968) as shown:

Mean scores	**Interpretation**
90-100	Very Easy
80-99	Easy
70-79	Fairly easy
60-69	Standard
50-59	Fairly difficult
30-49	Difficult
20-29	Confusing
0-19	Very Confusing

Results

Table 1: Mean Readability Scores of Students on each Chemistry Textbook for Males and Females

Group	Comprehensive Chemistry Mean	Essential Chemistry Mean	New School Chemistry Mean
Male	60.74	63.71	61.25
Female	53.53	55.51	54.26

Table 1 shows the mean readability scores of students on each chemistry textbooks for male and female. The result shows that male have mean score of 60.74 for comprehensive chemistry, 63.71 for essential chemistry and 61.25 for new school chemistry. These are interpreted to be standard for the students. While for female the result shows a mean score of 53.53 for comprehensive chemistry, 55.51 for essential chemistry and 54.26 for new school chemistry. These are interpreted to be fairly difficult for the students.

Table 2: Cumulative Mean Academic Achievement Scores for both Males and Females in Chemistry

	Mean ± SD
Male	57.98± 9.32
Female	53.21± 10.40

Table 2 shows the cumulative mean academic achievement for both male and female in chemistry. The result shows that the male have mean and SD of 57.98± 9.32 in Chemistry, while the females have a cumulative mean and SD of 53.21± 10.40 which are interpreted as pass grade value. The standard deviation values, shows that there is less difference in terms of the standard deviation scores.

Table 3: Relationship between Readability Scores of the Students and Academic Achievement Scores of Students in Chemistry.

		Comprehensive chemistry	New school chemistry	Essential chemistry
Academic Achieve	Pearson r	.181**	.200**	-.002
	Sig. (2-tailed)	.000	.000	.970
	N	376	376	376

*. Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation coefficient in Table 3 shows the nature of relationship between readability Score of the participants and academic score of students in chemistry. The correlation coefficient .181shows a weak positive significant relationship between students' academic achievement and comprehensive chemistry score. The study further shows a weak positive significant relationship between student academic achievement and new school chemistry (r = .200). However, the study also shows a weak negative relationship between student academic achievement and essential chemistry (r = -.002).

Table 4: t-Test of Correlation on the Relationship between Readability Scores and Academic Achievement in Chemistry.

Variable	N	R	Df	Cal. t	Crit. t	Remark
Comprehensive chemistry	376	0.18	374	19.67	1.96	Significant
New school chemistry	376	0.20	374	19.76	1.96	Significant
Essential chemistry	376	-0.002	374	19.37	1.96	Significant

The t-test of correlation in Table 4 shows the nature of relationship between correlation coefficient and corresponding t value of the readability of chemistry textbooks by chemistry students. The correlation coefficient 0.18 and corresponding t value of 19.67 for Comprehensive chemistry is in the region of rejection of H_o. Also, the correlation coefficient 0.20 and corresponding t value of 19.76 for New school chemistry is in the region of rejection of H_o. The study showed a correlation coefficient of -0.002 and corresponding t value of 19.37 for Essential chemistry which is in the region of rejection of H_o. The null hypothesis of no significant relationship between readability of chemistry textbook and academic achievement in chemistry is thus rejected.

Discussion

The finding of this study revealed that there is a significant positive relationship between the readability level of chemistry textbooks and academic achievement of senior secondary two (SS2) students in chemistry. This means that as the readability level of the textbooks increases, the academic achievement of students in chemistry increases and vice versa. A number of studies have identified that there is relationship between readability and academic achievement (Ajayi, 2014; Akin, 2014; Umoke & Nwafor, 2015; Toba, 2015; Yong,

2014). From these studies it was revealed that there is a significant relationship between the readability level of textbooks and academic achievement.

Although, all these researchers carried out their study outside Enugu State and their study were mainly on basic science, physics and biology textbooks. Only Toba (2015) and Yong (2014) carried out their study in chemistry but were conducted in Ekiti State. That is the reason why the present study was carried in chemistry but now in Enugu State of Nigeria to justify the finding of these studies. However, there is observed difference on the level relationship between the individual chemistry textbooks examined and the academic achievement of students in chemistry. While New school chemistry showed weak positive relationship with the students' academic achievement in chemistry, Comprehensive and Essential chemistry showed strong positive relationship with students' academic achievement in chemistry. This could be as a result of syntax and semantics used and differences in the intelligent quotient (I.Q) level of individual students.

The finding also revealed that male students read at standard level while female the female students read at fairly difficult level according to the Bormuth mean Cloze scores. The male students were found to read at standard level. This indicated that the recommended chemistry textbooks were appropriate for them and may not need the assistance of teachers because the textbooks are easy for them to read and understand on their own. The female students were found to read at fairly difficult level. This indicated that the female students may not be able to read and understand or comprehend the text materials without the assistance of the teachers.

Consequently, the male students possess better academic achievement in chemistry than the female students. This is in agreement with the findings of Iroegbu (2014), who found that boys performed significantly better than girls in Science subjects and further observed that there are elements in learning process, which affects the understanding of boys and girls

differently. The finding is also in agreement with the findings of Eke (2010) who reported that achievement of students in Science depended greatly on the readability of the textbooks. Therefore, the findings of previous studies are in agreement with the findings of the present study in the aspect of relationship being significant.

Conclusion

From the analysis and result of this study, it is necessary to place importance on the students' readability scores of the textbooks as the score may indicate their performance in chemistry. It is concluded that the level of understanding and academic achievement of students in chemistry, to large extent are determined by the readability of the textbook in use.

Recommendations

The following recommendations are made based on the findings and conclusion:

1. Chemistry textbooks should be revised periodically and difficult words be replaced with simpler words to facilitate reading comprehension for their readers.
2. Chemistry teachers and principals should always carry out readability checks on textbooks before they are recommended for use in the schools. They should not just rely on the information provided by authors and publishers as the basis for recommending such books for students' use.
3. Selection and recommendation of chemistry textbooks should be done by experts in the area.
4. Authors and publishers of chemistry textbooks should consult chemistry core-curriculum. That will ensure a good textbook coverage of the curriculum topics, good learning activities index and a readable textbook.

References

Ajayi, O. T. (2014). Use of Cloze procedure in assessing the readability of approved chemistry textbooks in Ondo State senior secondary schools. *Journal of science and mathematics Education, 11*(3), 54-68.

Akin, R. W. (2014). Evaluation of chemistry textbooks in use in Nigeria senior secondary schools. *International Journal of scientific and Engineering research, 6*(2), 34-46.

Allen, U. (2002). Location factors as correlates of private and academic performance of students' achievement and self-efficacy in chemistry. *African Journal of Science, Technology and mathematics Education*. 2(1), 54-65.

Dioch, E.W. (2005). *Methods in Reading*. New York: The Carried Press.

Eke, P.N. (2010). Are high school chemistry textbooks gender fair? *Journal of Research in Science Teaching 28*(4), 353-362.

Enoh, K.E. (2010). The language demands of Science reading in middle school. *International Journal of Science Teaching, 20*(5), 281-287.

Kola, A. A. (2012). Effect of cooperative learning method on students' achievement in reading comprehension. *International Journal of Art and Technology*, 10 (2), 345-357.

Petty, V.S. (2014). Readability of approved biology textbooks in Kwara State. *Ilorin Journal of Education, 3*(2), 45-57.

Salami, B.N. (2011). *Curriculum design and instructional evaluation*. Ibadan: Evans Brothers.

Umoke, C.C & Nwafor, C.E. (2015). Readability level of some approved science textbooks in use in Junior Secondary Schools in Ebonyi State of Nigeria. *Advances in social science Research Journal, 2* (8), 23-36.

Yong, B.C.S. (2014). Can students read secondary science textbooks comfortably? *Brunei International Journal of Science and Mathematics Education, 2*(1), 59-67.

Effect of Mind-Mapping Teaching Strategy on Students' Retention in Senior Secondary School Computer Studies in Imo state, Nigeria

Okereke, C. M.
Registry Department, Federal University of Technology, Owerri, Imo State, Nigeria
chuksmartinokereke@gmail.com
&
Okigbo, E. C.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
ec.okigbo@unizik.edu.ng

Abstract

Effect of mind-mapping teaching strategy on secondary school students' retention in computer studies in Owerri Municipal Council of Imo State was determined. Three research questions guided the study while three hypotheses were tested at 0.05 alpha levels. The design adopted for the study was the quasi-experimental involving non-equivalent control groups. The population comprised 1,052 senior secondary two (SS 2) Computer studies students found in the four co-educational schools within the study area in 2017/2018 academic session. The sample for the study consisted of 105 SS 2 students from four intact classes which were selected through multistage sampling procedure. Two classes each were assigned to experimental and control groups. Data were collected using researcher-made Computer Studies Retention Test (CSRT) which was validated by experts. The reliability coefficients obtained for the CSRT was 0.84 using Kuder Richardson Formula 20. The experimental group was taught using mind-mapping teaching strategy while the control group was taught with conventional method. The CSRT was administered to the participants as pre-test, post-test and retention tests and data collected were analysed using mean, standard and analysis of covariance. Findings revealed that mind-mapping strategy significantly enhanced retention in computer studies more than the conventional strategy. Gender was not a significant factor in determining students' retention computer studies using mind- mapping strategy. Based on the findings, it was recommended among others that computer studies teachers should be trained on the use of mind-mapping during their training process and the in-serving computer studies teachers also re-trained.

Keywords: Computer Studies, Retention, Interest, Mind-Mapping Strategy.

Introduction

For science and technology to successfully achieve the goals of sustainable development in Nigeria, there is need to engage creatively in science education. The valuable role of science education in the technological development of any nation is never in dispute. Fafunwa (2013) opined that we are living in a world where science and technology have

become an integral part of the world's culture, and any country that over looked this significant statement does so at its own peril. Hence, a solid background in the basic sciences is very crucial if Nigeria has to attain the required science and technological development height. One of such basic sciences is Computer science. At secondary levels of education, Computer Science as a school subject is called Computer Studies. Computer studies are not about learning how to use the computer, but it is much more than computer programming. It is the study of ways of representing objects and processes. It involves defining problems; analysing problems; designing solutions; and developing, testing, and maintaining programs. Computer studies, according to Ezeudu (2015) involve teaching and inculcating in the learner the basic skills required to independently manipulate the computer to achieve educational goals. The author further stated that, computer studies as a subject is aimed at making students acquire skills and competencies required in this digital word of competitiveness. Such basic skills and competencies upon graduation make them conversant with term and practices embedded in the world of computer. Computer studies are therefore a subject organized to enable people understand the function, uses and limitations of the computer and to provide an opportunity for the study of the modern methods of information processing.

The intention of Nigeria to include computer studies into the secondary school curriculum dates back to 1988 when the National Policy on Computer Education was enacted and launched (Abimbade, 2014). The policy on computer education suggested the following as some of the computer curriculum context at the secondary school level: A basic appreciation of how the computer works, an understanding of the basic principle of operating the computer, hands-on experience using the pre-programmed packages which are relevant to the interest of the students as teacher aids in different subjects. According to the National Policy on Computer Education (2013), it is expected that by the end of secondary education, the child would have acquired reasonable competence in software such as word processing, spreadsheet, database

and analysing programs that allow learners interact with the computer the way they desire. One of the major merits of the National Policy on Computer Education, is that it recommended the introduction of computer studies at all secondary schools in Nigeria. The committee on the policy recommended a total lifting of restriction on computer studies in a way that computer literacy program can begin right from primary school. According to the committee, computer studies should be introduced at any level provided the necessary facilities and resources are adequately provided for effective implementation. Since then, effort has been made to include computer studies in the primary and secondary school curriculum.

Report by the Chief Examiner, West African Senior School Certificate Examination (WASSCE, May/June 2014-2017) on students' academic performance in Computer studies showed that the pass rate at credit level decreases gradually as the failure rate increases correspondingly. Okeke (2015) attributed the low achievement in secondary school Computer studies to teachers' non utilization of appropriate teaching methods. Furthermore, Okeke also specifically noted that the use of ineffective teacher centred-strategies like conventional teaching method account for the highest poor performance. In addition, Ayogu (2014) remarked that most teachers in Nigerian secondary schools still believe that the most effective means of communicating to students' is through the conventional "talk and chalk" method of teaching.

The conventional teaching method is a method in which the teacher presents a verbal discourse mainly on a particular subject, theme or concept to the learners. The teacher delivers pre-planned lessons to the students with little or no instructional aid that involves students' activity (Okoli, 2016). Secondary school teachers very often teach subjects by conventional teaching method (CTM). This may be because the method is the easiest to deliver and large contents are usually covered by the teacher using the method. This may be why majority of

teachers often use this method without recourse to constructive teaching methods that promote the acquisition of scientific and technological skills in learners.

Teachers have been teaching their students using traditional lecture method over the years. Opara (2017) further opined that WAEC annual reports for the slated years revealed that students' pass rate at credit level in computer studies were poor as earlier reported. This is an indication that the use of CTM in teaching computer studies has not delivered effectively. The situation therefore calls for exploration of other teaching methods found effective in some other fields and countries (Okoli, 2016). Opara (2017) proposed that teachers should use teaching strategies that are helpful in nature and which should involve learners' active participation and encourage skill acquisition. Such strategies could be able to generate interest among students in the learning process. This is because it is expected that students' learning of Computer Studies through using realistic instructional techniques should enhance the inculcation of the generic skills of inquiry, reasoning, conceptualizing, problem-solving and communicating. By applying these skills, students are not only expected to construct their knowledge of computer studies but also to establish confidence and positive attitudes toward computer studies. One way of achieving this may be through the adoption of student-centred, activity-based and minds-on approaches that cater for individual needs and differences, learning styles, interests and abilities. One such student-centred, inquiry-based approach to organize learning is mind mapping.

Mind-mapping is a teaching strategy which is visual and non-linear representation of ideas and their relationship. The strategy is student-centred as described by Lea, Stephenson and Troy in Jubrin (2014) who pointed that it allows learners to be active rather than passive listener and emphasized deep learning and understanding. Mind mapping is a beneficial learning strategy to help students brainstorm any topic and think creatively. Mind maps are particularly helpful in the writing process and provide students with a natural way of thinking

and building thoughts on a story plot or theme. The Mind Mapping, which represents and classifies the knowledge in a powerful graphic technique for uncovering the potential of the brain (Jubrin, 2014). Generally, a mind map provides and organizes knowledge by means of hierarchies and categories. Along with this, those hierarchies and correlations in Mind Maps spread around meaningfully from a central image without a certain order (Budd, 2015). That is to say, Mind Maps are the expression of the radiant thinking on a piece of paper. The radiant thinking is about the associated thinking processes which connect to a central point or originate and advance from a central point. This phenomenon takes place naturally and spontaneously in the brain functions of all people (Jubrin, 2014; Obodo, 2011). Mind Maps can be used to increase the performance of humans in all areas of life.

Mind-mapping has also been described as one of the teaching strategies that promote creative thinking, ability and high retention in learners. It is a powerful tool that teachers can use to enhance learning as it is evident in brainstorming, note taking, problem solving, memory learning and visual thinking technique used by psychologist, educationist and other professionals (Yusuf, 2012). Yusuf added that mind mapping enhances the development of certain skills in learners such as thinking skills, reasoning skills and ability to make decision, taking action, information gathering and generating skills. Types of mind maps are (1) reference mind maps which is used for keeping document (2) planning mind maps used in making plans (3) institutions and presentation mind maps used for training in schools. The institutions and presentation mind maps will be relevant in the course of this study because it is relatively important in education. Mind maps can be used in teaching in the following ways: place an image or topic in the centre at least using three colours, use image symbol codes and dimension throughout your mind maps, select key word and print using upper or lowercase letters and each word is alone and sitting on its line. Buzan (2016) stated that mind mapping teaching strategy (MMTS) is a constructive and classification graphic organizer of ideas which

uses the cortical skills to unlock the brain potentials. Buzan added that a mind map is a powerful graphic organizer of ideas, which provides a universal key to unlock the potential of the individual brain. It harnesses the full range of cortical skills, words, image, number, logic, rhythm, colour and spatial awareness in a single uniquely powerful manner. In doing so, it gives the learner the freedom to roam the vast expanse of his or her brain. This study therefore explored how MMTS helped to improve the retention of male and female computer studies students in schools.

Retention can be seen as the ability to absorb, hold or keep in memory what has been learned and hence remember or utilize the already acquired knowledge or skills over an extended period of time. Retention plays a pertinent role when it comes to the effective or correct application of whatever a student has learnt. This is because a student retrieves the information he/she has retained in his/her memory when the need arises (may be during a test or examination). So what has been learnt and assimilated by the students can be measured by their ability to answer questions given to them in either test or examination. Retention according to Chauham (2009) is a direct correlate of positive transfer of learning. This means that a student who has high retention ability should invariably achieve highly when achievement test is given. Ugwuanyi (2010) maintained that the ability of the students to retain and hence remember what they have been taught by the teacher depends heavily on the appropriateness of the method of instruction. Luepruti (2012) observed that the ability to remember takes place more effectively when experiences are passed to the learner through an appropriate instructional method. For a student to retain or hold back something, the student must have good memory where what he has learnt can be stored and hence retrieved when the need arises.

In Computer studies teaching and learning, the ability to remember computer concepts takes place more effectively when the concepts are presented to the students through an

appropriate instructional method. Dulton in Ezeamenyi (2012) asserts that failure to provide enough application to real life activities, social usage cum poor teaching techniques are strong limiting factors to students' retention in Computer Studies. In support of this, Nneji (2013) states that retention depends mainly on teaching strategy adopted by the teacher and made case for adoption of instructional methods that promotes students' involvement and activity in the teaching of secondary school Computer Studies so as to enhance students' retentiveness. Many researchers used different strategies in teaching their students science and yet found divergent retention status by gender in their studies. Hence, there is yet no consensus report on the retention of students in sciences. Therefore, it is worthwhile to evaluate the effect of mind mapping teaching strategy (MMTS) on students' retention in Computer Studies.

Research Questions

1. What is the difference between the mean retention scores of students exposed to mind-mapping teaching strategy and conventional strategy?
2. What is the difference between the mean retention scores of male and female students taught computer studies using mind-mapping strategy?

Hypotheses

The following null hypotheses were tested at 0.05 significant level:

1. There is no significant difference between the mean retention scores of students taught computer studies with mind-mapping strategy and conventional strategy.
2. There is no significant difference between the mean retention scores of male and female students taught computer studies using mind-mapping strategy?
3. There is no interaction effect of gender and teaching strategies on mean retention scores in computer studies.

Method

This study adopted quasi experimental non-equivalent control group design. The population is made up of 1,052 senior secondary two (SS 2) Computer studies students found in the four co-educational schools within Owerri Municipal Council of Imo State in 2017/2018 academic session. The sample of the study was 105 SS 2 Computer studies students drawn through multistage sampling procedure. The instrument CSRT was developed by the researcher and validated by three experts. The reliability coefficients obtained for the CSRT was 0.84 using Kuder Richardson Formula20. Data obtained from this study were analysed. Mean and Standard deviation scores were used to answer the research questions while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA).

Two lesson plans, one for the experimental (MMTS) and the other for the control (CTM) were prepared by the researcher. The teachers used them for teaching the subjects. On the first day of the experiment the instrument (CSRT) were administered by their regular teachers as pre-test. An hour was allowed for the test. The test was marked, collated and collected by the teachers and handed over to the researcher. Teaching commenced on the next computer studies period by the teachers for five weeks. The contents covered were computer operations, DOS and Internet. Five weeks after, post-test was administered. An hour was allowed for the test. The test was marked, collated and collected by them and handed over to the researcher. Two weeks after the post-achievement test, the retention test was administered and as indicated earlier the pre-achievement was used as the retention test. One hour was allowed for the test. This is to check participants' retention in computer studies concepts and principles taught and examined as Post-test after two weeks. The test was marked by the teachers. Scores were collected, collated by them and handed over to the researcher. Some of the extraneous variables controlled in this study were effect of pre-test on post-test, Hawthorne

effect, initial group differences, instruction situation variable, subjects' interaction, novelty effect, teachers' variable and training of teachers.

Results

Table 1: Mean and standard deviation on retention scores of students taught Computer Studies using MMTS and conventional method

Group	N	Mean Post-test	Mean Retention test	SD Post-test	SD Retention test	Mean Loss
MMTS	52	66.3	62.9	11.6	11.3	3.4
Conventional	53	64,5	51.4	11.9	12.9	13.1

From Table 1, MMTS group has a mean retention score of 62.9 while conventional group has the mean retention score is 51.4. This shows that MMTS has effectively enhanced the retention of computer studies students in the MMTS group more than those in the control group in Computer Studies. This is clearly seen in the loss in mean by the two groups during retention tests.

Table 2: Mean Retention scores of Male and Female subjects taught with MMTS

Group	N	Mean Post-test	Mean Retention test	SD Post-test	SD Retention test	Mean Loss
Male	22	63.5	58.8	11.8	11.6	4.7
Female	30	69.1	67.0	11.4	11.0	2.1

From Table 2, the loss in mean for female (2.1) is less than the loss in mean for their male (4.7) counterparts taught Computer studies with MMTS. This implies that female students retained Computer studies concept higher than their male counterparts when taught with MMTS.

Table 3: ANCOVA Comparison Difference between the Retention of MMTS group and Conventional group and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	363.222a	4	90.806	.645	.632	.025
Intercept	27600.988	1	27600.988	196.047	.000	.662
Pre-Test	147.398	1	147.398	1.047	.309	.010
Method	59.204	1	59.204	.421	.018	.004
Gender	169.670	1	169.670	1.205	.275	.012
Method *Gender	3.206	1	3.206	.023	.880	.000
Error	14078.740	100	140.787			
Total	464198.000	105				
Corrected Total	14441.962	104				

Table 3 reveals that significant difference exists between the retention scores of students taught computer studies with MMTS and those taught with lecture method in favour of MMTS group. This shows that the MMTS has effectively enhanced the memory of the MMTS group more than the control group ($p < 0.05$). From the result of the ANCOVA test as shown in Table 3, the statement of hypothesis 2 is not rejected; implying that effect of MMTS on retention of male and female students in computer studies using their post-test mean scores is not significant ($p > 0.05$).

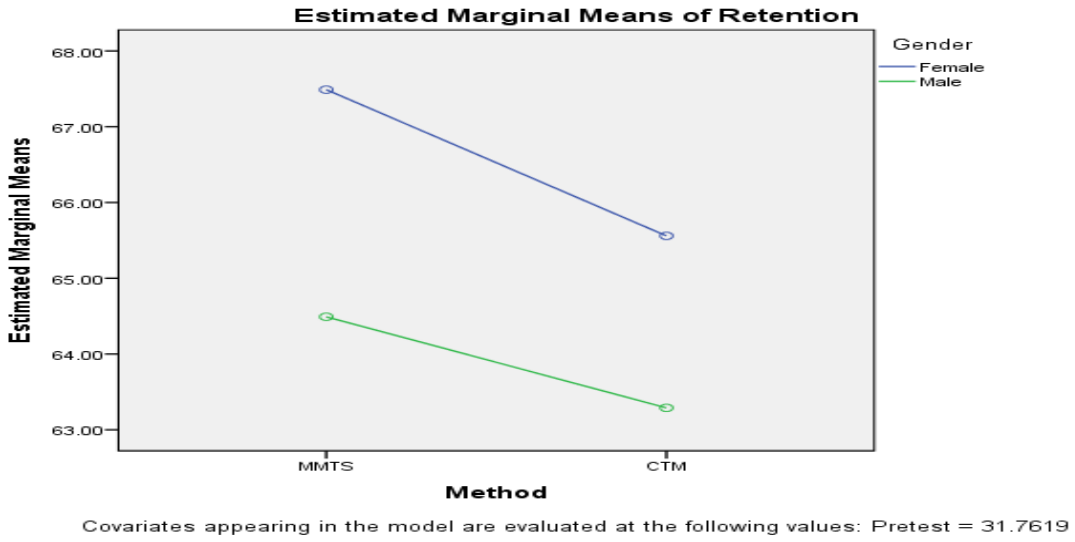


Figure 1: Interaction effect of teaching strategies and gender on students' retention in computer studies

Table 3 also reveals that there was no significant interaction between gender and teaching strategy (MMTS) as measured by the mean retention scores in computer studies ($p > 0.05$). Therefore, hypothesis 3 is up-held. This shows that the retention of students in relation to MMTS is not influenced by gender of the students. Figure 1 presents the profile plot showing the interaction effect of teaching strategies and gender on students' retention scores in computer studies. The interaction pattern shows that the plots for males and females do not intercept. This indicates that there is little likelihood of an interaction effect between strategies and gender in CSRT especially when the two lines are crossed.

Discussion

This study revealed that the mean retention score of students taught using MMTS was higher than those taught using CTM. This implies that MMTS had effectively enhanced the memory of the experimental group more than the control group as much that had caused a significant difference. This higher mean retention score by the treatment group could be as a result of the MMTS been able to have enhanced the brain cells of the experimental group. Furthermore, the gender inclusive instructional technique of MMTS made it possible for the experimental group to obtain higher mean retention score than the control group. The finding of this study showed that there was a significant difference on the mean retention score of students taught using MMTS and those taught using CTM. The finding supported similar innovative teaching reported by Jubrin (2014), Obodo (2011) and Okeke (2015). The study of science especially computer studies is activity based. Activity based teaching technique requires that the teacher does the activity while the students by simulation do the same over and over by themselves.

Evidence from this study revealed that the influence of gender on mean retention score of students taught using MMTS was not significant. This is an indication that students' gender group memory was greatly enhanced as a result of gender inclusive MMTS. Therefore, gender

influence on the mean retention score of students taught using MMTS was not significant. This finding supported the findings of Obodo (2011) and Jubrin (2014) who found no significant gender influence on mean retention score in Computer studies.

The interaction effect of treatment and gender on mean retention score was not significant. This finding supported Okeke (2015) who found no significant interaction effect of gender and use of resource materials in integrated science taught. Similarly, the finding supported Ifeakor (2012) in which it was reported that the interaction effect of assessment technique and gender on mean retention score was found not significant. More so, the interaction effect of treatment and gender on mean retention score was not significant in this study. This is an indication that the interaction effect of treatment and gender on mean retention score may be present but was insignificant. This finding supported Ezeh (2002) and Obodo (2011). This also confirmed the result in Figure 1 which showed that the plots for males and females do not intercept. This indicated that there is little or no likelihood of an interaction effect between strategies and gender in CSRT especially when the two lines are crossed. Since no interaction as measured by CSRT was observed in this study, one may begin to appreciate the fact that the main effect of mind-mapping does not change as a function of variations in gender.

Recommendations

Based on the findings from the study, the researchers recommended as follows:

1. Computer studies teachers should use mind-mapping strategy to improve students' retention in computer studies irrespective of their gender.
2. Student teachers should be trained on the use of mind-mapping strategy during their training process and in-service computer studies teachers also re-trained.
3. Curriculum planners should include MMTS as a teaching strategy in the senior secondary Computer studies curriculum during curriculum revision.

References

Abimbade, A. (2014). Information technology: The current strategy for effective science and technology instruction. *Bichi Journal of Education*, 2 (1), 33 –39.

Ayogu Z.C. (2014). Influence of gender and school location on students' achievements in physics. *The 40th Science Teachers Association of Nigeria Annual Conference Proceedings*,217-221.

Budd, H. Z. (2015). The relation between abstract concept achievement and prior knowledge, formal reasoning ability and gender in Egypt. *International Education II Journal of Science*, 12, 227 – 230.

Buzan T. (2016). *The Mindmapping gridlines.* New York: Penguin Books.

Chauhan, S. S. (2009). *Innovations in teaching learning process*. New Delhi: Vikas publishing House PVT ltd.125-130.

Ezeamenyi, M.O (2012). Effects of four games on mathematics achievement of J.S.S. students on some selected topics in mathematics. Nigerian *Journal of Functional Education (NAPFED), 6 (1), 156-161.*

Ezeh D.N. (2002). *Effects of study questions as advanced organizers on students' achievements, retention and interest in integrated science.* Ph.D. Thesis, Nsukka: University of Nigeria.

Ezeudu, F.O. (2015). *Effect of concept maps on students' achievements, interest and retention in Computer studies*. Unpublished Ph.D Thesis, University of Nigeria, Nsukka.

Fafunwa A.B. (2013). *Case of male literacy in science and technology in Nigeria* in G.A.

Federal Republic of Nigeria (2013). *National policy on education, Lagos: NERDC Press.*

Ifeakor, M.D. (2012). *Evaluation of commercially produced computer assisted instruction package for teaching secondary school computer*, Unpublished thesis, University of Port-Harcourt.

Jubrin, A. G. (2014). Improving the academic achievement of senior secondary school students in biology through enhanced problem- solving strategy in Bauchi Metropolis. *Journal of Technology and Educational Research (JOTER), 4(2),20-30.*

Luepruti, M. (2012). International comparison in science education. *Journal of Research in Science Education*,18 (3), 87 – 104.

Nneji, S.O. (2013). *Effect of Q-basic quadratic equation game on secondary school students' achievement, interest and retention in computer Science*. Unpublished Master Thesis. Enugu State University of Science and Technology (ESUT), Enugu.

Obodo, G.C. (2011). *The deferential effect of three teaching modes of performance of junior secondary school students in some computer studies concepts*. Unpublished Ph.D. *Thesis.* University of Nigeria, Nsukka.

Okeke, O.J. (2015). *Effect of students' prior knowledge of instructional objectives on their achievement in senior secondary computer studies*. Unpublished Master Thesis: ESUT.

Okoli, J.N. (2016). Effect of investigative laboratory approach and expository method on acquisition of science process skills by science students of different levels of scientific literacy. *Journal of STAN, 44*(1&2) 29–38.

Opara, E.N. (2017). *A survey of development in the instructional process in R.N.A. Amadi (Ed) principles and methods of teaching and learning:* Owerri M. (ATEC Publication).

Ugwuanyi, C. U. (2010). The 6-3-3-4 System of Education and Employment: Problems and Prospects. *Journal of Studies in Education* 4, (2), 14-17.

Yusuf, F. I. (2012). *Effects of using computer assisted instruction on the learning of mathematics at senior secondary school level in Minna, Niger State, Nigeria.* Unpublished M.Tech. Thesis, Federal University of Science and Technology, Minna, Nigeria.

Effect of Metacognitive Teaching Method on Secondary School Students' Achievement and Interest in Physics in Anambra State

Uzobuike, P. O.
Department of Physics, Institute of Ecumenical Education, Thinkers Corner, Enugu, Enugu State, Nigeria
&
Okoli, J. N.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
jn.okoli@unizik.edu.ng

Abstract

Metacognitive teaching method (MTM) has been noted for its effectiveness in enhancing the achievement of science students in subjects like Chemistry, Mathematics and Biology. This study investigated the effect of metacognitive teaching method on achievement and interest of secondary school students in physics. Two research questions guided the study and two hypotheses were tested at 0.05 level of significance. The study adopted a quasi -experimental design. The sample comprised 122 students (72 males and 50 females) senior secondary class one (SS 1) physics students purposively drawn from two co-educational secondary schools in Awka Education Zone of Anambra State. One of the schools was randomly assigned to experimental group and the other to control group. Two instruments namely: the Physics Achievement Test (PAT) and Physics Interest Scale (PIS) were used to collect data for the study. The instruments were administered once and the reliability index of 0.74 was established on PAT using Kuder Richardson Formula 21 while the reliability of the PIS was established to be 0.83 using Cronbach alpha formula. Mean and standard deviation were used to answer research questions while ANCOVA was used to test the null hypotheses. The results revealed that the MTM had significant effect on students' achievement and interest in physics. The finding implied that MTM enhances students' achievement and interest in physics more than the conventional method. Based on the findings, it was recommended among others that physics teachers should adopt MTM for teaching physics concepts to secondary school students.

Keywords: Academic achievement, interest, metacognitive teaching method, physics.

Introduction

The use of student-centred teaching methods is believed to have sustained students' interests and improved their academic performances during their internal and external examinations (Ibe, 2004). Inquiry, discussion, group and metacognitive teaching methods offer the students the opportunity to clear their misconceptions on some concepts in physics. These teaching methods take care of individual differences of the students and monitor the rate of understanding of each student for enhanced effectiveness in teaching, control and supervision.

The quest for review of these student-centred instructional strategies to be adopted in teaching physics concepts has resulted in the introduction of a number of innovative teaching methods that probably could enhance students' achievement and interest in the subject physics. One of such innovative teaching methods is metacognitive teaching method.

Metacognitive teaching method is defined as an effective tool which helps learners to be consciously aware of what they have learnt and recognizing situations in which they could be useful (Wichadee, 2011). It comprises three components such as explanatory information (what a strategy is), practical information (how strategy must be applied) and conditional information (to illustrate when a strategy must be employed). Metacognition was first put forward by John Flavell in 1976. Metacognitive knowledge involves proper monitoring directed towards the acquisition of information about the thinking process of a learner using three elements of planning, monitoring and evaluation (Flavell, 1976). According to Hammer (2012), application of metacognitive strategies like structuring, inferring, thinking, set a purpose, schema, etc. in metacognitive teaching method could enhance students' achievement and interest in the subject.

Achievement is an important academic factor that has been acknowledged to be influenced by teaching methods. According to Ibe (2004), achievement is the accomplishment of a goal. Academic achievement refers to the accomplishment of academic goals, the educational outcome of students, or rather, the extent to which a student, a teacher or an instructor has achievement the stated educational objectives. Achievement test questions are used to assess a person's performance in a course of study which he has undergone. If at the end of a course a test is given covering the area taught, in a course, the test is an achievement test. Achievement test is given by the teacher at the end of a year, term, week or lesson period covering the lesson(s) taught based on the instructional content.

Interest is a sense of concern with curiosity about someone or something. Gray (2011) observed that learning is more effective when students are actively engaged in the learning process rather than receive knowledge passively. Interest can also be defined as the willingness and ability of a learner to acquire knowledge with the right attitude. The teacher performs the supervisory role of guiding students to answer leading questions. Learners actively construct and build knowledge for themselves based on their prior experiences and what interests them; using what they already know which finally add to their knowledge.

Research Questions

1. What is the difference between the mean achievement scores of students taught physics with metacognitive teaching method and those taught using the conventional method?
2. What is the difference between the mean interest scores of students taught physics using metacognitive teaching method and those taught using the conventional method?

Hypotheses

1. There is no significant difference in the mean achievement scores of students taught physics using metacognitive teaching method and those taught using conventional method ($P < 0.05$).
2. There is no significant difference in the mean interest scores of students taught physics using metacognitive teaching method and those taught using conventional method ($P < 0.05$).

Method

The study adopted a quasi-experimental design with non-equivalent control and experimental groups. The population is 3,785 senior secondary school class one (SS1) students in the 60 Government owned secondary schools in the Awka Education Zone of Anambra State. This is made up of 1,203 male students and 2,582 female students enrolled for the 2017/2018 academic session. The sample is 122 (72 males and 50 females) SS I physics

students drawn from two co-educational schools using purposive and random sampling techniques.

Two instruments used for data collection are Physics Achievement Test (PAT) and Physics Interest Scale (PIS). PAT contained 30 multiple choice objective questions with four options each and validated by three experts in Science Education. PAT questions were adapted from the West African Senior School Certificate Examination (WASSCE) physics question papers from 1998-2016 and physics textbooks. The reliability of PAT was established to be 0.74 using Kuder Richardson formula (K-R-21) and the PIS was found to be 0.83 using Cronbach Alpha. The Physics Interest Scale (PIS) consisted of thirty (30) interest statement measured on a four-point interest rating scale.

With the help of the research assistants, the instruments was administered on the students before the experiment and the students' scores in this test served as the pre-test which showed the students' prior knowledge on the topics they were taught. This was followed by the treatment that lasted for four weeks of eight lesson period altogether. At the end of the treatment, the items were re-arranged and administered to the students as post-test. The data obtained from pre-test and post-test were recorded and used for analysis. The research questions were answered using the mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.

Results

Table 1: Mean and standard deviation of student's achievement scores in physics

Group	No.	Pre-test		Post-test		
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$gain
MTM	66	38.41	16.58	73.52	11.76	35.11
Conventional method	56	41.64	15.57	52.32	16.61	10.68

Table 1 reveals that the students taught physics with metacognitive teaching method had pre-test mean score of 38.41 and post-test mean score of 73.52 with gained mean of 35.11 while those taught using conventional teaching method had pre-test mean score of 41.64 and post-test score of 52.32 with gained mean of 10.68.

Table 2: Mean and standard deviation of student's interest scores in physics.

Group	No.	Pre-test		Post-test		
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$gain
MTM	66	76.88	15.00	94.18	11.15	17.3
Conventional mtd	56	83.71	15.41	90.05	23.02	6.34

Table 2 shows that the students taught physics with metacognitive teaching method had pre-test interest mean score of 76.88 and post-test interest mean score of 94.18 with gained mean of 17.3 while those taught physics using conventional method had pre-test mean score of 83.71 and post-test mean score of 90.05 with gained mean of 6.34.

Table 3: ANCOVA Summary of the mean achievement scores of students taught physics using metacognitive and conventional teaching methods.

Source of Variation	SS	df	Ms	Cal.F	P-Value
Correlated Model	13610.354	2	6805.177		
Intercept	65664.503	1	65664.503		
Achievement	2.594	1	2.594		
Teaching method	13508.511	1	13508.511	67.01	0.000
Error	23988.105	119	201.581		
Total		122			
Correlated Total	37598.459	121			

Table 3 shows that at 0.05 level of significance, 1df numerator and 121df denominator, the calculated F-value is 67.01 with p-value of 0.000 which is less than 0.05 ($P<0.05$). This means that there is significant difference in mean achievement scores of students taught physics using metacognitive teaching method and those taught with conventional method. Therefore the hypothesis is rejected.

Table 4: ANCOVA summary of the mean interest scores of students taught physics using metacognitive teaching method and those taught with conventional teaching method.

Source of Variation	SS	df	Ms	Cal.F	P-Value
Correlated Model	518.446	2	259.223		
Intercept	35733.481	1	35733.481		
Interest 1	2.145	1	2.145		
Teaching method	476.976	1	476.976	1.525	0.219
Error	37228.513	119	312.845		
Total	1076805.000	122			
Correlated Total	37746.959	121			

Table 4 indicates that at 0.05 level of significance, 1d.f numerator and 121 df denominator the calculated F-value is 1.53 with p-value of 0.219 which is greater than 0.05 (P>0.05). There is no significant difference in post-test mean interest scores of students taught physics using metacognitive teaching method and those taught with conventional method. Therefore, the hypothesis was not rejected.

Discussion

Result of the study shows that metacognitive teaching method is effective in enhancing students' achievement in physics. This finding agrees with (Akinsola, 2011) who found out that MTM produced higher achievement than the conventional method. The ANCOVA analysis further revealed that the observed difference in the achievements of the experimental and control groups is due to the treatment administered in the experiment. This finding agrees with the report of Opara (2011); comparing effects of Metacognitive Teaching Method alone and Regular Teaching Methods on students' achievement in physics. It also showed that MTM was the indicated significant increase in students' achievement. The finding is also in line with Vanessa (2015) who concluded that MTM is effective in inculcating physics concepts to students.

Similarly, this result was supported by the who reported that MTM was capable of bringing about positive changes in students' knowledge prior to the instruction, an evidence of improvement in students' academic achievement. It is therefore, the opinion of the researcher that MTM is an effective method of improving students' achievement in physics. Furthermore, findings of the study show that male students recorded higher achievement than their female counterparts in the experimental group and that there was significant difference between the mean achievement scores of male and female students in the two groups. This finding also agrees with Opara (2011) which reported that male students performed better than their female counterparts when taught with MTM. There was significant interaction effect of gender and teaching methods on students' achievements in physics. This indicates that the MTM favoured the male students more than their female counterparts. This agreed with Nzeadibe (2016) which implies that irrespective of the teaching method used, male students seemed to achieve better than their female counterparts. These findings are in line with many research findings that have reported higher achievement in physics among male students than their female counterparts.

Conclusion

The study revealed that students taught physics using MTM recorder higher achievement than those taught using conventional method. It further indicated that there is significant difference between the achievement and interest of students taught physics using MTM and those taught using conventional teaching method. Based on the findings, it was concluded that (MTM) is an effective method for enhancing secondary school students' achievement in Physics.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Physics teachers should be encouraged to use MTM in teaching physics in secondary schools.
2. The Governments at all level and other relevant bodies such as Post Primary Schools Management Board should sponsor Physics teachers to seminars, conferences, workshops and refresher courses on the use of MTM in teaching physics.
3. Teacher-training colleges and institutions should emphasize the use of MTM in training pre-service Physics teachers.

References

Adewale, P. & Oladipo, M. (2006). Managing education facilities for school effectiveness in Nigeria. *International Journal of Educational Research. (8),* 978-993.

Anderson, J.R. (2002), Learning and memory: An integrated approach (2nd Ed). *Ney York, John Willey and Sons.*

Aydin, F. (2011), Geography teaching and metacognition. *Education Research and Review*,6(3), 274-278.

Borkowoski, J.G., Carr, M., & Pressley, (2007), "Spontaneous" strategy use: Perspectives from metacognitive theory. *Intelligence, 11*, 61-75

Carr, M.; Kurtz, B.E.; Schneider, W.; Turner, L.A. & Borkowski, J.G. (2005), Strategy acquisition and transfer among German and American children: Environmental influences on meta cognitive. *Development Psychology, 25,* 231-235

Flavell, J.H. (1976), Metacognitive aspects of problem solving in L.B Resnick, (Ed.), The nature of intelligence. *Hillsdale, New jersey Lawrence Erlbaum Associates, 12*, 231-235.

Guisti, B.M. (2008), Comparison of guided and open inquiry instruction in a high school physics classroom. *Unpublished M.Sc. Thesis, school of technology Brigham Young University.*

Hammer, E.Y. (2012), Meta-studying: teaching metacognitive strategies to enhance students' success. *Xavier University of Louisiana. www.youtube.com/watch*

Ibe, E., & Nwosu, A.A. (2003), Effect of guided- inquiry and demonstration on science process skills acquisition among secondary school biology students'. *Journal of the Science Teachers' Association of Nigeria.* 38 (1 and 2) 58-63.

Ogunleye, B.O & Babaejide, V.F. (2011), Commitment in science and gender as determinants of students' achievement and practical skills in Physics. *Journal of Science Teachers Association of Nigeria. 1(46) 125-135.*

Opara, J.A. (2011), Inquiry method and students' academic achievement in biology: lessons and policy implications. American-Eurasian Journal of Scientific Research 6 (1) 314-325

Pintrich, P.R. (2002). The role of metacognitive knowledge in learning teaching and assessing theory into practice. 41(4), 2`9-225.

Vanessa, C. (2015), *Students' achievement*. Copyright 2003-2015.

West African Examination Council (2009-2016), Physics chief examiner's report,

Yaruk, N. (2005). Analysis of the nature of student' metaconceptual teaching practices on students' conceptual understanding of force and motion. *Doctoral Dissertation, Dept of Science Education, Ohio State University, Columbus.*

Yong, B.C.S 92009), Students' motivational orientations and their association with achievement in biology. *Brunei International Journal of Science and Mathematics Education 1* (1), 52-6.

Extent of Use of Practical Works by Biology Teachers in Public Secondary Schools in Anambra State, Nigeria

[1] Ogbuze, C. O. & [2] Okoli, J. N.
[1,2] Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[1] co.ogbuze@unizik.edu.ng [2] jn.okoli@unizik.edu.ng

Abstract

The extent of use of practical work by secondary school biology teachers in public schools in Anambra State of Nigeria was investigated. The design adopted was descriptive survey. The population of the study comprised all the biology teachers in Anambra State. The sample for the study was made up of 221 biology teachers selected through multi-stage sampling. The instrument for data collection was researcher constructed questionnaire titled Practical Work Questionnaire. The instrument was subjected to validation by three experts while reliability index of 0.86 using Cronbach Alpha coefficient was obtained. The data collected were analysed using mean. The findings of the study showed that among others that the ways by which the use of practical work by biology teachers in teaching biology can be enhanced include continuous supply of materials, inspection of laboratories, use of alternatives to practical, project work, outdoor practical, field trips/excursions, improvisations, use of simulations, invitation to experts in subject area, and alternative power supply. The findings also showed that schools have materials and equipment for practical works which are used by biology teachers to a moderate extent. The study recommended that government should also create a separate department under the minister of education, charged with the responsibility of carrying out occasional and routine check of school practical works to ensure they are used for teaching biology.

Keywords: Practical works, biology, laboratory, teachers, technicians

Introduction

The importance of education in the overall development of an individual and the society is sometimes underestimated. Since no nation can develop and advance beyond the provisions of her educational system, what should be taught and how it should be taught at all levels of the educational system, becomes the concern for all. In order to restructure the formal education bequeathed to Nigeria at independence in 1960 by the British Colonial masters and make education relevant to present needs, an indigenous National Curriculum Conference was held in 1969. The conference resulted in the Federal government publication of white paper entitled National Policy on Education (NPE) in 1977. In 2004, 2008, 2012 and 2013 respectively; the policy has been revised in order to reflect the nation's philosophy on education.

The NPE deals with all aspects of education from philosophy, different levels and structure, financing, types of education to educational services, administration and planning. Although, the curriculum materials have been revised, the system of education remains six-year primary education, three-year junior and three-year senior secondary school and four-year tertiary education (6-3-3-4 system of education). The national educational goals to which the philosophy of education is linked include the training of the mind in the understanding of the world around# (FRN, 2013). The broad goals of secondary school education as spelt out in the NPE are to prepare the individual for useful living in the society and higher education (FRN, 2013).

In 1986, the Federal Government of Nigeria in another policy document 'National Policy on Science and Technology' expressed well-defined philosophy and objectives of science and technology. The philosophy stipulates that scientific and technological activities should be planned to achieve their acculturation and use through mass science education, technology transfer and acquisition, copy creativity, design and fabrication (Federal Ministry of Science and Technology, (FMST), 1986). Among the objectives of the policy is emphasis on increasing and strengthening theoretical and practical scientific base of the society. The policy also emphasizes that educational system shall focus on science at all levels.

Science is the study of the nature around us. Biology being a branch of science is the study of life and encompasses the study of living things in the context of influences exerted by non-living things (Kwan, Lam & Ofofuna, 2011). At the senior secondary school level, biology is one of the basic science subjects required in Senior Secondary School Certificate Examination (SSCE). It is common knowledge that virtually all students opt for Biology as they enroll for senior secondary class. This may be because the study of Biology is fundamental to the development of the human mind and good living environment, hence, Eze (2009) observed that Biology class is usually very large compared to other basic sciences. To achieve

the objectives and meet up with the usefulness of science in general and Biology in particular, the teaching of Biology must involve practical works.

Practical works are very essential to the effective teaching and learning of sciences in schools. Those who are properly grounded in the knowledge of Biology are better equipped to tackle health challenges. Such knowledge will not come from mere theories, but from practical application of the instructional materials/equipment learnt in real life situations. According to Dan-ologe and Shittu (2012), most school subjects can be taught with ordinary tools such as pencil, paper, chalkboard, textbooks and some other teaching aids. For effective science teaching, well equipped laboratories are needed as science cannot be taught only theoretically. Teaching of biology without adequate practical work makes teaching teacher-centered and the student passive learners during lessons. This makes students prone to rote learning and do not develop in the student the attitude of scientific enquiry.

Practical work in biology entails the acquisition of laboratory and field skills in the scientific study of life and structure of plants and animals in relation to their environment (Opuh, 2013.) In the preamble to their syllabi, the National Examinations Council, (NECO) (2014), West African Examinations Council (WAEC), (2014), buttressed the need for practical work in teaching and learning of biology in senior secondary schools. Both syllabi were designed to assess candidates in understanding of the structure and function of living organisms as well as appreciation of nature; acquisition of adequate laboratory and field skills in order to carry out and evaluate experiments and projects in biology; acquisition of Science Process Skills (SPS); observing, classifying and interpreting data. According to the 2014 edition of WAEC syllabus, great importance should be attached to experimental works. It was recommended that whenever possible throughout the whole course, candidates should be aware of practical applications of what is being studied.

From the foregoing, one can infer that practical work is very essential for effective teaching and learning of biology. Practical works however, is rarely used by science teachers and biology teachers in particular. The reasons for the seldom use of practical work in most public schools are often reasonable. For instance, some biology teachers argue that sometimes, the lack of practical resources and equipment for practical works makes it difficult to conduct practical work for students. It is a common occurrence in most public secondary schools that it is during external examinations like WAEC and NECO that schools acquire most resources. The acquisition of resources for practical works at this time is often limited to the ones specified in the white papers and which will be used in the examinations. Most other resources which are available in public schools are either not useful or expired.

The problem of unavailability of instructional materials and resources for practical works in teaching and learning biology is often linked to the expensive nature of the resources. There is also the problem of preservation. Degradable resources such as leaves, flowers, animals such as toads, fish, rats, lizard and such other resources cannot be preserved for a very long time. At some instance, they become useless as some of their useful parts either fall off or dissolve in the chemical used in preserving them. At such times, their physical characteristics become hard to determine. These problems in listed did not end the list of the problems of the use of practical works on the part of the biology teacher. One peculiar problem relative to the biology teacher is that of time allocated for biology instruction.

The school timetable often contained a well-planned duration for all subjects which teachers must adhere to. The timing is to ensure smooth operation of the school system. However, there is barely any time specifically allocated for practical works by students or demonstration on the part of the teacher. This has made biology teachers to focus more on finishing the content of the scheme of work which is believed to be slightly overloaded. Given that biology is nearly offered by all students, the biology teachers' classes are often filled

beyond the number of students that can be effectively handled by a single teacher. Class exercises and assignments, marking of scripts and other academic functions further eat into the time which in any case could have been used for practical works. This being the case, the extent of biology teachers' use of practical works has continued to reduce and have become an area of research interest.

Research in the problems of practical works has shown that the concept of practical works can be re-conceptualized to include cognitive approach to laboratory experiments. This is the concept used in most external examinations such as WAEC and NECO where alternatives to practicals are used. Whereas the term 'practical work' refers to any teaching and learning activity which at some point involves the students in observing or manipulating the objects and materials they are studying, the observation or manipulation of objects might take place in a school laboratory, but could also occur in an out-of-school setting, such as the students' home or in the field (example when studying aspects of biology or Earth science).

Following this line of reasoning, it then follows that, cognitively, there is nothing uniquely distinctive about practical work which marks it off from other kinds of science learning activity. The same kind of discussion as might follow a practical activity/work can take place in a lesson where there is no data collection, observation or manipulation because the phenomena which the teacher wants to explore with the class are ones that the teacher can assume are already well-known to pupils from their everyday experiences. For example, imagine a teacher beginning a lesson on the idea of inertia in Newtonian mechanics. The teacher might ask the class if they have ever found themselves having to stand in a bus or train, because it was crowded – and to say what they remember happening (and feeling) as the vehicle started off, or when it stopped. From their shared experiences, the teacher might then draw out the idea that objects are somewhat resistant to changes in their motion.

There has been no practical work in the sense of in-class data collection, observation or manipulation. But the cognitive processes involved are the same as when data collected or observed and manipulated by the students are discussed and reviewed. The aim is to draw students' attention to a phenomenon, to isolate parts of it for particular scrutiny, and to talk of a way of thinking about it. The aim is to develop a link between an observation and a way of thinking about it – between the world and a mental representation of the world. This is at the centre of all science learning – and practical work plays a critical role in it. Practical work is used in science classes when students are unlikely to have observed the phenomenon one is interested in, or to have observed it in sufficient detail, in their everyday lives. In such situations, practical works is essential and irreplaceable, hence the investigation on the extent of use of practical work by biology teachers in public secondary schools in Anambra State.

Purpose of the Study

The purpose of this study was to determine the extent of use of practical work by Biology teachers in Anambra State. Specifically, the study determined:

1. Instructional materials/equipment that is available for teaching biology practical.
2. The extent to which biology teachers use practical works in the teaching of biology in senior secondary school level.
3. The strategies for enhancing the use of practical works in senior secondary schools.

Research Questions

1. What are the instructional materials/equipment available for practical works in secondary schools?
2. To what extent do biology teachers use practical works in teaching biology in senior secondary schools?
3. What strategies can be used for enhancing the use of practical works in senior secondary schools?

Method

Descriptive survey design was used in the study. The population of this study comprised all biology teachers in the six Education Zones of Anambra State, namely: Nnewi Education Zone, Onitsha Education Zone, Otuocha Education Zone, Ogidi Education, Aguata Education Zone and Awka Education Zone. Data obtained from the Post Primary School Service Commission (PPSSC) indicated that there are 457 biology teachers in the 21 Local Government Areas (LGAs) in the state. The sample size was 221 biology teachers in 11 LGAs within three (3) education zones. Simple random sampling technique was used to select three out of six (6) education zones. The entire biology teachers in the three selected zones were involved in the study.

The instrument for data collection was a researcher-constructed questionnaire titled Practical Work Questionnaire (PWQ). The data collection instrument was structured on a four-point response option ranging from Always Available (AA), Occasionally Available (OA), Rarely Available (RA) and Never Available (NA). A mean of these weighted responses which met the criteria/decision for acceptance was used to judge the availability of the materials and equipment for practical work in the school. Section B which sought to obtain information on the extent of practical works by biology teachers was designed on four-point rating scale Very Regularly in use (VR), Moderately in use (MU), Rarely in use (RU), Never in use (NU) and Sections C as modified four (4) point response scales from Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). PWQ was validated by three experts in science education and one in measurement and evaluation all in Nnamdi Azikiwe University, Awka. The reliability of the instrument was established using Cronbach Alpha. The instrument was administered once to 20 biology teachers from secondary schools in Onitsha Education Zone. The data obtained was used to compute the reliability of the instrument by applying Cronbach Alpha which yielded a reliability coefficient of 0.86.

The researcher with the help of research assistants administered the PWQ to the respondents. Before administering the PWQ, the researcher instructed the research assistants on what to do. The PWQ was administered to the biology teachers during their biology teachers' workshop. The data collected were analysed using weighted response average and grand mean with respect to research questions. The based criteria mean were used for questions 1, 3 and 4. The decision was that the weighted response average score of 2.50 and above for the all sections indicated acceptability while the items with mean score below 2.50 were not accepted. For the second research questions, the grand mean was used. The decision was that grand mean ranging from 3.01- 4.00 indicated that extent of use of practical works by biology teachers was very regularly in use, 2.01-3.00 was moderately in use, 1.01-2.00 was rarely in use, and 0.01 – 1.00 was never in use.

Results

Table 1: Availability of the Instructional Materials/Equipment for Practical Works

S/N	Questionnaire item	$\bar{X}$	Remark
1	Real objects	2.45	Not available
2.	Improvised material	2.37	Not Available
3.	Microscope	2.56	Available
4	Dissecting kit	2.67	Available
5.	Reagent	2.66	Available
6.	Projector for films	2.64	Available
7.	Bone/skeleton	2.79	Available
8.	Chart	3.41	Available
9.	Pictures/diagram	3.48	Available
10.	Test tube	2.71	Available
11.	Bunsen burner	2.62	Available
12.	Aquarium	2.32	Not available
13.	Audio/visual set	2.39	Not available
14.	Laptop	2.62	Available
15.	Rain-gauge	2.67	Available
16.	Wind-vane	2.58	Available
17.	Anemometer	2.93	Available
18.	Quadrant	3.25	Available
19.	Insect net	2.81	Available
20.	Petri dish	2.57	Available
21.	Measuring cylinder	2.54	Available
22	Beaker	2.62	Available

Cut off mean = 2.5 (Available)

From Table 1, it can be seen that all the items achieved mean scores above the cut-off mean except items 1, 2, 12 and 13. The respondents rating of materials/equipment available for practical work is that microscope, dissecting kit, reagent, projector for films, bone/skeleton, chart, pictures/diagram, test tube, bunsen burner, laptop, rain-gauge, wind-vane, anemometer, quadrant, insect net, Petri dish, measuring cylinder, beaker are available for practical works while real objects, improvised material, aquarium, audio/visual set are not available.

Table 2: Mean Responses on the Extent of use of Practical Work in Teaching Biology

S/N	Practical work (item)	$\bar{X}$	Remarks
1.	Collecting specimen	2.91	Moderately in use
2.	Biological drawing	1.55	Rarely in use
3.	Identify	1.86	Rarely in use
4.	Sample measurement	1.74	Rarely in use
5.	Investigating of specimen	1.00	Never in use
6.	Specimen preservation	1.32	Rarely in use
7.	Specimen storage	1.95	Rarely in use
8.	Observing specimen	2.44	Moderately in use
9.	Recording	2.67	Moderately in use
10.	Testing food substance	1.00	Never in use
11.	Drawing and labelling specimen	2.19	Moderately in use
12.	Classifying objects	1.00	Never in use
13.	Interpreting results	1.00	Never in use
14.	Analysing results	1.00	Never in use
	Grand mean	**1.69**	**Rarely in use**

Table 2 reveals that the respondents are in agreement that items 1, 8, 9 and 11 with mean score of 2.91, 2.44, 2.67 and 2.19 are moderately in use, while items 2, 3, 4, 6, 7, 10, with the mean scores of 1.55, 1.86, 1.74, 1.32, 1.95, were rarely in use, other items with mean scores of 1.00 are never in use. The grand mean scores of 1.69 indicates that practical works are rarely used by biology teachers.

Table 3: The mean Reponses of the strategies for enhancing the use of practical work in teaching Biology

S/N	Strategies (Items)	$\bar{X}$	Decision
1	Continuous supply of materials	2.63	Agree
2	Inspection of laboratories	2.57	Agree
3	Use of alternative to practical	2.54	Agree
4	Project work	3.01	Agree
5	Outdoor practical	2.60	Agree
6	Field trip/excursion	3.06	Agree
7	Improvisation	2.82	Agree
8	Use of simulations	2.76	Agree
9	Invitation to field workers	2.71	Agree
10	Alternative power supply	3.03	Agree

Cut off mean = 2.5 (Agree)

Data in Table 3 show that all the items in the table are accepted as ways by which biology teachers' use of practical work in secondary school can be enhanced

Discussion

The findings of the study revealed that the materials available for teaching practical works in secondary schools included microscope, dissecting kit, reagent, projector for films, bone/skeleton, chart, pictures/diagram, test tube, bunsen burner, laptop, rain-gauge, wind-vane, anemometer, quadrant, insect net, Petri dish, measuring cylinder, beaker. The availability of these materials could be because they are the basic apparatus required in biology laboratories. However, the absence of audio-visuals and computers are rather appalling. Aquarium which is one the most important tools that could give students an insight about the natural environment and real world are not available in schools. One possible cause of this may be because they are quite expensive and requires a lot of effort to maintain.

The findings of the study contrast that of Egbuonu (2005) who reported that schools do not have the needed instructional resources for teaching and learning of practical biology. The findings of the study however support that of Ukaegbu (2012) that 88% of biology laboratory resources are available in biology laboratories such as interactive white boards, prepared slides, chemicals, textbooks, beakers, flasks of different types, microscopes, first aid box, hand lens,

maps, models, computers, dissecting kits, fire extinguishers, thermometers, insect nets, bell jars, incubator, water baths, freezers and lecturers. The findings of the study further supported that of Nwafor and Eze (2014) that only two dimensional instructional materials are available in schools and those other instructional materials example audio materials, audio-visual materials are lacking in most schools.

The finding of the study showed that practical work is rarely used by biology teachers in teaching biology. This observation of the study could be because secondary school biology teachers often reserve most practical work for the examination class. Quite often, practical works are conducted only in preparation for external examinations. This is done to save material wastage and the cost of acquisition of more materials. The teachers may also not conduct practical work due to the class size. Most public secondary schools are over-loaded. Conducting practical works for large number of students is often problematic and requires a lot of time to involve all the students. Pairing or grouping students often result in some students taking over the exercise to the disadvantage of others. In such cases, students who were not able to interact directly with the materials/equipment for learning may not grow interest for another practical work.

The findings of the study support that of Egbuonu (2005) that biology teachers have not been using most of the science equipment for practical activities. The findings of the study is in line with that of Nwafor and Eze (2014) that teachers do not use instructional materials or improvise instructional materials to facilitate their teaching. The findings of the study also support that of Tolessa, Baressa, Bula and Itefa (2016) who reported that the frequency of practical work was 8.8%. Rabi (2017) finding is in line with that of this study. The findings show that teachers indicated reluctance and inability in conducting practical works using the few available laboratory facilities.

The findings of the study showed that the strategies through which the use of practical work by biology teachers in teaching biology can be enhanced include among others the continuous supply of materials, inspection of laboratories, outdoor practical, project work, field trip/excursion, improvisation, use of simulations, invitation to field workers, and alternative power supply, use of alternative to practical. The continuous supply of practical work materials ensures the availability of the materials for usage. When such materials are in continuous supply, the teachers can have enough to conduct practical exercises. The supply of materials often warrants inspection for usage and for malfunctional materials. Through such inspection, teachers are made to use the materials. Also, through the inspections, faulty materials are replaced and adequacy for the number of the students who are going to use the materials is ensured.

Another way to enhance the use of practical works is through the use of alternative to practical by the biology teacher. Here, the perquisite knowledge and skills is acquired through cognitive activities. This approach to practical activity does not require too much time and can be achieved within the time frame stipulated in the school timetable. Also, great number of students can be handled with ease and it is less expensive. Another alternative could be through the use of outdoor practical, field works and excursions. Visits can be made to companies, laboratories, workshops and factories to see the practical applications, procedure, skills used by the scientists.

The field workers or experts may otherwise be invited to the school to teach the students. In case of any difficulty, the teacher has as a final alternative, the use of simulation. Here, the practical work can be simulated and shown to the students. The benefit associated with the use of simulation is that it involves more senses of the learner and can facilitate easy recall. Moreso, the use of simulation can be used for large number of students. However, constant power supply is needed. This is why it is important to provide alternative power

supply. The findings of the study lend credence to the study of Opuh (2013) who noted that the teachers' mastery of the subject area is important for good practical work. Opuh noted also that if the practical equipment and experience is accessible, it plays a major role in influencing student attitude and academic achievement.

Conclusion

It can be concluded from the findings of the study that biology teachers' use of practical work is to a rare extent. Strategies that can help to improve the use of practical works include among others the use of improvisation, field trip and outdoor practical.

Recommendations

Based on the findings of the study, the following recommendations are put forward:

1. Government should provide more laboratory equipment/materials to ensure availability of those materials needed for practical work and to adequately meet up with the increasing population of students in schools.
2. There should be inclusion of outdoor practical, field trip/excursion in the secondary school curriculum according to seasons, festivals or occasions, for students to link studies with their daily experiences in the locality.

References

Dan-Ologe, I. A. & Shittu, A. O. (2012). Improving the standard of teaching and learning of practical in our secondary schools, emphasis on biology and chemistry practical. *Journal of Education*, *6*, 231-236.

Egbuonu, R.U. (2005). *Availability and utilization of instructional resources for teaching and learning of practical skills in biology.* Retrieved from: https://globalacademicgroup.com/journals/nard/Egbunonu.pdf

Eze, S. O. (2009). *Perception of biology teachers on the competencies possessed by the biology laboratory assistants in Nsukka and Obollo education zones*. Unpublished M.Sc. Thesis, University of Nigeria, Nsukka

Federal Republic of Nigeria (2013). *National policy on education*. Lagos: Nigerian Educational Research and Development Council (NERDC).

Kwan L. P, Lam, E. Y. K, & Olofuna J. O. (2011) *Biology for senior secondary school.* Ondo: Africana Feb publishers.

Nwafor, C.E, & Eze, S.O. (2014). Availability and utilization of instructional materials in teaching basic science in selected secondary schools in Abakiliki Education Zone of Ebonyi state. *Global Journal of Bio-science and Biotechnology, 3*(3), 492-295.

Opuh S.O (2013). *Problem of teaching practical work in biology, Igbo-Etiti local government. area of Enugu state*. Unpublished MSc thesis, University of Nigeria, Nsukka

Rabi, M. (2017). A survey of availability, utilization and maintenance of biology laboratory equipment and facilities in secondary schools in Sokoto state, Nigeria. *International Journal of Science and Technology, 6*(1), 662- 668.

Tolessa, M.D., Baressa, A., Bula, K.O., & Itefa, D. (2016). Status of biology laboratory and practical activities in some selected secondary and preparatory schools of Borenza Zone, South Ethiopia. *Educational Research and Reviews, 11*(1), 1709-1718.

Ukaegbu, C.G. (2012). *Provision and management of biology laboratory resources in colleges of education in South-Eastern Nigeria.* (Unpublished thesis), University of Nigeria Nsukka.

Secondary School Physics Teachers' Level of Awareness and Extent of Use of Professional Ethics and Codes of Conduct in Enugu State

Anosike, O. C.
University of Nigeria Secondary School, Enugu Campus, Enugu State, Nigeria
&
Okigbo, E. C.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
ec.okigbo@unizik,edu.ng

Abstract

Secondary school Physics teachers' awareness and use of professional ethics and codes of conduct in teaching in Enugu state was established. Six research questions and four null hypotheses tested at 0.05 level of significance guided the study. Descriptive survey design was employed in the conduct of the study. The population of the study involved 196 Physics teachers in the 291 government owned secondary schools in Enugu state, Nigeria. Simple random sampling technique specifically balloting with replacement was applied to obtain a sample of 105 Physics teachers from three education zones in the state. The codes of conducts questionnaire for Physics teachers (CCQPT) was used as the instrument for data collection. The CCQPT was validated by three experts. The coefficient of reliability was obtained using Cronbach Alpha method. The internal consistency of CCQPT was found to be 0.87and 0.76 for sections I and II respectively. Statistical mean and standard deviation were used to answer the research questions, while multivariate analysis of variance (MANOVA) was used to test the null hypotheses. The findings showed that Physics teachers are aware of and use the professional ethics and codes of conduct in teaching to a very high extent; there is no significant difference between the male and female Physics teachers' awareness and use of professional ethics and codes of conduct in teaching. Recommendations were made among which are that Government should mandate all Physics teachers to register with TRCN and possess their maximum education training and appointment of ethics specialist who plays a role in top management decision making in schools should be approved.

Keywords: Awareness, Codes, Ethics, Profession, Physics teachers.

Introduction

Education is the process of facilitating learning through acquisition of knowledge, skills, values, beliefs and habits. According to Fafunwa (2004), it is exclusively used for the development of human being in the cognitive, affective, psychomotor and psycho-productive domains. It is a means by which a person acquires appropriate knowledge and skills as well as abilities, competencies, attitude, appropriate values and other forms of behaviour of positive value to the society. Amaele (2003) opined that education is the total development of the

individual person, through acceptable methods and techniques, according to his abilities and interest as well as the needs of the society, to take his rightful place and contribute adequately to the advancement of the society. From these definitions, it could be concluded hat education involve imbibing a desirable change in human behaviour through the process of teaching and learning. For teaching and learning to be efficient and effective, a teacher should be involved.

Teachers are prime movers of any educational institution and they are professionals, who are important implementers of the subject curriculum. Abiri (2005) describes a teacher as a professional, who impacts knowledge, learning experience at his disposal, stimulates, guide, directs and facilities learners to acquire adequate mastery of the skills being impacted. Teachers create a positive learning environment in which the student is responsible for learning and understanding the concepts. In Nigeria according to Shaibu (2008), secondary school teachers are grouped into science teachers and art teacher. Physics as a subject is one of the science subjects. Science in this context, according to Hornby (2006) is the pursuit of systematic and ordered knowledge. Science Teachers Association of Nigeria STAN (2005) views science as a process of social activity in which we seek to discover and understand the natural world. Shaibu (2008) also defines science as some form of organized knowledge on which we can describe a sort of prescribed esoteric procedure from unravelling the nature. Based on these definitions, science is a body of empirical, theoretical and practical knowledge about the world accumulated through scientific methods, which emphasizes observation, experimentation and explanation of the real-world phenomenon. In secondary schools in Nigeria, the science subjects include Physics, chemistry, biology, agriculture, but in all, Physics is accepted as one of the bedrock of all science subject (Shaibu, 2008).

Okeke (2004) defines Physics as the study of matter while Hornby (2006) sees it as that branch of science concerned with the study of nature, properties of matter and energy. According to Adeyemo (2010), the subject matter of Physics includes mechanics, heat, light

and other radiation, sound, electricity, magnetism and the structure of atoms. Physics is actually viewed as the study of matter and energy and the interaction between them. The actual knowledge of Physics is the understanding of all these subject matter (Adeyemo, 2010). Excellence in secondary school Physics depends on many things; the level of course content covered, availability of apparatus for laboratory experiments, a clear philosophy and workable plan for meeting students' needs, serious dedication to learning goals, adequate financial support, and so on, but most importantly, the Physics teachers' knowledge. Without a well-educated, strongly motivated, skilled, well – supported teacher, the core of excellence in secondary school Physics collapses (Well, 2000). Hence, the Physics teacher's knowledge is the key stone of quality.

Teaching is a profession and a type of job that needs high level of education and special training or skills. The professional training of teachers therefore, should not only be directed at providing appropriate knowledge and teaching skills but should also aim at equipping teachers with the right kinds of values, ethics and attitudes to enable them become efficient and successful in their teaching career. In other words, there are personal attitudes like self-discipline, commitment and dedication to duty, respect for constituted authority, understanding and a pride in the teaching profession that need to be developed in training teachers for best practices in education.

Every professional body has a set of rules that guide the conduct of the members and a standard value, norms or behaviour acceptable or required by its members. This standard value, norms, or moral behaviour are called ethics and codes of conduct. Teaching as a professional body also has its ethics and codes of conducts required to be strictly adhered to by all their members. Enyi (2010) opined that all teachers understand that ethics and codes of conduct of teaching must be codified and its basic items should form ethical requirement for professional, personal and moral capabilities. According to Bzinka (2002), ethics and codes of conduct of

teaching give teachers suitable tools for solution of ethical and moral problems of their profession. They also investigate ethics and moral aspects of teachers' work in the educational process, characterizes the teachers' position in educational system and also examines personal, character and pedagogical –psychological characteristics that play important roles in the pedagogical activities of teachers, mainly in relation to pupils and students in the class (Enyi, 2010).

Ethics in the broadest sense is a set of principles of rights of conducts. Hornby (2000) defined ethics as moral principles that control or influence a person's behaviour. According to Enyi (2010), ethics is the theory of value, norms or standard of behaviour of a society or individual or professional bodies. In his own words, Ezeagu (2003) defines ethics as the rules of a conduct recognized in respect to a particular class of human action or a particular group or culture. It is also a set of moral principles, especially ones relating to or affirming a specialized group, field or form of conduct. Okoli and Okigbo (2015) opined that professional ethics are moral principles or principle of right or wrong behaviour that control or influence the behaviour of a professional in the discharge of his or her duty to the public.

In education, the teaching profession like other noble professions has professional ethics and codes of conduct for teachers. By this, teachers should recognize the impact of their own deeds on their moral subject and consequences of their activities and behaviour. The professional ethics and codes of conduct for teachers is an important instrument or document which clearly and precisely defines what the professional teacher must know and put into practice as well as the core values, ideas, attitude, conducts, rights, privileges and obligations, expected of professional teachers (Okoli & Okigbo,2015).The ethics and codes of conduct for teachers is a vital instrument to assist professional regulatory authority such as Teachers Registration Council of Nigeria (TRCN), Teachers Education Supervisory Agencies (TESA) such as the National Commission for Colleges of Education (NCCE) and the National

Universities Commission (NUC), employers of teachers, teachers union non-governmental organization, international and other critical stake holders to constantly gauge, monitor and sustain the performance of teachers on the job and to constantly improve teacher education (TRCN, 2010).

To achieve high education standard in Nigeria, educational system as well must maintain high ethical standards among Nigerian teachers. The Federal Government of Nigeria (FGN) established by Decree (now Act) No.13 of 1993 a Teachers' Registration Council of Nigeria (TRCN), and section 9 (6) of the Act empowers TRCN to make rules to define the minimum ethical standards expected of professional teachers. These rules were documented in a handbook titled "Teachers codes of conduct and ethics" (TRCN, 2005). These rules according to (TRCN, 2005) include; commitment to students, commitment to parents, commitment to community, commitment to employer and commitment to profession.

According to TRCN (2004, p. 15), the National Policy on Education summarized the professional ethics and codes of conduct for teachers as follows: Teaching should be professionalized and teachers must have undertaken some approved courses appropriate for teacher preparation before being employed, teachers should be disciplined and there should be sanctions and penalties for misbehaviour. To this end, a Teacher Disciplinary Committee (TDC) and a Teacher Investigating Panel (TIP) had been provided by TRCN, teachers should be enjoying academic freedom particularly in deciding what to teach, materials to use and the appropriate methodology, teachers' assessment should be objectively done and there should be right of appeal against such assessment.

To effectively enforce the teachers' ethics and codes of conduct, the TRCN Act section 9 established a Teachers Investigation Panel (TIP) and a Teachers Disciplinary Committee (TDC) respectively. The TIP is charged with the responsibility of conducting preliminary investigations into alleged cases of professional misconduct and refers such cases to the

Teachers Disciplinary Committee (TDC). The teachers' disciplinary committee is a tribunal responsible for considering and determining any case referred to it by the TIP and to punish a teacher if he or she is judged by the committee to be guilty of infamous conduct in any professional respect. The TDC may award penalties to erring members in the form of reprimand, suspension, deletion of name of erring member temporarily or permanent from the list of registered teachers and revocation of license to practice as a professional teacher.

Fafunwa (2004) opine that teachers could be male or female and that the effectiveness of a teacher is in determinant of the sex but highly depends on the teachers' qualification and years of teachers' experience. Experience in this context, according to Brown (2003) involve so many years of series of experiments, observation, modified initiatives, verifications, revalidation of facts, concepts and principles added in teaching. Physics teachers believe that the primary purpose of Physics education is to develop enlightened students that will understand the principle, unsymmetrical nature of the two disciplines (Physics and mathematics), and foundations of Physics. It is a well-established fact that to attain this goal, an experienced teacher is required irrespective of the sex. There is always a stereotyping in society that male Physics teachers have natural talent in science more than their female counterparts, and as such will perform better as Physics teachers more than their female counterparts and irrespective of their experiences. These relatively small achievement disparities precede larger differences in the number of male Physics teachers to their female counterpart. However, these estimates of Physics teachers female bias may be misleading, confounding achievement with behaviour, learning approaches and experiences (Fafunwa, 2004).

Some factors may be responsible for Physics teachers not heeding to professional ethics and codes of conduct while teaching. According to Aallan (2006), some of the factors militating against Physics teacher's inability to use ethics and professional codes of conduct in teaching includes unsymmetrical nature of two disciplines, scientific language and communication, lack

of modern and adequate laboratory apparatus, unavailability of qualified teachers, inadequate finance, inadequate curriculum and so on. Finally, candidates for secondary Physics teaching positions may be drawn from a variety of backgrounds. Some may have completed an accredited Physics or Physics teaching programs, other may have training in other educational field like science and Engineering, but are they aware of these professional ethics and codes of conduct in teaching? And to what extent do they practice these professional ethics and codes of conduct while teaching? This research sought to answer these questions.

Purpose of the Study

The aim of this study was to determine the secondary school Physics teachers' awareness and use of professional ethics and codes of conduct in Enugu State secondary schools. Specifically, the research sought to:

1. Determine the level of Physics teachers' awareness of the professional ethics and codes of conduct.
2. Investigate the extent to which secondary school Physics teachers' use the professional ethics and codes of conduct in the classroom.
3. Investigate males and females Physics teachers' level of awareness of the professional ethics and codes of conduct in teaching.
4. Determine the extent to which males and females Physics teachers' use the professional ethics and code of conducts in teaching.

Research Questions

1. What is the level of secondary school Physics teachers' awareness of the professional ethics and codes of the conduct?
2. To what extent do secondary school Physics teachers use the professional ethics and codes of conduct during classroom instruction?

3. To what level do male and female Physics teachers aware of the professional ethics and code of conduct?
4. To what extent do male and female Physics teachers use the professional ethics and code of conduct in teaching?

Hypotheses

The following null hypotheses were tested at 0.05 levels of significance.

1. There is no significant difference between the mean rating of male and female Physics teachers on their level of awareness of professional ethics and code of conduct for teaching.
2. There is no significant difference between the mean rating of male and female Physics teachers on the extent of use of professional ethics and codes of conducts for teaching.

Method

The descriptive survey design was employed in the study. The study was conducted in Enugu state. The population of the study includes all the Physics teachers in the 291 government owned secondary schools in Enugu State. The total population of Physics teachers in the 291 government owned secondary schools is 196. The sample consist of 105 Physics teachers drawn from three out of the six education zone in Enugu state using simple random sampling technique, specially, balloting with replacement. The instrument used for data collection is the Codes of Conduct Questionnaire for Physics Teachers (CCQPT) constructed using the TRCN manual on the codes of conduct for teachers. It is a 44-item questionnaire structured and adopted by the researcher to elicit responses from the participants. The instrument is in two parts, A and B. Part A is structured by the researcher to generate the respondents' personal data like age, gender, qualification and years of teaching experience. Part B is also divided into two sections, I and II. Section I sought out information on the level of Physics teachers' awareness of the

professional ethics and codes of conduct of teaching. This section is structured on a four (4) point rating scale of Fully Aware (FA), Moderately Aware (MA), Little Aware (LA), and Not Aware (NA). Section II sought out information on the extent of Physics teachers' use of professional ethics and codes of conduct in teaching. It is also structured on a four (4) point rating scale of Very High Extent (VHE), High Extent (HE), Low Extent (LE) and, Very Low Extent (VLE). Section I and II are made up of 22 items each making a total of 44 items. For the face validation of the items in the questionnaire, the questionnaire was given to one lecturer in the Department of Educational Foundations, one senior lecturer in the Department of Science Education, both from the Faculty of Education, Nnamdi Azikiwe University, Awka and one experienced Physics teacher in a secondary school in Enugu state. These specialists validated the instrument in terms of grammatical adequacy and proper wording of the items, clarity of question to the research topics and appropriation and adequacy of the items in addressing the purpose and problem of the study.

Based on their corrections and suggestions, amendments were made and the final instruments were produced. To ensure the reliability of the instrument administered to some Physics teachers in Anambra state. The researcher administered the instrument to 10 Physics teachers in government owned secondary schools in Anambra state twice at the interval of two weeks. The two sets of scores from the teachers' rating were recorded and cronbach alpha correlation was employed to determine the estimate of stability of the items. The reliability index for section I is 0.87 while the reliability index of section II is 0.76. The researcher accepts the instrument to be reliable by these indices (Agu, 2015).

For distributed of the instrument, the researcher trained two assistants to assist in the exercise. After the briefing, the researcher and the trained assistants separately moved to each of the schools in two weeks to administer the instrument and as well collect them immediately after the respondents might have attended to them. In this way, 105 copies of questionnaire was

distributed and collected and this ensured 100% return rate. Mean and standard deviation were used to answer the research questions.

The mean interpretation of the level of the Physics teachers' awareness of professional Ethics and codes of conduct in teaching:

Mean score	**Interpretation**
72.00 – 88.00	Fully aware
55.00 – 71.00	Moderately aware
39.00 – 54.00	Little aware
22.00 – 38.00	Not aware

The mean interpretation of the Physics teachers' extent of use of professional ethics and code of conduct in teaching is represented as follows:

Mean score	**Interpretation**
72.00 – 88.00	Very High extent
55.00 – 71.00	High extents
39.00 – 54.00	Low extents
22.00 – 38.00	Very Low extent

In testing the hypothesis MANOVA were used, if the calculated value is less than the critical value at 0.05 ($P<0.05$) alpha levels accept the null hypothesis or otherwise reject the null hypothesis.

Results

Table 1: mean ratings of respondents on the level of Physics teachers' awareness of Professional ethics and codes of conduct in teaching.

Items	N	Mean	Std. deviation
Aware1	105	3.21	1.149
Aware2	105	3.60	0.614
Aware3	105	3.43	o.842
Aware4	105	3.57	0.602
Aware5	105	3.72	0.490
Aware6	105	3.85	0.387
Aware7	105	3.50	0.590
Aware8	105	3.74	0.481
Aware9	105	3.62	0.544
Aware10	105	3.60	0.629
Aware11	105	3.74	0.519
Aware12	105	3.58	0.585
Aware13	105	3.48	0.666
Aware14	105	3.80	0.402
Aware15	105	3.72	0.490
Aware16	105	3.36	0.735
Aware17	105	3.70	0.536
Aware18	105	3.65	0.537
Aware19	105	3.54	0.636
Aware20	105	3.62	0.656
Aware21	105	3.61	0.596
Aware22	105	3.58	0.585
Total awareness of ethics	105	79.2286	5.2555
Valid N (listwise)	105		

The result on Table 1 shows a total mean of 79.23. This shows that the Physics teachers are fully aware of the professional ethics and codes of conduct of teachers.

Table 2: Mean rating of the respondents on the extent of Physics teachers' use of the professional ethics and codes of conduct in teaching

items	N	Mean	Std deviation
Use1	105	2.72	1.139
Use2	105	3.31	0.711
Use3	105	3.02	1.083
Use4	105	3.29	0.874
Use5	105	3.48	0.786
Use6	105	3.42	0.864
Use7	105	3.26	0.855
Use8	105	3.46	0.772
Use9	105	3.32	0.860
Use10	105	3.27	0.963
Use11	105	3.06	0.886
Use12	105	3.34	0.782
Use13	105	3.39	0.803
Use14	105	3.57	0.770
Use15	105	3.49	0.833
Use16	105	2.99	0.956
Use17	105	3.45	0.796
Use18	105	3.44	0.820
Use19	105	3.42	0.794
Use20	105	3.27	0.891
Use21	105	3.28	0.860
Use22	105	3.31	0.902
Total use of ethics	105	72.5429	12.10295
Valid N (listwise)	105		

The result on Table 2 shows a total mean of 72.54. This shows that there is a very high extent of the use of professional ethics and codes of conduct among Physics teachers in Enugu state.

Table 3: Summary of the mean rating of male and female Physics teachers on the level of awareness of professional ethics and codes of conduct of teaching?

	N(male) = 79			N(female) = 26		
items	N	Mean	Std. dev.	N	Mean	Std. dev.
aware1	79	3.23	1.097	26	3.15	1.317
aware2	79	3.59	0.635	26	3.73	0.533
aware3	79	3.34	0.861	26	3.69	0.736
aware4	79	3.57	0.634	26	3.58	0.504
aware5	79	3.68	0.520	26	3.85	0.368
aware6	79	3.85	0.395	26	3.85	0.368
aware7	79	3.41	0.610	26	3.77	0.430
aware8	79	3.72	0.505	26	3.81	0.402
aware9	79	3.58	0.569	26	3.73	0.452
aware10	79	3.61	0.608	26	3.58	0.703
aware11	79	3.71	0.484	26	3.85	0.613
aware12	79	3.58	0.546	26	3.58	0.703
aware13	79	3.51	0.658	26	3.38	0.697
aware14	79	3.78	0.414	26	3.85	0.363
aware15	79	3.73	0.445	26	3.69	0.618
aware16	79	3.41	0.670	26	3.23	0.908
aware17	79	3.67	0.548	26	3.81	0.491
aware18	79	3.59	0.543	26	3.81	0.491
aware19	79	3.51	0.658	26	3.65	0.562
aware20	79	3.61	0.629	26	3.65	0.745
aware21	79	3.61	0.541	26	3.62	0.752
aware22	79	3.54	0.616	26	3.69	0.471
Total awareness of ethics	79	78.7975	5.14004	26	80.5385	5.48621
Valid N (listwise)	79			26		

The result on Table 3 shows a total mean of 78.80 with a standard deviation of 5.14 for male respondents and a total mean of 80.54 and a standard deviation of 5.47 for female respondents**.** This shows that both male and female respondents used for this study are aware of the professional ethics and code of conduct of teachers.

Table 4: Summary of mean rating of male and female Physics teachers on the use of professional ethics and codes of conduct of teachers.

	N=79			N=26		
Item	N	Mean	Std. dev.	N	Mean	Std. dev.
use1	79	2.68	1.110	26	2.96	1.216
use2	79	3.32	0.651	26	3.31	0.884
use3	79	2.94	1.1054	26	3.27	1.151
use4	79	3.33	0.796	26	3.15	1.084
use5	79	3.53	0.657	26	3.31	1.087
use6	79	3.43	0.779	26	3.38	1.098
use7	79	3.24	0.755	26	3.31	1.123
use8	79	3.53	0.617	26	3.21	1.107
use9	79	3.35	0.801	26	3.21	1.032
use10	79	3.24	0.964	26	3.35	0.977
use11	79	3.06	0.852	26	3.04	0.999
use12	79	3.44	0.693	26	3.04	0.958
use13	79	3.42	0.761	26	3.31	0.928
use14	79	3.54	0.765	26	3.65	0.797
use15	79	3.54	0.730	26	3.31	1.087
use16	79	2.94	0.925	26	3.15	1.047
use17	79	3.53	0.657	26	3.19	1.096
use18	79	3.51	0.714	26	3.23	1.070
use19	79	3.47	0.657	26	3.27	1.116
use20	79	3.28	0.876	26	3.23	0.951
use21	79	3.25	0.792	26	3.35	1.056
use22	79	3.35	0.801	26	3.19	1.167
Total awareness of ethics	79	72.8987	9.92355	26	71.4615	17.33489
Valid N (listwise)	79			26		

The result on table 4 shows a total mean of 72.90 with a standard deviation of 9.92 for male respondents and a total mean of 71.46 and a standard deviation 17.33 for female respondent. This shows that the male respondents used for the study used professional ethics and codes of conduct to a very high extent, in classroom while the female respondents used for this study use the professional ethics and codes of conducts in classroom to a high extent.

Table 5: Summary of mean ratings of male and female Physics teachers on their level of awareness and extent of use of professional ethics and codes of conduct for teaching.

TEST OF BETWEEN – SUBJECTS EFFECTS

Source	Dependent Variable	Types III Sum of Squares	df	Mean Square	F	Sig.
Sex	Awareness of ethics	119.308	1	119.308	2.340	0.129
	Use of ethics	93.198		93.198	0.504	0.479
Sex*experience	Awareness of ethics	2.865	1	2.865	0.056	0.813
	Use of ethics	278.530		278.530	1.507	0.222
Error	Awareness of ethics	5149.287	101	50.983		
	Use of ethics	18661.657	101	184.769		
Total	Awareness of ethics	635404.000	105			
	Use of ethics	559605.000	105			
Corrected Total	Awareness of ethics	5290.133	104			
	Use of ethics	19166.057	104			

a. R Square=0.027 (Adjusted R Square= - 0.002
b. R Square=0.026 (Adjusted R Square= - 0.003

From Table 5 the significant level is 0.129 this means that there was no significant difference between the mean rating of male and female Physics teachers on their level of awareness of professional ethics and codes of conduct for teachers. The null hypothesis is therefore accepted at 0.05 alpha level. Hence; this proves that the male and female Physics teachers have almost equal awareness of professional ethics and codes of conducts of teaching in Enugu state. From Table 5 also, the significant level is 0.479. This means that there is significant difference between the mean rating of male and female Physics teachers on their extent of use of professional ethics and codes of conduct of teaching. The hypothesis is therefore accepted at 0.05 alpha levels. Therefore, the hypothesis shows that there is no much difference in male and female Physics teachers' use of professional ethics and codes of conduct of teaching in Enugu state

Discussion

The findings of this study showed that the Physics teachers have knowledge of professional ethics and code of conduct to a high extent. Furthermore, the findings also revealed that both male and female Physics teachers in Enugu state are aware of professional ethics and codes of conducts. This is in line with Enyi (2010) who states that teachers are aware of ethics and code of conduct in teaching but the challenge is on applying it during learning.

Based on the use of professional ethics and codes of conduct in teaching, most of the Physics teachers use the professional ethics and codes of conduct of teaching in classroom to a high extent. The finding also revealed that both male and female Physics teachers showed a low extent in using the following obligations of teachers as stipulated in the codes of professional ethics for teachers. Teachers shall not teach without registration with TRCN, indulge in drinking and smoking in open places and administer unauthorized corporal punishment to the students. In general, the total mean of the male and female teachers' use of professional ethics and codes of conduct proved that they apply it to a high extent in teaching.

It is however surprising to note that despite the high extent of adhering to professional ethics and codes of conduct by Physics teachers in Enugu state, many teachers including the Physics teachers still exhibit unethical behaviours that put the integrity of the teaching profession to question. A close observation of events in the society today, reveals that many teachers (Physics teachers inclusive) come late to work on daily bases and are irregular in attendance to duty sometimes without permission. In addition, there are wide spread and diverse forms of cheating at examination at all levels of the education's system, sometimes the teachers connive with students to facilitated and abet examination misconducts. Teachers (including the Physics teachers) sometimes get involved in forgery and mutilation of official documents and sometimes take undue advantage of their students by extorting money or demanding sex in exchange for award of marks in examination. It is worrisome that some teachers have high

extent of knowledge of what constitutes unethical behaviour, yet they get involved in them. This is in line with Aghenta (2002) who noted that work ethics in Nigeria is inexplicable that educated workers come late work daily and are irregular at work, and that there are examination cheats at all levels of Nigeria education system aided by the home and the school. The consequences of all these according to Aghenta (2002) is that productivity is very low and leadership at secondary level of education is ineffective and inefficient, consequently the graduates of the secondary education system are grossly inadequate in many aspects including discipline, behaviour, right type of attitude, appropriate values, knowledge and skills. Aghenta (2002) further stated that such graduates from the secondary education system cannot contribute meaningfully to national development. To revamp the educational system, the codes of professional ethics need to be enforced to make teachers practice in accordance with the ethics of the teaching profession.

The finding also revealed that a high number of Physics teachers (52 out of 105 Physics teachers) are not professionally trained and does not have teaching qualification because they are not registered teachers. These finding are not in line with the pronouncement of the Federal Government of Nigeria as stated in the revised national policy on education (FGN 2008) in section 5, sub-section 78a, and 84b that: all teachers in educational institutions in Nigeria shall be professionally trained; that only professionally qualified and registered teachers shall be allowed to practice at all levels of the education system, and that the teachers registration council of Nigeria (TRCN) shall continue to register and license teachers and regulate the teaching profession and practices. It is expected that in no distant time all the Physics teachers in Enugu state will be registered with TRCN. Finally, the result of the study showed that there is no significant different between the male and female Physics teachers' level of awareness of professional ethics and codes of conduct and also in their extent of use of professional ethics and codes of conduct in teaching.

Conclusion

The study concludes that secondary school physics teachers are aware of the professional code of conducts and ethics and they apply them during instructional delivery.

Recommendations

Based on the findings from the study, the following recommendations are made:

1. Effort should be made by the government to compel all Physics teacher to register with TRCN and possess their minimum education requirement.
2. The Government should appoint ethics specialist in schools who plays a role in top management decision making in schools.
3. The school administrators should identify possible ways to reduce the unethical conduct among Physics teachers.

References

Aallan, T. (2006). Teacher demand and supply for improving quality and addressing teacher shortages. Paris: Olien Publisher.

Adeyemo, S. (2010). Teaching/learning of physics in Nigerian secondary school: The curriculum transformation, issues, problems and prospects: International Journal of Education Research and Teaching, 1(2), 99 – 111.

Brown, A.M. (2003), Challenges of higher education in Nigeria: A manager's perspective, Being a paper presented at the maiden edition of the faculty of Education Annual lecture series, University of Ado – Ekiti.

Bzinka, R. (2002). Teacher – child interactions: Relations with children's self–concept in second grade. Infant and Child Development, 119 (4), 340 – 341.

Enyi, S. (2010), Introduction to teacher education in Nigeria, Enugu: J.J.C Publishers.

Etkina, E. (2003), Physics teacher preparation: Dreams and reality. Journal of Physics Teacher Education Online. 3 (2), 3-9.

Ezeagu, A. (2003), Professionalization of teaching in Nigeria: Problems and prospects. A paper presented at a National conference on education for self-reliance and national development, College of Education, Gindin, Plateau State, Nigeria.

Fafunwa, A. B. History of Education in Nigeria. (Ibadan: NPC Educational Publishers 2004).

Federal Republic of Nigeria (2013), National policy on education. Lagos: Government Press.

Hornby, A.S. (2000), *Oxford advanced learners dictionary of current English (6th Edition)*, Oxford: Oxford University Press.

Okoli, J.N & Okigbo, E.C. (2015), Level of awareness of code of professional ethics for Teachers by secondary school Science, Technology and Mathematics (STM) education in Anambra state. *International Journal of Education, Research and Development (IJERD), 5*(1), 195 – 203,

Science Teachers Association of Nigeria (2004). *Laboratory Codes and Ethics*. Lagos: NERDC Press.

Teachers Registration Council of Nigeria (TRCN, 2004), *Teachers codes of conduct.* TRCN Kano: NERDC Press

TRCN (2005), *Teachers handbook.* Abuja: NERDC Press

TRCN (2010), *Professional standards for Nigerian teachers*. Abuja: NERDC Press.

Well, M. (2000), A modeling method for high school Physics, *American Journal of Physics, 6*(7), 606 – 619.

Effect of Reflective Instructional Strategy on Secondary School Students' Achievement in Chemistry in Awka Education Zone, Anambra State

[1] Agbasi, O. S. & [2] Okeke, S. O. C.

[1,2] Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[2] soc.okeke@unizik.edu.ng

Abstract

The strategy used in teaching chemistry to students is one of the determining factors towards their achievement. Thus the study investigated the effect of reflective instructional strategy (RIS) on secondary school students' achievement in chemistry. Two research questions guided the study and two hypotheses were tested at 0.05 level of significance. A quasi experimental design, specifically pre-test post-test non-equivalent control group design was adopted for the study. The population of the study was 2,474 senior secondary class two (SS2) chemistry students. A total of 165 SS2 chemistry students from four co-educational schools in Awka Education Zone of Anambra state were involved in the study. Simple random sampling was used to select four schools from the 46 co-educational schools in the zone. The four schools were randomly assigned, two schools respectively were assigned to the experimental and control groups. Chemistry Achievement Test (CAT) was used for data collection. The instrument was validated by three experts. The internal consistency of the CAT was established using KR-20. The reliability coefficient of 0.83 was obtained. Two regular chemistry teachers in each of the schools were trained on the use of RIS. The students in the experimental group were taught using RIS while the students in the control group were taught using conventional teaching method. Treatment in the two groups lasted for five weeks. The instrument was administered as pre-test and post-test. The data obtained were analysed using mean, standard deviation and analysis of covariance. Findings showed that students in experimental group taught with RIS achieved significantly higher than those in the control group. Also, RIS influenced the achievement of both male and female students. The study recommended that, chemistry teachers should use RIS in teaching and learning of chemistry to male and female students so as to enhance their academic achievement.

Keywords: Chemistry, Reflective Instructional Strategy, Achievement

Introduction

Chemistry is the science that deals with the structure of substances (element and compounds). It is an aspect of science that studies compositions, properties and uses of matter. It probes into the principles governing the changes that matter undergoes (Ababio, 2010). It is concerned with the utilization of natural substances and creation of artificial ones. It is also the science that deals with the properties of organic and inorganic substances (Armstrong, 2012).

Chemistry is the scientific discipline involved with elements and compound of atoms, molecules and ion: their composition, structure, proportion, behaviour and changes they undergo during reaction with other substances. In Nigeria, low achievement of students in chemistry has continued to be a major cause of concern to all, particularly chemistry teachers. The minimum entry requirement into Nigerian universities, polytechnics and colleges of education is that students wishing to study science courses must possess credit passes in five or four subjects, which include chemistry. Specifically, in Anambra State, the performance of students in chemistry has not been encouraging. The available statistics from examination organized by West African Examination Council (WAEC, 2019) showed low enrolment as well as poor achievement in chemistry. Some factors have been identified as the cause of students' poor achievement in chemistry. These factors include ineffective teaching methods and strategies, poor motivation of students, ill-equipped laboratories, poor students' attitude to science and students' laziness (Ouma, 2011, Nwosu, 2013 and Hassan, Ali, Salum, Kassim, Elmoge & Amour, 2015). Despite the number of factors outlined as being responsible for low achievement in chemistry, teachers' inappropriate and uninteresting teaching methods and strategies are seen as one of the factors (Abudulkamid, 2016; Enebechi, 2016).

Strategies are the tools of the teacher for achieving their set goals and objectives (Bello, 2012). If the tools are faulty or inappropriate, the goals and objectives can never be achieved. A teaching strategy comprises the principles and methods used for instruction to be implemented by teachers to achieve the desired learning in students (Otu & Avaa, 2011). These strategies are determined partially by the subject matter to be taught and partly by the nature of the learner. For a particular teaching strategy to be appropriate and efficient, it has to be in relation with the characteristic of the learner and the type of learning it is supposed to bring about. One of such strategy is Reflective instructional strategy.

Reflective instructional strategy is seen as a broad based instructional technique that affords learners the opportunity to think critically, discuss and share their wealth of knowledge and experiences together in small groups on particular subject matter (Timitimi, 2010). Reflective instructional strategy is learner-centred as it engages learners in series of questioning and thinking processes which make learners construct knowledge within and among themselves without necessarily relying on the teacher for everything (Anyima, 2011). According to Ogbuanya and Owodunni (2013), reflective instructional strategy is an innovative strategy that draws from certain skills. These skills include: thinking skills, collaborative learning, questioning, scaffolding and oral discourse. The use of reflective instructional strategy in secondary schools can make significant contributions by providing appropriate learning opportunities to diverse learners and motivate students to learn chemistry thereby improving their academic achievement in chemistry.

Academic achievement connotes performance in school subject as symbolized by a score on an achievement test. Odagboyi (2015) defined achievement as the learning outcome of students which includes the knowledge, skills and ideas acquired and retained through their course of studies within and outside the classroom situation. Academic achievement in chemistry is the quality and level of skills acquired and retained by students. Despite the fact that researchers attribute the poor achievement of students in science to teaching methods, other science educators are of the view that gender is one of the determining factors of poor achievement in science. Hence, this study sought to investigate the effect of gender on students' achievement when taught chemistry with reflective instructional strategy.

Gender is a socio-cultural construct that assigns roles, attitudes and values considered appropriate for each sex (Godpower-Echie & Owo, 2019). There is a growing recognition that there are psychological differences between gender which affect the way the males and females think, communicate and behave .With these contractions and lack of clear trend in gender

influence on students' achievement, more investigations has become necessary. This necessitated the present study which tries to attend to such a gap that has been introduced by seeking to establish gender differences, if any in the achievement of students taught with reflective instructional strategy.

Purpose of the Study

The purpose of the study was to determine the effect of reflective instructional strategy on secondary school students' achievement in chemistry. Specifically, the study determined the:

1. Difference between mean achievement scores of students taught chemistry using reflective instructional strategy and those taught using conventional method.
2. Difference between mean achievement scores of male and female students taught chemistry using reflective instructional strategy.

Research Questions

1. What is the difference in the mean achievement scores of secondary school students taught chemistry using reflective instructional strategy and those taught using conventional method?
2. What is the difference in the mean achievement scores of male and female secondary school students taught chemistry using reflective instructional strategy?

Hypotheses

1. There is no significant difference between the mean achievement scores of secondary school students taught chemistry using reflective instructional strategy and those taught using conventional method.
2. There is no significant difference between the mean achievement scores of male and female secondary school students taught chemistry using reflective instructional strategy.

Method

Quasi-experimental research design was used for the study. It is an experimental research design where random assignments of subjects to experimental and control is not possible (Nworgu, 2015). Specifically, the non-equivalent control group design was used. In this design, intact groups are randomly assigned to treatment conditions. The population of the study comprised 2,474 senior secondary class two (SS 2) students offering chemistry in the 46 co-educational government owned secondary schools in Awka Education Zone of Anambra state The sample of the study consisted of 165 (84females and 81males) SS 2 chemistry students. The Four schools were randomly picked from the 46 co-educational secondary schools in Awka Education Zone by simple random sampling.

Chemistry Achievement Test (CAT) is made up of 50 multiple choice questions with options from A-D. The items in CAT were a collection of standard examination questions drawn from three examination bodies namely: West African Examination Council, National Examination Council and Unified Tertiary Matriculation Examination. The objective questions from these examinations were based on the following topics in SSII chemistry curriculum: oxygen (properties and preparations and test); halogens (physical and chemical properties); preparation, properties, uses of chlorine and test for chlorine.

The researcher used four teachers: two for the experimental group and two for the control group. The two teachers for the experimental groups were trained on the use of reflective instructional strategy which comprised the following: thinking skill, scaffolding, questioning, collaborative learning and discussion. Before the experiment, pre-test was administered to all the students in the two groups using the CAT. The experimental groups were taught chemistry concepts based on the lesson plan integrated with reflective instructional strategy while the control groups were taught using conventional teaching method. After five weeks of teaching, one week was allowed for revision, post-test (reshuffled CAT) were

administered to the students. The data obtained were recorded and analysed. The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA).

Results

Table 1: Mean Achievement Scores of Students taught Chemistry using Reflective instructional strategy (RIS) and Conventional Method.

Method	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean gain
RIS	99	16.30	8.23	62.97	9.26	46.67
Conventional	66	16.23	10.30	20.70	13.65	4.47

Results in Table 1 show that for each of the group, the post-test mean scores were greater than pre-test mean scores with RIS having the highest mean score of 62.97. This is an indication that Reflective Instructional Strategy (RIS) had effect on students' achievement in chemistry.

Table 2: Mean Achievement Scores of Female and Male Students taught Chemistry using RIS

Gender	N	Pre-test Mean	Pre-test SD	Post-test mean	Post-test SD	Mean gain
Female	51	16.31	8.57	61.41	9.12	45.10
Male	48	16.29	7.95	64.63	9.83	48.34

Results in Table 2 show that the female and male groups taught chemistry using RIS. The female students had a mean gain of 45.10 while that of male students was 48.34. The male group had a higher mean gain. This result shows that gender may have little effect on students' achievement in chemistry.

Table 3: Analysis of covariance of the mean achievement scores of students taught chemistry using RIS and conventional method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	71157.144[a]	4	17789.286	137.726	.000
Intercept	62174.477	1	62174.477	481.360	.000
PRE-TEST	110.565	1	110.565	.856	.356
METHOD	70877.324	1	70877.324	548.739	.000
GENDER	229.617	1	229.617	1.778	.184
Error	20666.250	160	129.164		
Total	441884.000	165			
Corrected Total	91823.394	164			

The result in Table 3 shows the significant difference in the achievement mean scores of students taught chemistry using RIS and conventional method. The results show that an F-ratio of 548.74 was obtained with exact probability value of 0.000. Since the exact probability value (0.000) was less than 0.05 level of significance, the null hypothesis was rejected.

Table 4: Analysis of covariance of the mean achievement scores of male and female students taught chemistry using RIS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	271.567[a]	2	135.783	1.501	.228
Intercept	77221.390	1	77221.390	853.733	.000
Pre-test	16.261	1	16.261	.180	.673
Method	.000	0	.	.	.
Gender	255.479	1	255.479	2.824	.096
method * gender	.000	0	.	.	.
Error	8683.342	96	90.451		
Total	401508.000	99			
Corrected Total	8954.909	98			

The result in Table 4 also shows significant difference in the mean achievement scores of male and female students taught chemistry using RIS. Result shows an F-ratio of 2.82 with exact probability value of 0.096. Since the probability value of 0.096 was greater than 0.05

level of significance, the null hypothesis which states that there is no significant difference between the mean achievement scores of male and female secondary school students taught chemistry using reflective instructional strategy was not rejected. Thus, this indicates that male and female students did not differ in their mean achievement scores in chemistry. There is statistically no significant difference in the mean achievement scores of male and female students.

Discussion

Evidence obtained in this study shows that RIS had effect on the achievement of students in chemistry. The students taught with RIS achieved higher than those taught with conventional method. There is significant difference in the mean achievement scores of students taught chemistry using RIS and conventional methods. This implies that RIS was found to be effective. This therefore indicates that reflective instructional strategy (RIS) encourages students' active involvement and participation in the learning. This result is in line with the findings of Owodunni (2013) and Anyima (2011) who found out that students exposed to reflective instructional technique achieved significantly better than those exposed to conventional method of teaching. Therefore, the result of this study showed that gender has no significant effect on students' achievement in chemistry. This implies that male and female taught chemistry with RIS did not differ in their achievement. The result was in agreement with Odagboyi (2015) and Gbendu (2014) who has found out that innovative strategy enhance the teaching and learning of science.

Conclusion

This study has found that innovative strategy such as reflective instructional strategy enhances the teaching and learning of Chemistry, providing student-centred strategy to learning and teaching of chemistry.

Recommendations

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

1. Chemistry teachers should adopt RIS as an innovative teaching strategy to improve on students' achievement instead of relying on conventional method.
2. Curriculum planners should incorporate RIS as an innovative teaching strategy in planning Chemistry curriculum.

References

Ababio, O.Y. (2010). *New school chemistry for secondary schools.* (5th edition). Onitsha: Africana first Publishers

Abdulhamid, M. (2016). *Method of teaching science subject in secondary school in Sokoto municipal*. Retrieved from www.htt://mtsst/Abdulhamid

Anyima, F.F. (2011). *Effect of reflective inquiry instructional technique on students' achievement in Government in senior secondary schools.* Unpublished master's thesis, University of Nigeria, Nsukka. Retrieved from http://www.unn.edu.ng

Armstrong, J. (2012). *General, Organic and Biochemistry: An applied approach*. Retrieved from Brooks/ cole .com

Bello, A.A. (2012). Teaching nature of atom using concept mapping method. *STAN National Chemistry Panel Series, 8*, 39-41

Enebechi, R.I. (2016). Effects of two instructional scaffolding strategies on secondary school students' achievement and interest in biology. *Review of Education, 20*(1), 45-56.

Gbendu, G.O. (2014). *Effect of reflective inquiry instructional technique on students' achievement in environmental related contents in senior secondary geography*. (Unpublished master's thesis). University of Nigeria Nsukka.

Godpower-Echie, G., & Owo, W. J. (2019). Gender Differences in Basic Science Achievement of Private Junior Secondary School Students in Obio/Akpor Local Government Area, Rivers State. *International Journal of Scientific Research in Education, 12*(2), 320-329. Retrieved from http://www.ijsre.com

Hassan, A.A., Ali, H.I., Saliu, A.A., Kassim, A.M., Elmoge, Y.N, Amour, A.A (2015). Factors affecting students' performance in chemistry. *International Journal of Educational and Pedagogical Sciences9*(11), 4086-4093

Nworgu, B.G. (2015). *Education Research basic issues and methods*. Nsukka: University Trust Publisher.

Nwosu, S.O. (2013). *Classroom interaction pattern as correlates of senior secondary school achievement in chemistry in Awka Education Zone.* (Unpublished master's thesis) Nnamdi Azikiwe University, Awka Anambra State.

Odagboyi, I.A. (2015). Effect of gender on the achievement of students in Biology using jigsaw method. *Journal of Education and Practice, 1*(23), 55-67.

Otu, L. E., & Avaa, (2011). The challenge of effective teaching of chemistry: A case study. *Cognitive science 17*,397-434

Ouma, C.O. (2011). *Factors Influencing performances of students in Chemistry in public secondary schools in Kayiado, North district of Kenya.* Unpublished master thesis. University of Nairobi. Retrieved from www.uninairobi.edu.org.

Owodunni, A. S. (2011). *Effect of reflective inquiry instructional technique on academic achievement an interest of radio television an electronic works student in technical college.* Unpublished doctoral dissertation, University of Nigeria, Nsukka.

Timitimi, S. A. (2010). *Effect of reflective inquiry instructional technique on students' achievement in agricultural science.* Unpublished master thesis, Niger Delta University, Wilberforce Island.

Information and Communication Technology Competences Possessed by Biology Teachers in Secondary Schools in Anambra State

Ugbaja, J. N.
Biology Education Department, School of Sciences, Federal College of Education (Technical), Umunze, Anambra State, Nigeria
&
Okeke, S. O. C.
Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
soc.okeke@unizik.edu.ng

Abstract

The new requirement for working and living in the 21st century is the ability of individuals to be technologically compliant. There is always need for teachers to possess the right competences to operate Information and Communication Technology (ICT) facilities available in the schools. This necessitated the study on the ICT competences possessed by secondary school biology teachers in Anambra State. Two research questions and two hypotheses guided the study. The study adopted descriptive survey research design. The population of the study comprised 288 biology teachers in all government owned secondary schools in the state. The sample for the study comprised 99 biology teachers drawn from six education zones in the state using a purposive sampling technique. The instruments for data collection were biology teachers' ICT competence questionnaire (BTICTCQ) and biology teachers' ICT competence practical test (BTICTCPT). Three experts validated the instruments. They were trial tested to ascertain its reliability using Cronbach Alpha, BTICTCQ gave a reliability coefficient value of 0.83 while BTICTCPT gave a reliability coefficient value of 0.88. The instruments were administered through direct delivery approach by the researchers and six research assistants. The data collected were analysed using mean and standard deviation to answer the research questions and t-test to test the null hypotheses at 0.05 alpha levels. The study revealed among others that there is a significant difference between the assumed and actual mean ICT competences of biology teachers in demonstrating basic ICT tasks and age is a significant factor on actual mean ICT competence of secondary school biology teachers. The study concluded that secondary school biology teachers in Anambra do not possess the required ICT competence to use ICT facilities to teach biology concepts. The study recommended among others that practicing biology teachers should enrol in in-service training programme on ICT to update their competences in its use in teaching and the education/teacher training institutions should make sure that pre-service biology teachers possess the required competency before graduation.

Keywords: ICT competence, Biology teachers, Secondary school, Anambra state

Introduction

Biology is a science subject offered in Senior Secondary School in Nigeria which attracts the greatest patronage of both science and art-oriented students (Nwosu, 2012). It addresses the needs of students through its relevance and functionality in content, practice and

application (Chioma, 2005). Thus, biology teaching needs teachers that are well grounded not only in subject matter but also in the skills and competences needed to impart such knowledge to bring about meaningful learning in the students. One of the competences needed by biology teachers is Information and Communication Technology (ICT) competence.

Margaret (2005) defined ICT as an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software and satellite systems, the various services and applications associated with them such as videoconferencing and distance learning. In the context of this study, ICT are those devices that help the teacher to facilitate and enhance learning. However, the study focuses on competences possessed by biology teachers is the use of computer system to teach biology concepts.

Ojiegbe (2010) defined competence as the acquisition of knowledge, skills and abilities at a level of expertise sufficient to be able to perform a given task in a work place appropriately. Competence is a specific practical ability possessed by someone to do a given task. ICT competency, according to Dike (2014), is the ability to effectively demonstrate practical use of ICT facilities to teach desired contents. ICT competences are set of technology standards that define proficiency in using computer technology in the classroom (www.google.com , 2017).

United Nations Educational, Scientific and Cultural Organization (UNESCO, 2011) outlined ICT competence for teachers to includes the use of ICT to form teaching pedagogy, incorporation of ICT activities and skills into lesson plans to support students acquisition of school subject matter. Use of presentation software and digital resources to support instruction, ability to demonstrate and describe the use of common hardware technologies and basic tasks in use of ICT and the use of input devices for word processors such as text entering, editing, formatting and printing. Ability to describe the purpose and function of graphic software, to describe the internet and World Wide Web, elaborate on their uses and how a browser works.

Ability to create an e-mail account and use it for a sustained series of e-mail correspondence, to integrate the use of computer laboratory into ongoing teaching activity, and to use of ICT resources to support students' acquisition of subject matter and pedagogical knowledge. The competence covered in this study is the ability to demonstrate basic tasks in the use of ICT. Mastery of these abilities means mastery on how to use ICT to perform basic task in teaching biology contents. It is quite pertinent to note that the competence discussed cover practical and functional skills the teacher needs to demonstrate if he/she had the ability to effectively teach biology using ICT facilities.

ICT competences of teachers could be determined by a number of factors such as teacher's qualification, year of experience, age, gender and location among others. This study considered age to be of great interest. Age is the number of years someone has lived or something has existed. Dike (2014) reported that older teachers find it difficult to adapt to the present form of teaching with ICT while young teachers feel more comfortable working with computers. Jegede (2009) reported that age is not a factor when considering the competence. There is therefore need to ascertain whether age bracket of biology teachers impede their ICT competences. It should be noted that education industry has become ICT driven in recent time. The evolving global digital society is an indication that the next generation of students will not likely make use of paper and pencil. More also, students' nowadays are more curious about what happens around them using ICT. They are no longer interested in teacher's old methods of instruction. The new requirement for working and living in the 21st century is the ability of individuals to become technologically compliant. Educators have recognized that there is need to equip learners with the necessary skills and experiences that will enable them to become contributing members of the global community.

Therefore, uncertainty exists about whether biology teachers possess the right competences to operate ICT facilities effectively. Where they lack the needed ICT competences, it means that their students' would probably be cut off from the rest of the world in terms of globalization. A times teachers assumed that they possess the ability to use ICT but in actual sense that might not be true. This is why Anih (2013) observed that ICT skills computer science teachers claim they possessed were far below what they actually possessed. On the basis of this, the study compared the ratings of secondary school biology teachers on their possessed ICT competences with their actual ICT competences through a practical test to determine their ICT competences.

Purpose of the Study

The purpose of this study was to determine the ICT competences possessed by secondary school biology teachers in Anambra State. Specifically, the study determined the:

1. ICT competences of secondary school biology teachers in Anambra State in demonstrating basic ICT tasks.
2. ICT competences of secondary school biology teachers in Anambra State in demonstrating basic ICT tasks based on their age.

Research Questions

1. What are the assumed and actual mean ICT competences of secondary school biology teachers in Anambra State in demonstrating basic ICT tasks?
2. What is the influence of age on the actual mean ICT competence of secondary school biology teachers in Anambra State in demonstrating basic ICT tasks?

Hypotheses

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

1. There is no significant difference between the mean scores on the assumed and actual ICT competences of secondary school biology teachers in demonstrating basic ICT tasks.
2. There is no significant difference between the actual mean ICT competences of young and old secondary school biology teachers in demonstrating basic ICT tasks.

Method

The study employed a descriptive survey research design. The area of the study is Anambra state. The population comprised 288 biology teachers (39 males and 249 females from all public secondary schools in the six Education Zones of the State. The choice of public secondary schools is because the state government has supplied each one of them with ICT facilities/ computers. A sample size of 99 (15 males and 84 females) biology teachers was drawn from 10 schools in each education zone using purposive sampling technique based on schools that have functional computer laboratories, biology teachers, and ICT personnel.

The instruments used for data collected were Biology Teachers ICT Competency Questionnaire (BTICTCQ) and Biology Teachers' ICT Competency Practical Test (BTICTCPT) developed by the researchers. BTICTCQ comprised two sections A and B. Section A contained the biodata of the respondent, while section B contained five items that assumed Biology Teachers ICT Competences. The items were adapted from the objectives identified by United Nations Educational Scientific and Cultural Organization Information and Communication Technology Competency Framework for Teachers (UNESCO ICT CFT, 2011). The respondents have allowed to rate their specific ICT competences which enable them to teach biology effectively. The second instrument (BTICTCPT) was developed from the first instrument and is also a 5-item practical test on ICT competences the biology teachers

actually possessed. The BTICTCPT lasted for 40 minutes for each teacher. The researchers score the actual ICT competences possessed by the biology teachers based on a four-point rating scale of Very High Competence (VHC), High Competence (HC), Moderate Competence (MC) and Low Competence (LC).

The instruments were validated by three experts from Faculty of Education, Nnamdi Azikiwe University, Awka. To establish the reliability of the instruments, trial testing was carried out on 10 secondary school biology teachers from Imo State who were not part of the population of the study and their internal consistency were established using Cronbach Alpha which yielded reliability coefficient value of 0.83 and 0.88 respectively. Data were collected by the researchers with the help of six research assistants who are computer compliant and trained for two days.

Ninety-nine (99) copies each of BTICTCQ and BTICTCPT were produced and administered to the teachers. Each biology teacher was given the BTICTCQ to fill first (responses on BTICTCQ is called assumed competence), the reason is to entice the teacher to take the BTICTCPT. After, the BTICTCQ was collected; the teacher was given laptop to carry out the practical exercises (i.e. BTICTCPT with response called actual competence). This is to enable the researchers' match their assumed competences of BTICTCQ with their actual competences got from the BTICTCPT. The exercise was not carried out collectively for the whole teachers at a spot in one day, but it was done individually, school by school. After administering, 88 instruments were recovered and used for analysis.

Data collected were analysed using mean and standard deviation to answer the research questions while t-test was used to test the null hypotheses at 0.05 alpha level. Decision on the research questions were based on the average on a 4-point scale. For hypothesis testing, accept H_o if p-value > 0.05, otherwise reject H_0 if p-value < 0.05.

Results

Table 1: Mean and standard deviation of respondents on the assumed and actual ICT competences of Biology teachers in demonstrating basic ICT tasks

S/N	Ability to demonstrate basic ICT tasks Ability to	Assumed (n=88) Mean	SD	Decision	Actual (n=88) Mean	SD	Decision
1	Set up and boot a computer system without making a mistake.	3.66	0.64	Very High Competence	2.43	0.76	Moderate Competence
2	Locate and activate the Microsoft word icon on the desktop and key in data into system.	3.46	0.66	High Competence	2.18	0.88	Moderate Competence
3	Format page into paragraphs, do alignment, bold, italicize, underline and save document	2.86	0.85	High Competence	1.61	0.69	Moderate Competence
4	Select the command a printer from the options, number of pages and print.	2.74	0.86	High Competence	1.33	0.56	Low Competence
5	Shut down a computer system by selecting the appropriate commands from the desktop	3.72	0.61	Very High Competence	2.25	0.76	Moderate Competence
	Average Mean	**3.29**	**0.57**	**High Competence**	**1.96**	**0.64**	**Moderate Competence**

Table 1 shows the assumed ICT competence of biology teachers has an average mean score of 3.29 which is high competence while their actual ICT competence has an average mean score of 1.96 which is moderate competence. This indicates that there is difference between the assumed and actual ICT competences of biology teachers in demonstrating basic ICT tasks.

Table 2: Mean and standard deviation of the respondents on the influence of age on actual ICT competences of Biology teachers in demonstrating basic ICT tasks.

		Young (n=38)			Old (n=50)		
S/N	**Ability to demonstrate basic ICT tasks**	**Mean**	**SD**	**Decision**	**Mean**	**SD**	**Decision**
	Ability to						
1	Set up and boot a computer system without making a mistake.	2.63	0.79	High Competence	2.28	0.70	Moderate Competence
2	Locate and activate the Microsoft word icon on the desktop and key in data into system.	2.50	0.86	High Competence	1.94	0.82	Moderate Competence
3	Format page into paragraphs, do alignment, bold, italicize, underline and save document	1.84	0.72	Moderate Competence	1.44	0.61	Low Competence
4	Select the command a printer from the options, number of pages and print.	1.50	0.65	High Competence	1.20	0.45	Low Competence
5	Shut down a computer system by selecting the appropriate commands from the desktop.	2.53	0.80	High Competence	2.04	0.67	Moderate Competence
	Average Mean	**2.20**	**0.66**	**Moderate Competence**	**1.78**	**0.55**	**Moderate Competence**

Table 2 shows that the average mean ICT competence score of young biology teachers in demonstrating basic ICT tasks was 2.20 while that of old teachers was 1.78 with a mean difference of 0.42 in favour of young teachers. This indicates that age influences ICT competence of biology teachers in demonstrating basic ICT tasks.

Table 3: t- Test analysis of the assumed and actual ICT competences of biology teachers in demonstrating basic ICT tasks.

Sources of Variation	**N**	**Mean**	**SD**	**Df**	**t-cal.**	**p-value**	**Remark**
Assumed	88	3.29	0.56	174	14.58	0.000	S
Actual	88	1.96	0.64				

S-Significant, NS- Not Significant

Table 3 shows that there is a significant difference between the assumed and actual mean ICT competences of secondary school biology teachers in demonstrating basic ICT tasks.

This is indicated by the calculated t-value (14.58) and the corresponding *P*-value (0.000) which is less than the stipulated 0.05 level of significance. The null hypothesis was therefore rejected

Table 4: t- Test analysis of young and old biology teachers' actual mean competence in demonstrating basic ICT tasks

Sources of Variation	N	Mean	SD	Df	t-cal.	p-value	Decision
Young	38	2.20	0.66	86	3.24	0.002	S
Old	50	1.78	0.55				

S-Significant

Table 4 shows that the calculated t-value is 3.24 with p-value of 0.002 which is less than the p-value of 0.05. This means that there is significant difference between the actual mean ICT competence of young and old secondary school biology teachers in demonstrating basic ICT tasks. Therefore, the null hypothesis of no significant difference between the two groups is rejected.

Discussion

The study showed that there was a significant difference between the assumed and actual ICT competences of biology teachers in demonstrating basic ICT tasks. This was shown on the assumed and actual mean ICT competences of biology teachers whereby the assumed mean ICT competences were greater than actual mean ICT competences. It shows that the ICT competence the biology teachers actually possessed is far below what they assumed they have. This result is in agreement with the findings of Anih (2013) who reported a difference between claimed and actual ICT skills possessed by computer science teachers. The study further showed that there is significant difference between the assumed mean ICT competence of secondary school biology teachers and what they actually possessed.

Similarly, the findings of the study revealed that actual mean ICT competence possessed by young biology teachers is greater than that of the older ones. This means that age

has influence on actual mean ICT competence of secondary school biology teachers in demonstrating basic ICT tasks. This study is in line Anih (2013) and Dike (2014) who reported that age is a factor in ICT competence possession, that younger teachers possessed ICT competences more than older teachers. However, the findings contradict Jegede (2009) who revealed that age is not a factor when considering ICT competences.

Conclusion

The study concluded that secondary school biology teachers in Anambra state have not possessed the required ICT competence to use ICT facilities to teach biology concepts. Therefore, secondary school biology teachers need to improve in their ICT competences through the use of ICT facilities for effective service delivery.

Recommendations

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

1. Practicing Biology teachers should enrol in in-service training programme on ICT so as to update their competences in the use of ICT in teaching.
2. The teacher training institutions should make sure that pre-service biology teachers possess the required competence before certification.
3. Ministry of Education should encourage biology teachers to procure personal computers by supplying and subsidizing the cost for them so as to practice the necessary skills and become competent in the use of ICT for teaching.

References

Anih, A. A. (2013). *Assessment of ICT proficiency level of computer science teachers in secondary schools in Agbani Education zone of Enugu State.* Unpublished M Sc. Ed Thesis Nnamdi Azikiwe University, Awka.

Chioma, U. (2005). Science curriculum trends implications. *Journal of Professional Teachers, 1 (1)*, 172-180.

Dike, F. O. (2014). *Assessment of economics teachers' perception of their information and communication technology competencies using UNESCO ICT competency framework for teachers.* Unpublished M.Ed. Thesis University of Nigeria, Nsukka.

Jegede, P. O. (2009). Age and ICT-related behaviours of higher education teachers in Nigeria. Issues in Informing Science and Information Technology 6, *jegede@oauife.edu.ng.*

Margaret, N. T. (2005). *Teacher training in technology-pedagogy integration; experts meeting on teachers facilitators training in technology-pedagogy integration.* Bangkok: Drenver Publishing.

Nwosu, A. A. (2012). Inquiry skill acquisition for enhancing women's participation in sustainable development: Implication for science education. *The 43rd Annual Conference Proceedings of STAN,* 98-101.

Ojiegbe, N. (2010). *ICT competencies of library staff at the University of Abuja, FCT and University of Jos, Plateau State.* Unpublished master's thesis. University of Nigeria, Nsukka.

UNESCO (2011). ICT competency standards for teachers' implementation guidelines Version 1. Retrieved from: http://www.unesco.org/new/en/communication-and-information/resources/publications-and-communication-materials/publications/full-list/ict-competency-standards-for-teachers-implementation-guidelines-version-10/