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EDITORIAL COMMENT

The Unizik Journal of STM Education publishers reports of empirical research in Science, Technology, Engineering and Mathematics (STEM) Education as well as related studies in education generally. The publication is a medium of communicating well researched works for the science community as a forum for communication and cooperation among STEM teachers and students, policy makers, educators and other educational practitioners across the globe.

This sixth edition of the journal contains fifteen (15) articles that have passed through peer-review by professionals. The opinions expressed are not necessarily those of the editorial board but of individual authors. These papers are very informative, educative and instructive and I therefore invite the readers to enjoy reading the contributors.

The editorial board of UNIZIK Journal of STM Education appreciates those who subscribe to the journal, reviewers and the consulting editors for their contributions.

Prof. Abigail M. Osuafor
Editor-in-Chief

CONTENTS

EFFECT OF DIFFERENTIATED SCIENCE INQUIRY ON ACADEMIC ACHIEVEMENT AND CREATIVE THINKING SKILLS OF CHEMISTRY STUDENTS IN ANAMBRA STATE, NIGERIA

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Abstract

This study investigated the effect of differentiated science inquiry (DSI) on academic achievement and creative thinking skills of chemistry students in Anambra State. To achieve the purpose of the study, two research questions were drawn and three hypotheses formulated and tested at 0.05 level of significance. The study adopted quasi experimental design. The population of the study was all the SS3 chemistry students in Aguata education zone totaling 2,278 students from 60 public schools in the zone. Multi-stage sampling procedure was used to obtain 72 (SS3) senior secondary III chemistry students. Two intact classes made up the sample. By a throw of coin, one intact class of 37 was used as control group while the other of 35 was used as the experimental group. The experimental group was taught using DSI while the control group was taught using lecture method of instruction. Chemistry Achievement Test (CAT) and Creative Thinking Skill Test (CTST) were used to collect the data for the study. The instruments were validated by experts and their reliability was established at 0.89 and 0.97 respectively. The data obtained for the study were analyzed using mean and standard deviation to answer the research questions and analysis of covariance (ANCOVA) wa2s used to test the hypotheses at 0.05 level of significance. The findings revealed that differentiated science inquiry teaching method was more effective in enhancing students' academic achievement and creative thinking skills in chemistry than lecture method of instruction. There was significant difference in the creative thinking skill of the male and female students taught chemistry using differentiated science inquiry. There was improvement in the creative thinking skill for the male students than that of 2the female students taught chemistry using differentiated science inquiry. The study also revealed that there was no significant interaction effect of gender and teaching method on students' creative thinking skill. Based on the findings, recommendations were made among which are chemistry teachers should adopt the use of differentiated science inquiry in their classroom instruction in order to enhance students' academic achievement and creati2ve thinking skill in the subject.

Keywords: Differentiated Science Inquiry, Science Inquiry, Creative Thinking, Creative Thinking Skills, Academic Achievement.

Introduction

Science has permeated the life and daily activities of man to the extent that man's life can hardly be sustained without it. Everybody in the society today feels the impact of science and technology. The advancement of science and technology is greatly governed by its application to societal needs and aspirations. The role of science and technology encompasses political, social, medical, economic, education and so on. Science and technology provide new and fast routes to economic growth. They are used in establishing the global position of a nation. Thus, the superpowers, the developing and underdeveloped nations are classified based on their levels of scientific and technological advancement. This is with respect to their military might, economical power, industrial development and level of agricultural mechanization. The aforementioned indices of scientific and technological advancement require chemistry as a core discipline. This may be among the reasons why the federal government of Nigeria in the NPE (2013, revised) included chemistry as one of the science subjects students offered in the senior secondary school. Also, chemistry is a critical determinant of the post-secondary education and career options available to young people in the sciences (Ezeliora, 2009; Nnaka, 2010).

Chemistry according to Peter Atkins (2013) is defined as a science that deals with the structure and properties of substances and with the changes that they go through. Chemistry is the scientific study of interaction of chemical substances that constitute atoms or the subatomic particles; protons, electrons and neutrons (Gabriel, 2012). Chemistry is therefore defined as the study of the composition, properties, structures, interactions and transformation of aggregates of matter either in isolation or in combination. It is an integral part of the science curriculum both at the senior secondary school as well as higher institutions. At this level, it is often called "general chemistry" which is an introduction to a wide variety of fundamental concepts that enables students to acquire tools and basic skills useful at the advanced level. Chemistry contributes enormously to all aspects of human endeavor. All activities carried out by man, through man and in man, have to do with chemical activities. Chemical reactions occur when you breathe, eat or just sit at a place reading. Nations of the world recognize the importance of chemistry and build their national capacity on chemical related disciplines for sustainability. Nigerian is not let out, for she is focusing on improving her economy through industrialization. In view of this, Nigeria has in the national policy on education made chemistry a compulsory science subject at secondary school level and a compulsory subject requirement for all science related disciplines in university admission (FRN, 2014).

Interestingly, as important as chemistry is, students' achievement in the subject at secondary school level has not been encouraging. Record of students' performance at Senior School Certificate Examination (SSCE) in chemistry conducted by West African Examination Council (WAEC) shows that between 2010 and 2019 (except in 2010, 2011 and 2012), less than 50% of 2the students who enrolled for chemistry obtained credit level pass and above to secure admission into the university in order to pursue courses that require chemistry. The records stressed that there 8was improved achievement in 2010, 2011 and 2012 (50.2%, 62.6% and 67.2%) but the failure rate continued in 2013, 2014, 2015 and 2018 (46%,

47.83%, 38.68% and 48.15%) with an improved achievement in 2016, 2017and 2019 (52.97%, 59.22% and 64.18%), In general, this cannot be considered an acceptable achievement.

The students' poor achievement in chemistry in particular and sciences in general has been attributed to many factors. These include school factors, students' factors and teacher's methods of teaching such as conventional methods and mostly inquiry method, a constructivist approach among others (Gabriel, 2012; Uzoamaka, 2013; Oguama, Ugwoke & Ugwuanyi, 2020). Research findings revealed that chemistry teachers in particular and science teachers in general in Nigeria education system has remain stock to the conventional approach (talk-chalk method) of instruction. This is teacher-centered method of chemistry instruction whereby the teacher present verbally the facts and their own knowledge about the subject and the students passively listen and jot down notes. There is therefore the need to shift from the didactic method of chemistry instruction to constructivist (activity-oriented) approach which would induce creative thinking skills in the learners to enhance achievement outcome.

One of the skills students are predominantly trained in to achieve the objectives of education in the 21st century is creative thinking skills (Moon, 2008). Creative thinking skills according to Boden as cited in Fuad, Mahana, Suarsini and Zubaidah (2017) is the ability to bring new ideas that are surprising and valuable in many ways. Creative thinking is related to novelty, to the ability to do, create something, to implement new forms, to generate a lot of imaginative skills or to make something that already exists into something new (Greenstein, 2012). Abraham (2016) defined creative thinking as a form of expressing oneself in a unique way. Creative thinking therefore is the intentional gaining of new insights and different ideas through existing experience or information. Students' creative thinking skills which are different from one another require learning condition involving learning experience so that the potential of creative thinking can develop (Yusaeni, Corebima, Susilo&Zubaidah, 2017). Creative thinking skills according to Hadzigeorgion (2012) are the foundation of science. These skills thus need to be trained through learning. Hence chemistry in particular and science learning in general should put more emphasis on students' activities through inquiry (Harris & Rooks, 2010; Ozdemir & Isik, 2015) and provide opportunities for students to develop their creative thinking skills. Johnson as cited in Fuad et al (2017) noted that inquiry learning is considered to be basic and widely used for encouraging creative thinking skills in chemistry and science learning. Previous studies (Michalopoulon, 2014; Nurhadi, Lukman, Abas, Erni, Yuliana & Hamrina, 2016) revealed that inquiry learning can train students' creative thinking skills. This study is set to find out the effect of differentiated science inquiry learning models on the creative thinking skills of students in chemistry.

Inquiry-based learning is a form of active learning that starts by posing questions, problems or scenarios to the students and the students are allowed to proffer solutions to the probl8ems. Abugu (2010) defined inquiry method of instruction as a constructivist approach whereby the learners construct and reconstruct problems based on their past experience with a view to

proffering solution to the problems. There are five levels or models of inquiry according to Llwellyn (2013) with each model being differentiated by the amount of teacher's intervention towards the students or on the amount of guidance given by the teachers to their students. In classroom, the implementation of one model or level of inquiry sometimes posses problem to the accomplishment of stated classroom objectives because of the students' differences in their academic interest, readiness, learning styles and speed of receiving and processing information. In view of this, implementing one type of model of inquiry in a class has disadvantage which is not accommodating students' development in achievement outcome. For instance, if a teacher selects and applies inquiry model 4 to a class, students having low ability would find it difficult to follow the lesson and hence would not do well in their academic achievement. Conversely, if the teacher selects and applies inquiry level 1, students with high ability would quickly get bored because it would be easy for them. Therefore an inquiry learning model such as differentiated science instruction (DSI) that accommodates such diversity is very necessary. Liewllyn (2011) stated that differentiated science inquiry is evidence-based teaching practices such as knowing who students are as learners, choosing multiple instruction strategies, using ongoing classroom assessment and organizing flexible groupings. Differentiated science inquiry can take any form like, confirmation, structural, guided, coupled and open inquires, which can help teachers select learning resources, plan instruction and assess student learning for better academic achievement output.

Academic achievement is a very important factor in education. It is the extent to which a student, teacher or institution has achieved their educational goals (Sepehrian, 2013). Kpolovie, Joe and Okoto (2014), defined academic achievement as the ability of a student to study and remember facts and being able to communicate his knowledge orally or in written form even in an examination condition. The authors also opined that academic achievement is a measurable index that depicts a student's cognitive, affective and psychomotor domains in educational settings. The researchers are of the opinion that students will achieve more academically when various science inquiry has been adopted in learning sciences which may highly contribute to improving creative thinking skills of the students. They believe that differentiated science inquiry may facilitate students in managing and understanding information effectively and systematically.

Irrespective of the importance of chemistry to everyday life and requirement for many science disciplines, student still dread the subject and poor achievements as recorded by the secondary school external examinations (WAEC, 2018; NECO 2018). The chief examiners report has consistently showed that the percentage of credit pass in chemistry never got up to 50% for the past six years (WAEC 2020). The poor performance in chemistry is not acceptable since this will affect the nation in future, not only in secondary school level but in the universities and all scie8nce disciplines and by implication Nigerian security, economy and manpower development.

Ample evidence abounds to show that student's achievement and creative thinking skill in chemistry is still poor. Various factors have been2 attributed to be responsible for the poor performance which is generally clustered into teacher related, some student related and subject 2nature related. One of the major factors is ineffective teaching methods, thus the call

for other teaching methods that are constructive in nature which should involve learner's active participation and promote skill acquisition, like differentiated science inquiry which have received very little attention if any, in the literature of Aguata Education zone which will seek to answer the problems students are facing in increasing their achievement level and creative thinking skills.

Purpose of the study

The study sought to determine;

1. difference in mean achievement scores of students taught Chemistry using differentiated science inquiry and those taught using traditional mode of instruction.
2. difference in mean creative thinking skill scores of male and female students taught Chemistry using differentiated science inquiry.
3. interaction effect of gender and teaching method on students' creative thinking skill.

Research Questions

The following research questions guided the study;

1. What is the difference in mean achievement scores of students taught Chemistry using differentiated science inquiry and those taught using traditional mode of instruction?
2. What is the difference in mean creative thinking skill scores of male and female students taught chemistry using differentiated science inquiry?

Hypotheses

The null hypothesis was tested at 0.05% alpha level of significance.

1. There is no significant difference in mean achievement scores of students taught Chemistry using differentiated science inquiry and those taught with lecture method of instruction.
2. There is no significant difference in mean creative thinking skill scores of male and female students taught Chemistry using differentiated science inquiry.
3. There is no Interaction effect of gender and teaching method on students' creative thinking skill.

Methods

The research design adopted for this study is a quasi-experimental which involves the pretest, posttest experimental and control group design (Nworgu, 2018). The design was adopted because the two groups have common variable (achievement, creative thinking skills and gender). In this study, there are two levels of independent variables (two treatments) and two levels of gender (male and female). Pretest and posttest were given to both the experimental and control groups. Experimental group are subjected to treatment using differentiated

science inquiry while the control group was also subjected to treatment using traditional mode of instruction. The independent variables in this study are the differentiated science inquiry and traditional mode of instruction while the dependent variables are the creative thinking skills and achievement scores. Gender is a moderating variable.

Sample and Sampling technique

The sample of this study consists of 72 (37 males and 35 females) SS3 students offering chemistry, drawn from two schools out of the 60 government owned secondary schools in Aguata Education zone. The subjects were sampled using multistage sampling procedure. Firstly, simple random sampling technique was used to choose one Local Government (Orumba South Local Government Area) out of the three local government Area in Aguata Education zone. This method ensured that each local government area (LGA) was given an equal and independent chance of being selected. Secondly, using purposive sampling technique, two schools were sampled out of the 14 government schools in the selected local government area (Orumba South Local Government Area), the reason for purposive sampling was to get schools with teachers 2who have BSc in chemistry and have taught for more than 5 years and also to obtain schools with more than 20 chemistry students in SS3. Lastly, toss of coin was used to assign the two schools to experimental group and control group. After the sampling, the experimental class consisted of 35 students (18 males and 17 Females), while the control group consisted of 37 students (19 males and 18 females).

Validation of the Instrument

Two research instruments (CAT and CTST) were subjected to face validation by three experts, one from Measurement and Evaluation and one from Science Education, all from faculty of Education, Nnamdi Azikiwe University, Awka and one experienced chemistry teacher from secondary school, who have taught chemistry for over 10 years. The instrument was validated in terms of clarity of instructions; correct wording of items and appropriateness and adequacy of the items in addressing the purpose and problems of the study. The reliability coefficients of the instruments were established at 0.89 and 0.97 respectively. On the basis of the index, the instruments were considered reliable and suitable for conducting the research.

Experimental procedure

The study involved two groups which were experimental and control groups. On the first day of 8the experiment, the CAT was administered by their regular chemistry teachers as pretest to the groups in their intact classes. Thirty minutes was allowed for the pretest. The teachers invigilate their students in both the experimental and control groups. At the end of the test the question papers and answers was collected from the students by their teachers. The reason for the retriever of the question papers was to ensure that the students did not reserve the same content for the posttest. The pretest achievement paper was marked; scores was collected and handed over to the researcher. The initial administration was aimed at establishing the same level of content knowledge for the experimental and control groups. The CTST was also

administered by their regular chemistry teachers as pretest to the groups in their intact classes to measure the students' creative thinking skills immediately after the CAT.

Teaching commence on the next chemistry period by their regular teachers for 5 weeks of teaching, posttest was administered to the subjects by the chemistry teachers. Thirty minutes was allowed for the test, after which the CTST was also administered for ten minutes. The test was marked by the teachers. Scores was collated, collected by the teachers and handed over to the researcher. The aim of the posttest was to find out if there was any gain in knowledge that might have arisen from the treatment.

Method of Data Analysis

The data obtained from each group using the creative thinking skills test (CTST) and chemistry achievement test (CAT) were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA) statistics. Mean and standard deviation was used to answer the research questions and ANCOVA was used to test the hypotheses. Four hypotheses were tested. One of the reasons of choice of ANCOVA for testing the research hypotheses was based on its ability to c2ontrol the effect of pretest. All the hypotheses were tested at 0.05 level of significance.

Results

Results were presented in tables according to the two research questions and three hypotheses.

Research Question One: What is the difference in mean achievement scores of students taught Chemistry using differentiated science inquiry and those taught using lecture method of instruction?

Table 1: Mean(x) and Standard Deviation (SD) of achievement scores of students

Mode of Instruction	N	Mean X	Standard Deviation (SD)
Control	37	13.08	3.233
Experiment	35	18.36	3.582
Total	72	15.74	4.347

Table 1 show that the two groups had improvement as observed in their posttest. For instance, those taught chemistry using differentiated science inquiry had a mean of 18.36 after treatment with a standard deviation of 3.582, while those taught using traditional mode of instruction had a mean score of 13.08 with standard deviation at 3.233. This shows that group taught chemistry with differentiated science inquiry had more variation in the spread.

Research Question Two: What is the difference in mean creative thinking skill scores of male and female students taught ch2emistry using differentiated science inquiry?

Table 2: Mean(x) and Standard Deviation (SD) of creative thinking skill scores of maleand female students.

Gender	N	Mean X	Standard Deviation (SD)
Male	**18**	**57.22**	15.511
Female	**17**	**54.42**	10.886
Total	35	55.83	13.443

From table 2, male students have a mean creative thinking of 57.22 while female students have a mean creative thinking skill of 54.42. The mean showed that a creative thinking skill 2of male students was improved more by differentiated science inquiry than their female counterpart.

Hypothesis 1: There is no significant difference in mean achievement scores of students taught Chemistry using differentiated science inquiry (DSI) and those taught with traditional mode of instruction (TMI).

Table 3: Analysis of Covariance (ANCOVA) Test of significant Difference Between the mean achievement scores of students taught chemistry using DSIMM and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1386.188[a]	2	693.094	73.702	.000	.509
Intercept	2355.349	1	2355.349	25 0.462	.000	.638
Pre_Test_CAT	333.162	1	333.162	35.428	.000	.200
Method_of_Instruction	1030.622	1	1030.622	109.594	**.000**	.436
Error	1335.371	69	9.404			
Total	38667.000	72				
C2orrected Total	2721.559	71				

a. R Squared = .509 (Adjusted R Squared = .502)

Table 3 shows that there is significant difference between the mean achievement scores of students taught chemistry using DSI and those taught using TMI with F=109.594, P= 0.000 < α=0.05. The null hypothesis that there is no significant difference between the mean achievement scores of students taught chemistry using DSI and those taught using TMI is rejected. There is significant difference between mean achievement scores of the students which favours DSI group.

Hypothesis 2: There is no significant difference in mean creative thinking skill scores of male and female students taught Chemistry using differentiated science inquiry.

Table 4: Analysis of Covariance of the influence of Gender on Students' Creative Thinking Skills in Chemistry.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6962.867[a]	2	3481.433	25.934	.000	.268
Intercept	15728.665	1	15728.665	117.166	.000	.452
Pre_CTST	6678.209	1	6678.209	49.747	.000	.259
Gender	2.223	1	2.223	.017	**.898**	.000
Error	19062.485	32	134.243			
Total	478173.000	35				
Corrected Total	26025.352	34				

a. R Squared = .268 (Adjusted R Squared = .257)

Table 4 reveals the result of the hypothesis 2. The F=0.017 was not significant when P=0.898(P>0.05). This shows that there was no significant difference in the mean creative thinking scores of male and female students taught using differentiated science inquiry. Thus, the null hypothesis was not rejected. There was no significant difference between the mean creative thinking skill scores of male and female students taught chemistry using differentiated science inquiry.

Hypothesis 3: There is no Interaction effect of gender and teaching method on students' creative thinking ability.

Table 5: Analysis of Covariance (ANCOVA) Test of Interaction Effect of Gender and teaching method on students' creative thinking ability in chemistry.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7882.464[a]	3	2627.488	20.420	.000	.303
Intercept	452984.396	1	452984.396	3520.432	.000	.961
Method_of_Instruction	6321.131	1	6321.131	49.126	.000	.258
Gender	311.755	1	311.755	2.423	.122	.017
Method_of_Instruction * Gender	1238.259	1	1238.259	9.623	**.003**	.064
Error	18142.888	69	128.673			
Total	478173.000	72				
Corrected Total	26025.352	71				

a. R Squared = .303 (Adjusted R Squared = .288)

2Table 5 shows the interaction between gender and teaching method on students' creative 8thinking ability in chemistry. It can be deduced that there exist significant interaction effect between method and gender on the creative thinking ability of the students, thus, F=9.623. P=0.003 < α = 0.05. By implication the method of teaching and the gender of the students had its effect on the creative thinking ability of the students, thus, the null hypotheses that there is no Interaction effect of gender and teaching method on students' creative thinking ability was rejected.

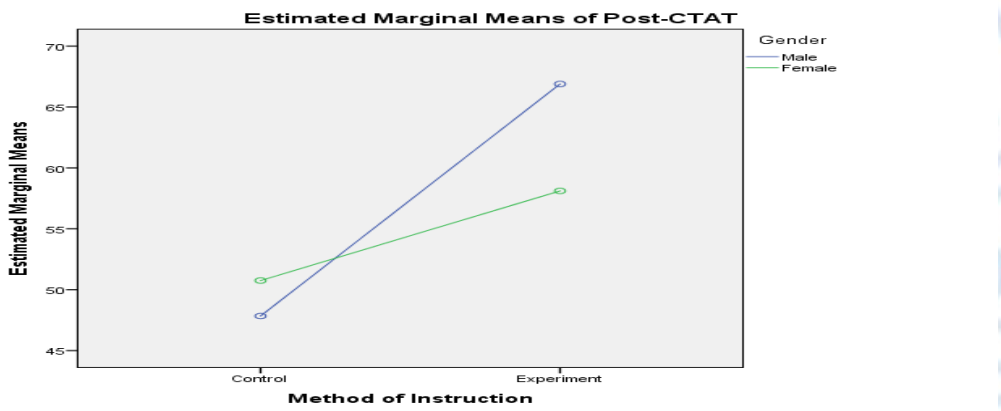

Figure 2: profile plot of interaction effect of teaching approach and gender on the creative thinking ability of students in chemistry.

Discussion

The result of this study had shown that students taught using differentiated science inquiry performed better than those taught using traditional mode of instruction. The findings of the study revealed that the students taught chemistry with Differentiated science inquiry had more variation in their spread as seen in research questions one.The findings of the study as shown in hypothesis 2 revealed that there was significant difference in the creative thinking skill of the male and female students taught chemistry using differentiated science inquiry. There was improvement in the creative thinking skill for the male students than that of the female students taught chemistry using differentiated science inquiry as revealed in table 2 showing standard deviation of male and female students to be 15.512 and 10.887 respectively, showing a wide variation spread. This revealed that gender had significant effect on creative thinking skill in favour of males. This agreed with the opinion of Gok (2014), who indicated that males have a better problem-solving ability than female; problem solving ability is closely related to creative thinking skills.

It is also revealed that there was significant interaction effect of gender and teaching method on students' creative thinking skill. The male students scored higher creative skill than the female students with the difference in the mean scores which were not significant at 0.05 level of confidence.

Conclusion

On the basis of the findings of this study, the following conclusions were made. The use of differentiated science inquiry significantly enhances students' academic achievement in chemistry when compared with those taught with traditional mode of instruction. Secondly, differentiated science inquiry promotes creative thinking skill among chemistry students. However, male students creative thinking skills is significantly higher than female students when taught chemistry with differentiated science inquiry.

Recommendations

T2he following recommendations were made based on the findings of the study.

1. Chemistry teachers should adopt the use of differentiated science inquiry for chemistry instructions, in order to enhance students' general understanding of contents of the subject. This will help to improve their creative thinking skills.
2. Government should regularly organise and monitor workshops, seminars, conferences and in-service training for teachers on the use of differentiated science inquiry, in order to enhance teachers' expertise. It is expected that if Chemistry teachers' professional know-how is improved upon, it will impact positively on students' academic achievement.
3. Teacher educators and institutions should become mentors of Chemistry teachers on how to effectively apply the differentiated science inquiry, not only during the course of a teachers' training program, but on a continuous basis with follow-ups.

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PHYSICS TEACHERS PERCEPTION ON THE RELEVANCE OF THEIR UNIVERSITY TEACHER TRAINING PROGRAMMME IN TEACHING OF PHYSICS CONTENTS IN SECONDARY SCHOOLS IN ANAMBRA STATE

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Abstract

The study determined the physics teachers' perception on the relevance of physics contents of university teachers training programme in teaching of physics contents in secondary schools in Anambra State. The study adopted a descriptive survey research design, guided by thr8ee research questions. The entire population of this study 156 physics teachers in Anambra State (male: 79 and female: 77) in the 261 secondary schools in Anambra State was used without sampling. This is because the population was considered small and not all the schools have physics teachers. The instrument for the study was Teachers Perception on the Relevance of Physics Contents of their Training Program Questionnaire (TPRPCTPQ) adopted from Buabeng, Conner and winter (2016) and modified to suit the present study. The instrument was subjected to face validitation. The instrument was given to experts in measurement and evaluation from Nnamdi Azikiwe University, one science education lecturer from Nnamdi Azikiwe University. The internal consistency of the instrument was determined using conbranch's alpha. The coefficient of 0.74 was obtained. Data collected was analyzed using mean and standard deviation. The findings of result show among others that Physics teachers in secondary schools in Anambra state have a very high relevance perception on the use of physics contents of university teachers training programme in teaching of physics contents in secondary schools in Anambra State and that Greater percentage of physics teachers in secondary schools in Anambra state are not professionally trained as physics educationalist. Based on the findings, it was recommended among others that Physics lecturers in Universities should continue to implement the Benchmark Minimum Academic Standard for undergraduate physics programme in Nigeria universities curriculum planned effectively since it is of very high relevance to the teaching of physics contents in secondary school.

Key words: Physics contents, Physics teachers, physics education programme

Introduction

Education has been an instrument of transformation. It is a matchless asset of fundamental importance to man and his environment. According to Okeke in Obialor (2022) education is defined as the art of making available to each generation the organized knowledge of the past. The author continued that education embraced not only direct knowledge from schools and colleges but also the development of character. In the same view, the importance of the teachers and the process of their making cannot be overlooked in education.

Teacher education is a program that trains men and women to become professional teachers. Teacher education is a form of formal education which prepares people to become qualified teach2ers Okeke in Obialor (2022). Teacher education is the component of any educational system charged with the education and training of teachers to acquire the competences and sk8ills of teaching for the improvement in the quality of teachers for the school system (Onyema, Igwe&Ogadi 2018). In Nigeria educational system, especially at the university level, teachers' education program is designed to provide the teachers with the intellectual and professional background adequate for their assignments and make adaptable to changing situation (National Policy on Education (NPE), 2013).

Faculty of education in Nigeria universities therefore, is expected to produce prospective teachers with proper leadership qualities, knowledge, attitudes and enhance the skills of teachers in the use of new technologies (National University Commission (NUC), 2007).Each university is allowed to decide the title of the degree to be awarded in its faculty of education. The following variety of degrees are in operation and available in faculty of education of the Universities in Nigeria: B.Ed. in Integrated subjects; B.Ed. in Specialist Education Areas; B. 2A (Ed.) Arts and Humanities related program; B.Sc. (Ed) science related program; B. Sc. Ed Social Sciences related Program; B. L. S. /B.A (L.S)/B.Sc. (L.S) Library Science, B. Sc. Ed (LIS/RM)(NUC, 2018). Physics education which is the interest of this study can be seen as part of degree under B.Sc. (Ed) Science related program.

Physics education progamme is one of the programmes studied in Nigeria universities and it is made to specifically prepare professional physics teachers who are to teach at the secondary school level. In Nigeria University, this program involves months of teaching practice in the secondary school which is the practical aspect of the pre-service training. However, the following are the courses contained in the bench mark minimum academic standard for physics students teachers' in Nigeria universities; mechanics, heat, light, sound, laboratory physics, electricity & magnetism, properties of matter, general mathematics, thermal physics, electric circuit & electronics, atomic physics, classical mechanics, electromagnetic field , wave, nuclear physics, energy physics, electrodynamics, solid state physics, quantum physics, experimental technique, environmental physics and material. McDermott and Shaffer (2000) recommended that teachers should study each topic in a way that is consistent with how they are expected to teach that material, so they can experience effective models for learning that particular content.

Physics as a subject in senior secondary program is one of the core science subjects establish by National Educational Research and Development Council (NERDC). Physics involves every attempt of humans to explore, interpret and manage the natural world. Physics is the most basic and fundamental natural science which involves universal laws and the study of the behavior and relationships among a wide range of important physical phenomena (Cutnell& Johnson, 2007). Physics encompasses of the study of the universe from the largest galaxies to the smallest subatomic particles. Physics is the basis of many other sciences, including chemistry, oceanography, seismology, astronomy and physicists may work in many fields including the health services, communications, education and meteorology's (American Physics Society, 2008; Gibbs,2 2003). Despite the importance of physics to the n8ation's development, the students' performance in physics at both internal and external examination has remained persistently poor. For instance, Inyang and Josiah (2018) reported that the West African Examination Council (WAEC) results of physics students from 2010 to 2016 were poor. In line with this, Bad8mus&Omesewo in Oluwatoyin (2020) showed that students perform poorly in physics in external examination. Similarly, research performance of physics students at the tertiary level points to the fact that the students did not acquire the requisite knowledge and skills expected of them at the lower (secondary) level of education system (Meckonnen, 2014).This could be one of the reasons the number of students admitted in the tertiary institution to study physics remain the least compared to other sciences including Biology, Chemistry and Mathematics (Agommuoh, 2014). Many researchers have identified many factors as being responsible for the poor performance of students in physics without looking at the physics teachers' perception on the relevance of their university teacher training programmme in teaching of physics contents in secondary schools in Anambra state. It is on this ground that the researchers carried out this study in order to ascertain the physics teachers'perception on the relevance of their training program to teaching of physics contents in secondary schools in Anambra State.

Purpose of the Study

The purpose of the study is to determine the perception of physics teachers on the relevance of their university teachers training program in teaching of physics contents in secondary school in Anambra state. Specifically, the study sought to find out;

1. Physics teachers' perception on the relevance of their university teachers training program in teaching of physics contents in secondary schools.
2. Physics teachers' perception on the relevance of their university teacher training program in teaching of physics contents in secondary schools based on their qualification.

Research Questions

The following research questions guided the study

1. What is the perception of the physics teachers on the relevance of their university teachers training program in teaching of physics contents in secondary schools?
2. What is the Physics teachers' perception on the relevance of their university teacher training program in teaching of physics contents in secondary schools based on their qualification?

Methods

The descriptive survey research design was adopted in the study. According to Nworgu (2015), descriptive survey design is those studies which aim at collecting data and describing in a systematic manner the characteristics feature or facts about a given population. The study 8was carried out in secondary schools in Anambra State. The population of the study consisted of the entire 1256 physics teacher in Anambra State (male: 79 and female: 77) in the 261 secondary schools in Anambra state. The entire population was used without sampling. This is because the population was small and not all the schools have physics teachers. The instrument for the study was Teachers Perception on the Relevance of Physics Contents of their Training Program Questionnaire (TPRPCTPQ**)** was adopted from Buabeng, Conner and Winter (2016) and modified to suit the present study. The instrument consisted of teachers' demographic information, physics teachers program drawn from National University Commission (NUC) and Senior School Physics Curriculum drawn from Nigeria Educational Research and Development Council (NERDC). The items drawn from NUC and NERDC were on 4 points Likert-type scale of Very High Relevance (VHR) High Relevance (HR), Low Relevance (LR) and Very Low Relevance (VLR) to be rated 4, 3, 2 and 1 respectively. The questionnaire was of two (2) parts; A and B. Part A was on the demographic information of the teachers, part B was 20 items based on the NUC program for physics education and NERDC which checked physics teachers' perception on the relevance of their teachers training physics contents for teaching secondary physics. The instrument was subjected to face validity. The instrument was given to experts to validate. They experts were asked to validate the instrument in terms of clarity, relevance, and substance-ability. Comment and corrections made by the validators were affected by the researcher in the final copy of the instrument. In order to established the reliability of the instrument. The TPRPCTPQ was administered to 10 physics teachers different from those of the research area. The questionnaire was answered and was returned to the researchers. The internal consistency of the instrument was determined using the Cronbach's alpha. The coefficient of 0.74 was obtained. However, a total of 156 questionnaires were given out to the 156 physics teachers of the various schools in the educational zones, through the help of the principals, guidance and concealing unit and the HOD of the science department, 122 questionnaires were returned back. This was because some schools do not have physics teachers and some of the physics teachers have retired. The information collected using the TPRPCTPQ was used for the data analysis. Mean, standard deviation and percentage were used to answer the research questions. In answering the research questions, mean scores that fall between 4.00-3.50, 3.49-2.50, 2.49-1.50 and1.49 below were taken to indicate VHR, HR, LR and VLR respectively.

Results

Research Question One: What is the perception of the physics teachers on the relevance of physics contents of university teachers training programme in teaching of physics content in secondary schools?

Table 1: Mean rating on perception of the physics teachers on the relevance of their university teachers training programme in teaching of physics in secondary school

S/N	Items	Mean	Std. Deviation	REMARK
1	My knowledge of classical mechanics help me to teach translational motion, conservation and mechanics in secondary school physics	4.25	0.846	VHR
2	My knowledge of radiation, nuclear energy, nuclear reaction and atomic structure help me to teach nuclear physics in secondary.	4.02	0.853	VHR
3	My knowledge of solid state physics in the university helps me to teach crystals structure in my class room.	3.97	0.927	VHR
4	My knowledge of material science in the university helps me to teach crystals structure in class room.	3.77	1.027	VHR
5	In teaching of quantization energy, I find the knowledge of quantum mechanics of the university useful in the class room.	3.75	0.992	VHR
6	When I want to teach basic electronics in the class room, I find electronics knowledge I gained in the university useful.	3.85	0.951	VHR
7	My knowledge of mathematics I gained in the university is relevant when I am teaching derivation of projectile and linear equation to my students	4.27	0.909	VHR
88	My knowledge in material science in university is relevant when I am teaching x- ray under nuclear physics in secondary school	3.59	1.018	VHR
9	In solving mathematical problems, I find my knowledge of general mathematics of the university useful in secondary school physics classroom.	4.35	0.908	VHR
10	I use my knowledge of electricity to teach electric field lines of forces, static and current electricity in secondary school physics.	4.30	0.890	VHR

11	When teaching magnetic field, I find my knowledge of magnetism in the university useful in the class room.	4.16	0.894	VHR
12	My knowledge of atomic physics in the university is useful in the teaching of atomic models in secondary physics.	4.07	0.892	VHR
13	In teaching heat and temperature in secondary school, I find the knowledge of thermal physics I gained in the university useful.	4.20	0.933	VHR
14	During experimental physics on verification of Hooks law and simple pendulum, I find my knowledge of mechanics very relevant in carrying out the experiment.	4.52	0.730	VHR
15	When teaching heat in secondary school, I find the knowledge I gained from the university thermal physics useful.	4.16	0.971	VHR
16	During experiments on light, I use my knowledge of optics in the lab.	4.10	1.071	VHR
17	My knowledge of physical quantities in university is relevant to teaching of fundamentals and derived quantities in secondary school physics	4.34	0.860	VHR
18	In teaching wave in secondary school, I find the knowledge of quantum physics I gained in the university useful.	4.00	0.971	VHR
19	The knowledge gained from electrodynamics in the university is relevant in teaching of electromagnetic spectrum and electromagnetic induction in secondary school physics	3.84	0.936	VHR
20	The knowledge of environmental physics I gained in the university is useful in the teaching of the solar system in secondary school physics.	3.71	0.992	VHR
	Grand mean	**4.06**	**0.244**	**VHR**

The result in Table 1 shows the perception of the physics teachers on the relevance of their university teachers training programme in teaching of physics contents in secondary school. All the items had mean rating above 4.00- 3.50. The grand mean 4.06 also falls within 4.00-3.50 above indicating a very high relevance of physics contents of university teachers training programme in teaching of physics content in secondary schools in Anambra State. The trend in their mean indicates that all the physics teachers in secondary schools do not have equal view/opinion on the relevance of the university physics contents for teachers training programme.

Research Question Two: What is the Physics teachers' perception on the relevance of physics contents of university teacher training programme in teaching of physics content in secondary schools based on their qualification?

Table 3: Mean rating on physics teachers perception on the relevance of their university teachers training programme in teaching of physics content in secondary schools based on their qualification

Qualification	Frequency	Mean	SD
B.Sc. Ed (Physics)	31	4.04	0.881
B.Sc. (Physics)	30	4.09	0.893
B. Eng	35	4.12	0.938
M.Sc .Ed (Physics)	19	3.98	1.019
M.Sc. Eng	4	4.06	0.718
Ph.D	3	3.98	0.722
Total	**122**	**24.27**	**5.171**

The result from Table 6 showed the mean rating for teacher qualification: B.Sc. Ed (Physics) is 4.04, (SD=0.8881), B.Sc. (Physics) is 4.09(SD=0.893), B.Eng is 4.12, (SD=0.938), M.Sc. Ed is 3.98, (SD=1.019), M.Sc Eng. Is 4.06, (SD=0.718), Ph.D is 3.98, (SD=0.722). This indicates that more of the physics teachers with B. Eng. perceived physics contents of university teacher -training programme of very high relevant than physics teachers with B.Sc.Ed, B.Sc, M.Sc Ed, M.Sc. Eng, and Ph.D in teaching of physics content in secondary schools. This also indicates that most persons who study engineering ends up as teachers in the class room.

Discussion of the findings

The findings of the result in table 1 revealed that the physics teachers perceived the university physics contents of the teachers training programme to be very high relevance in teaching of physics in secondary school. The result also showed that the teachers of physics do not have equal view/opinion on the relevance of the university physics contents for teachers training programme. This agrees with the findings of Buabeng, Conner and Winter (2016) who noted that physics teachers have varying degree of need in order to be effective in the content they

teach. However, the findings of th8is study is in contrast to Omoseyo (2009) who reported that teachers that taught physics at the senior secondary school level could not teach some topics well because they were not taught well while in the college/university.

In terms of physics teachers perception on the university physics contents relevance in teaching of physics contents in secondary school based on their qualification. The findings of the result revealed that more of the physics teachers with B. Eng. perceived physics contents of university teacher -training program of very high relevant than physics teachers with B.Sc.Ed, B.Sc, M.Sc. Ed, M.Sc. Eng, and Ph.D in teaching of physics contents in secondary schools. This also indicates that most persons who study engineering ends up as teachers in the class room. This could be that the number of persons that enroll into physics as a teaching course is low. This is in line with the findings of Omoseyo (2009) who stated that the number of physics teachers is not as desired in Nigerian secondary schools and that many schools do not have physics teachers. This lack of physics teachers is very obvious in Anambra state where the study was carried out. Among the reason for this lack of physics teachers could be that students' perceived it as hard and abstract subject because no qualify teacher to handle it. In view of the above, Omoseyo (2009) also recommended that scholarship should be granted to candidates willing to read physics education in the university and also that there should be in-service training for those on the job.

CONCLUSION

From the findings of the study, the following conclusions were drawn

1. Physics teachers in secondary schools in Anambra state, have a very high relevance perception on the use of physics contents of university teachers training programme in teaching of physics content in secondary schools in Anambra State.
2. Greater percentage of physics teachers in secondary schools in Anambra state are not professionally trained as physics educationalist

Recommendations

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

1. Physics lecturers in Universities should continue to implement the Benchmark Minimum Academic Standard for undergraduate physics programme in Nigeria universities curriculum planned effectively since is of very high relevance to the teaching of secondary school physics.
2. Secondary Educational Management Board should ensure that all the physics teachers in secondary schools in Anambra state are professionally trained as physics educationalist

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COMPARATIVE EFFECTS OF TEACHING WITH IMPROVISED INSTRUCTIONAL MATERIALS AND STANDARD INSTRUCTIONAL MATERIALS ON SECONDARY SCHOOL STUDENTS' ACADEMIC RETENTION IN CHEMISTRY

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Abstract

This study investigated the comparative effect of teaching with improvised instructional materials and standard instructional materials on secondary school students' academic retention in Chemistry. It covered the topics; acids, bases and acid- base reactions. Two research questions and two hypotheses were used to guide the study, relevant literatures were also reviewed. The study was carried out in Awka education zone in Anambra State. The population of the study consists of 8,583 SS1 Chemistry students in the zone. The sample size for the study comprised of 192 SS1 Chemistry students. The study adopted quasi-experimental design. Four purposively selected co-educational schools were used for the study of which students of chemistry in two schools were assigned to experimental group which received treatment of involvement in teaching Chemistry using improvised instructional materials and the other two schools were assigned to control group which were taught using standard instructional materials. Twenty- five (25) Chemistry Retention Test (CRT) was used as the instrument. The instrument was validated by experts in science education department and education foundation (measurement and evaluation) CRT reliability was established using Kudar Richardson 20 (KR-20) which yielded reliability coefficient of 0.81. Mean and standard deviation were used to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at .05 level of significance. The findings of the study revealed that, there was high knowledge retention when Chemistry students were taught using improvisation instructional material than those taught with standard instructional material and gender has no influence on use of improvised 2instructional material and standard instructional material. Based on the findings of the study, recommendations were made.

Keywords; Science, Chemistry, Retention, Standard Instructional Material (SIM) and Improvised Instructional Material (IIM)

Introduction

Science is important in the development of any nation. This is because science is directly linked to the tackling of the problems of humanity. The contributions of science and technology to the overall development of nations cannot be overemphasized. This is the reason science holds an important position in the curriculum of the nation's educational system. It was in the bid to further underline the importance of science and technology to modern development that Science, Technology, Engineering and Mathematics (STEM) education was introduced in 2001 by the Scientific Administrators at the US National Science Foundation (NSF) with three major goals; to expand the number of students who ultimately pursue advanced degrees/careers in STEM fields and broaden participation of woman and minorities in those fields, expand STEM- capable workforce and increase STEM literacy for all students including those who do not pursue STEM related careers or additional studies in STEM disciplines (Hallinen, 2011).

STEM education is an integration of interrelated discipline into a new whole, which gives students the opportunity to understand their environment and exploit it for self and national development (Hallinen,2011). The interdisciplinary nature of STEM makes it unique as it has elements of creativity and objectivity. Strong STEM education is culturally responsive, employs problem-solving and inquiry-based approaches and engages students in hand-on activities that offer opportunities to interact with science professionals (Tera, 2018). However, Samuel and Obikezie (2020) define science as the rational and systematic study of the environment through observation and experimentation with a view to understanding the environment and manipulating the resources of nature for human development. This implies that teaching must be proactive, creative and student centered to achieve the objectives of STEM at secondary school level. The authors also asserted that one of the activities of science is experimenting, it provides a forum for putting the theoretical knowledge acquired in the classroom into practice and also, to demonstrate the psychomotor skills of the teacher and students in teaching and learning subject like Chemistry through experimentation. Experimenting in science is however dependent on the availability of instructional materials (Ogwo, 2014).

Lack of instructional materials, non-availability of equipped laboratories among others in the teaching of science in schools is an established issue (Ezeliora, Ibe & Obikezie, 2021).This is in line with Odigie (2011) and Dike (2013) who agreed that educational instructional materials and equipped laboratories are lacking in schools. Ezeliora, Ibe and Obikezie (2021) are of the opinion that the use of instructional materials to facilitate teaching and learning should be a welcome development because it help in enhancing students academic performance and retention. This is in conformity with Dike (2013) who asserts that science teachers should work beyond stereotyped science teaching-learning process and utilize the available materials in the environment to facilitate effective science teaching-learning process. Therefore for effective teaching of science subjects like Chemistry, the use of instructional materials to enrich instruction is very vital (Dike, 2013).

Chemistry is one of the core subjects of science. As a building block for a range of science disciplines, Chemistry has the potential to link other sciences together and to foster greater scientific literacy (Tera,2018). Chemistry is the basic gateway and the key to modern technology, medicine, engineering and other sciences (Chikendu, Obikezie & Eke, 2021). The study of Chemistry is needed to develop the necessary skills, intellectual and mental training needed to observe measure and apply scientific attitude and skill towards natural phenomena that include the eagerness to learn and the ability to think critically. In contemporary Nigeria, great emphasis is placed on science for technological development and Chemistry is an important raw material for science. In spite of the relevance of Chemistry in the life of the society, the study of Chemistry in our secondary schools is challenged with poor performance and lack of interest on the part of students (Obikezie & Abumchukwu 2021).

According to Obikezie, Abumchukw and Chikendu (2021) factors responsible for students' poor performance in Chemistry include – ineffectiveness in teaching process, poor laboratory facilities and inadequate number of learning facilities in schools as against the consistent increase in the number of students. Other reasons adduced for poor performance in Chemistry include abstract nature of Chemistry, student and teacher factors, concept difficulty and teaching of Chemistry without instructional materials (Nnoli, 2014).

WAEC Chief Examiners' report (2018) pointed out that Chemistry students' have poor knowledge of acids, bases and acid-base reactions and are unable to report results of acid-base titration experiments, unable to make calculations on molar and mass concentration. These topics are fundamental and basic concepts in Chemistry. Judging from the percentage analysis of those who passed Chemistry at credit level in WAEC over the years, there has not been consistent increase in the percentage of students who enrolled and passed at credit level. From 2007-2012, the percentage of those who passed at credit level was below 50% except in 2011. From 2013 to 2018, although, the percentage of those who passed at credit level was above 50%, still a good number of the registered students failed it resulting to dropout in science careers in higher institutions of learning (Samuel & Obikezie 2020). Could it be that the dropout in science careers is as a result of non availability of instructional materials?

Ogwo (2014) stated that the basic tools that science uses in the learning of science processes are instructional materials. Instructional materials are wide varieties of equipment and materials used for teaching and learning processes to stimulate self-activity on the part of the students. According to Engida (2012) instructional materials increase the rate and quantity of learning by students and at the same time allow the teacher to use more time on other gainful activities. They make abstract terms, concepts and generalizations more practical and realistic. Instructional materials create in the learners' awareness of problem, open up possibilities for exploration, present meaningful interactions which naturally lead to provision of solutions. Chemistry as a science subject is hands on activity based and must be taught with instructional materials (Ezeliorah, Ibe & Obikezie 2021). Teaching of Chemistry without instructional materials may result to rote learning.

Due to the galloping inflation in the country, foreign exchange rate is high and makes it impossible for schools to purchase already made instructional materials which are often imported into the country. For these reasons and even more, Chemistry teachers have been called upon to be creative in improvising these instructional materials so that in the absence of standard ones or when the number is not adequate, the teacher can locally make use of resources from the environment as an alternative (Ezeliora, Ibe & Obikezie 2021). The importance of using instructional materials whether standard or improvised according to Oriade (2008) is that no matter how good a curriculum may be, the absence of the use of instructional materials can jeopardize its effective implementation. Instructional resources help the teachers to improve their instruction. They make the message clearer, more interesting, standard and easier for the learners to assimilate (Onasanya & Adegbija, 2012).

There are two major types of instructional materials: standard instructional material used as conventional in this study and improvised instructional material used as experimental parameter in this study. The standard materials are conventional instructional materials that are imported or factory made laboratory equipment for teaching science. They are standardized because they adapt to all conditions and serve the same purpose wherever they are used. Examples are laboratory chemicals, laboratory glassware, bunsen burners, tripod stand etc, while improvised materials refer to a diversity of educational resources that can easily be obtained from the environment, with high local content and relevance to the curriculum (Engida, 2012). They are used as instructional materials for teaching and learning purposes. They are made by the teacher or students. Improvised materials include; sodium rich materials as base, such as akanwu, ugwu dyes of plants and flowers (zobo) as acid base indicators. Standard Instructional Material (SIM) and Improvised Instructional Material (IIM) may have effect on students' academic performance and retention in learning science (Ez2eliora, Ibe & Obikezie, 2021).

Retention is the ability to store what has been learnt and recall what has been stored in the memory. According to Obikezie, Abumchukwu and Chikendu (2021) retention is the ability to retain and later remember information or knowledge gained after learning into memory. The authors further added that the nature of the resources to be coded contributes to the level of retention. Retention is, therefore, the ability to recall learning experiences after about three weeks of learning and beyond. Conditions that relate to poor retention include such factors like lack or inadequate use of instructional materials. Insufficient use of instructional materials in the process of teaching and learning Chemistry can lead to poor retention of knowledge among genders in classroom (Ikwuanusi, 2011).

Genders as an important determinant factor in an educational setting constitute a hindrance to students' retention in Chemistry and have received research attention for some years Attah (2014). According to Attah (2014) gender is not a significant factor in students' retention in science. In the other hand, Okwuduba and Okigbo (2018) identified sex-role stereotyping and masculine image of science as the origin of the differences between male and female retention in sciences. In relation to the present study, since gender has proved a significant

determinant of academic retention in Chemistry and in other science subjects in some comparative studies.

Engida (2012) reported that Chemistry students taught using improvised instructional materials performed excellently well and retained what they had been taught more students taught using standard instructional material in Kogi state. Similarly, Attah (2014) revealed that there was a significant difference between retention scores of students taught science subjects with improvised instructional materials when compared with those taught with standard instructional materials in Nsukka in favour of students taught with improvised instructional material. The author further stressed that female students proved superior to male students in retention in using both improvised and standard instructional materials, that is to say that a significant differences exist male and female students taught science with improvised and standard instructional material in favour of female students. In contrary view, Ibrahim (2012) observed that there was no significant difference in the mean retention between male and female students taught Biology using improvised instructional material and those taught with standard instructional materials in northern Kaduna. Ibe (2021) maintained that there was a significant difference in mean scores in a comparative study of secondary school Chemistry students taught with improvised instructional material and those taught with standard improvised instructional material in favour of those taught with improvised instructional material. Ibe further opined that in as much that improvised instructional material improves academic retention of secondary school Chemistry students when compared with standard instructional material, that there is a significant different in academic retention of male and female Chemistry students who were taught with improvised instr2uctional material and standard instructional material in favour of male students . In a comparative study carried out by Okwuduba and Okigbo (2018), the researchers observed that there was a significant difference when students were taught with cooperative learning strategy and think pair learning strategy in favour of those taught with think pair share learning strategy. The authors maintained that think pair share learning strategy enhances students' academic retention in Chemistry than cooperative learning strategy in Ogidi education zone. The above comparative studies reviewed were done outside the present scope of study. However the researchers wish to investigate the comparative effect of teaching with improvised instructional materials and standard instructional materials on secondary school students' academic retention in Chemistry.

Realizing the importance of Chemistry for national development, a lot of students tend to register Chemistry in secondary school. This has resulted to large surge of students in Chemistry giving rise to large number of students in one class. Unfortunately the increase in number of students has not been matched with the supply of instructional materials in the laboratories. This has made Chemistry teachers to teach Chemistry with little or no instructional materials. This has constituted difficulties in the teaching and learning of practical Chemistry. Without the use of instructional materials in teaching and learning of Chemistry which supposed to be activity based, do not help the students to understand Chemistry concepts. The consequences are rote learning, lack of retention.

Secondly, students have not been performing well in the following Chemistry topics acids, base, acid-base reaction, calculations of molar and mass concentration. However, most Chemistry laboratories are equipped with standard instructional materials which are at times not enough or even not available. This has made it inevitable for Chemistry teachers to improvise teaching resources.

Teachers are encouraged to engage in improvisation of instructional materials to avoid teaching Chemistry without instructional materials. Thus, the crux of this study if put into question is: what is the comparative effect of teaching with improvised instructional materials and standard instructional materials on secondary school students' academic retention in Chemistry in Awka education zone of Anambra state Nigeria?

Purpose of the Study

The purpose of the study is to investigate the comparative effect of teaching with improvised instructional materials and standard instructional materials on secondary school students' academic retention in Chemistry. Specifically, the study sought to achieve the following:

1. Mean retention scores of students taught Chemistry using improvised instructional materials (IIM) and those taught using standard instructional materials (SIM)

2. Mean retention scores of male and female students taught Chemistry using improvised instructional materials (IIM)

Research Questions

The following research questions guided the study;

1. What is the difference in the mean retention scores of students taught Chemistry using improvised instructional materials and those taught using standard instructional materials?

2. What is the difference in the mean retention scores of male and female students taught Chemistry using improvised instructional materials and those taught using standard instructional materials?

Hypotheses

The study tested the following null hypothesis at 0.05 level of significance.

1. There is no significant difference in the mean retention scores of students taught Chemistry using improvised instructional material and those taught using standard instructional material.
2. There is no significant difference in the mean retention scores of male and female students taught Chemistry using improvised instructional materials and those taught using standard instructional material.

Methods

The design of the study was quasi-experimental design of pretest-posttest non-equivalent control group design. Quasi-experimental design is where random assignment of subjects to experimental or control groups is not possible (Nworgu, 2015). In such research, intact classes were used. The design is considered appropriate for the study because treatment and control groups are used. The study was carried out in Awka Education Zone of Anambra state, Nigeria. Awka Education Zone comprises of five Local Government Areas namely; Awka North, Awka South, Anaocha, Dunukofia and Njikoka local government area respectively. To obtain this study, four co- educational government owned secondary schools were chosen out of forty nine (49) co-educational government schools in the area. Two schools were assigned to control group, the other two were also assigned to experimental group. Out of 8583 SS1 students in Awka education zone 192 SS1 students were selected using purposive sampling technique. One hundred and four students (104) expunge and comprising fifty four (54) male students and fifty (50) were assigned to experimental group who were taught with improvised instructional materials. In like manner, eighty eight students (88) were assigned to control group forty eight (48) male students and forty (40) female were assigned to control group who were taught Chemistry concept using standard instructional material. The instrument for data collection was Chemistry Retention Test (CRT). CRT was developed by the researchers from the West Africa Examination Council (WAEC) past questions. The instrument was validated by two experts one from department of Chemistry Nwafor Orizu Collage of education Nsugbe and one from department of educati2on foundation Chukwuemeka Odumegwu Ojukwu University Igbariam Campus. The reliability co-efficient of CRT was established by administering the instrument to 25 Chemistry students in Enugu state which is outside the place of study using Kuder Richason formula and score obtained was 0.81.Mean and standard deviation were used to answer research questions while analysis of covariance (ANCOVA) was used to test the hypothesis at .05 level of significance

Research Question one: What is the difference in the mean retention scores of students taught Chemistry using improvised instructional materials and those taught using standard instructional materials?

Table 1: Mean and Standard Deviation Scores of the Retention Score for Students Taught

Chemistry with Improvised Instructional Materials and those Taught with Standard Instructional Materials.

Instructional Material	N	Mean $\bar{X}$	SD	Mean Difference $\bar{X}$

Improvised Instructional Material Group (IIM)	104	59.08	7.50	6.51
Standard Instructional Material Group (SIM)	88	52.64	8.16	

Table 1 shows that the mean retention scores of students taught with improvised instructional materials and standard instructional materials were 59.08 and 52.6 respectively. The difference in mean retention score of 6.5 implies that students taught Chemistry with improvised instructional materials had better retention in Chemistry than their counterparts taught with standard instruction materials. The standard deviation scores for the two groups were 7.50 and 8.16, indicating that students taught with the improvised instructional materials had slightly more variability in their retention scores.

Research Question Two: What is the difference in the mean retention scores of male and female students taught Chemistry using improvised instructional materials and those taught using standard instructional materials?

Table 2: Mean and Standard Deviation Retention score for Male and Female Students Taught Chemistry with Improvised Instructional Materials and those Taught with Standard Instructional Material

Instructional Material	**Gender**	**N**	**Mean $\overline{X}$**	**SD**	**Mean Difference $\overline{X}$**
Improvised Instructional 2Materials (IIM)	Male	54	60.15	7.69	2.23
	Female	50	57.92	7.19	
Standard Instructional Materia2l (SIM)	Male	48	51.01	6.10	4.09
	Female	40	46.92	5.90	

Table 2 presents the Chemistry mean and standard deviation Chemistry retention scores of male and female students taught with improvised instructional materials and those taught with standard instructional material. The mean and standard deviation retention scores of male students taught with improvised instructional material were 60.15 and 7.69 whereas those of female students in the same group were 57.92 and 7.19. However, the mean gain difference between male and female students taught Chemistry concepts using IIM was 2.23 in favour of male students. This implies that in use of improvised instructional materials, male students had better retention in Chemistry than their female counterpart. More so, the mean and standard deviation retention scores of male students taught with standard instructional material were 51.01 and 6.10 whereas those of female students in the same group were 46.92 and 5.90. However, the mean gain difference between male and female students taught Chemistry concept using SIM was 4.09 in favour of male students as well.

This implies that in use standard instructional material, male students had better retention in Chemistry than their female counterpart.

Hypothesis 1

There is no significant difference in the mean retention scores of students taught Chemistry using improvised instructional material and those taught using standard instructional material.

Table 3. Summary of Analysis of Covariance of Main Effect of Mean Retention Scores of Students Taught Chemistry using Improvised Instructional Materials and those Taught with Standard Instructional Materials.

Source of Variation	Sum of Squares	Df	Mean Square	*F*	*p*-value
Pretest	1678.11	1	1678.11	32.01	.000
Instructional Materials	2103.19	1	2103.19	40.11	.000*
Error	9909.64	189	52.43		
Total	13565.00	191			

*Significant

Table 3 shows there was a significant ofmean retention scores of students taught Chemistry with improvised instructional materials and those taught with standard instructional materials $F(1, 187) = 40.11$, $P = .000$. Since the obtained p-value of .000 was less than the 0.05 level of significance, the null hypothesis which stated that the two groups will not differ significantly was rejected. This implies that students taught Chemistry using improvised instructional materials had greater mean retention score than those taught with standard instructional materials. This implies that the significant difference was in favour of those taught chemistry us2ing improvised instructional materials.

Hypothesis 2

There is no significant difference in the mean retention scores of male and female students taught Chemistry using improvised instructional materials and those taught using standard instructio2nal material.

Table 4. Summary of Analysis of Covariance of Mean Retention Scores of Male and Female Students Taught Chemistry with Improvised Instructional Materials and Those with Standard Instructional Material.

Source of Variation	Sum of Squares	Df	Mean Square	*F*	*p*-value
Posttest in	1408.38	1	1408.38	33.37	.000

IIM					
Gender in IIM	58.42	1	58.42	1.38	.242*
Error	4262.11	101	42.20		
8					
Posttest in SIM	1514.00	1	1408.38	23.17	.000
Gender in SIM	62.42	1	58.42	1.00	.151*
Error	488.11	87	42.20		
Total	3215.38	88			

*Not Significant

As shown in table 4, there was no significant difference in mean retention scores of male and female students taught Chemistry using improvised instructional materials and those taught with standard instructional material, $F(1,101) = 1.38$, $P = .242$ and F(1,87)=1.00, P=.151 , since the obtained *p*-value of .242 was greater than 0.05 level of significance in IIM and p-value of .151 was greater than 0.05 level of significance in SIM; The null hypothesis which indicated that there was no significant difference in the mean retention scores of male and female students taught Chemistry using improvised instructional materials and those taught using standard instructional material was not rejected. Though the male students obtained higher mean score than the female students was not high to be significant difference. This implies that both male and female students retained equally when taught with both instructional materials.

Discussion

The findings of the study showed that students taught Chemistry with improvised inst2ructional materials showed higher retention than when compared with those taught with standard instructional materials. The result showed a statistically significant difference in retention between the two groups in favour of improvised instructional material. This result is in conformity with the findings of Engida (2012) reported that Chemistry students taught using impr2ovised instructional materials performed excellently well and retained what they had been taught more students taught using standard instructional material in Kogi state. The result is also in line with Attah (2014) who revealed that there was a significant difference between retention scores of students taught science subjects with improvised instructional materials when compared with those taught with standard instructional materials in Nsukka in favour of students taught with improvised instructional material. The high retention in Chemistry students from improvised instructional material group could be as a result of originality of the materials used in teaching the students. It could also be that the students were able to identify the local materials used in constructing or developing the instructional materials which help the students to assimilate and retained the Chemistry concept easily.

The finding of the study also showed that there was no significant difference in mean retention scores of male and female students taught Chemistry using improvised instructional materials and those taught with standard instructional material. This result is in consonance

with Ibrahim (2012) who observed that there was no significant difference in the mean retention between male and female students taught Biology using improvised instructional material and those taught with standard instructional materials in northern Kaduna. The result of no significant difference in both instructional material groups could be as a result of the ability of male and female Chemistry students to comprehending and making use of instructional material giving to them not minding if it improvised or standard instructional material which lead to high and equall retention not minding the gender.

Based on the findings of this study, the following conclusions were drawn: the use of improvised instructional material enhances students' retention than improvised instructional material. Also gender has no influence in academic retention of students when taught Chemistry with improvised instructional strategy and standard instructional strategy

Recommendations

The following recommendations are made in the light of the findings of the study:

1. School administrators should also provide financial support for the acquisition of the materials from which improvised instructional materials can be made since they are cheap and readily available.
2. Chemistry teachers to be resourceful in materials selection and planning.
3. Chemistry teachers should seek individual knowledge on how they can convert local materials in their immediate environment as alternatives to standard materials needed for 2Chemistry instructions.

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COMPARATIVE EFFECTIVENESS OF MATHEMATICS AND BIOLOGY TEACHERS' LESSON STUDY ON STUDENTS' ACADEMIC PERFORMANCE

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Abstract

Teachers collaboratively working to develop and execute classroom instructions until it has been fine-tuned to the greatest extent possible while also collecting data on how well the lessons performs is critical to improving students' performance. This study focused on the comparative effectiveness of mathematics and biology teachers' lesson study on students' academic performance. The research design used in the study is quasi-experimental design of the pretest and posttest control group. A sample of 102 senior secondary school students and 10 (5 mathematics and 5 biology) teachers were selected from two secondary schools in Ekiti State Nigeria. The two schools were purposively selected; the school selected must have more than four mathematics and four biology teachers. The intact classes of the selected schools were used in the study. Three research instruments were used for data collection namely; Mathematics Performance Test (MPT), Biology Performance Test (BPT) and Lesson Study Inventory (LSI). Kudar-Richardson 20 (KR-20) was used to determine the reliability coefficient of the MPT and BPT after administering it to 20 students outside the study area. The analysis yielded a reliability coefficient of 0.741 and 0.796 for MPT and BPT respectively. The MPT and BPT were administered to the students as a pretest before the treatment and as a posttest after the treatment, while data was collected from the instruments. Mean, standard deviation and bar charts, t-test, Analysis of Covariance (ANCOVA) and Estimated Marginal Means (EMM) were used to analyze the data collected. The study revealed that teachers' lesson study significantly affect the students' mathematics performance ($F(2, 99) = 185.915$; $p<0.05$); teachers' lesson study significantly affect the students' biology performance ($F(2, 99) = 616.335$; $p<0.05$); there was a significant difference between the academic performance of students whose teachers engage in lesson study in mathematics and biology ($t = 12.562$; $df = 90$; $P < 0.05$) in favour of biology. It was recommended that mathematics and biology teachers should regularly engage in lesson study over a long period.

Keywords: Lesson study, professional development, Mathematics, Biology, performance

Introduction

The teachers are ultimately accountable for transforming policy into actions and principles based on practice through their interactions with the students. Teachers are essential to both the process of passing on knowledge and the quality of students' understanding of concepts of science and mathematics. There is no use in having a well-developed and comprehensive curriculum if it cannot be put into practice; the teachers are directly responsible for its implementation. The limit to the success of using a curriculum depends on the calibre of the teacher and what they do during classroom instructions.

The knowledge acquired during the teacher education programme cannot adequately take a teacher through an active teaching career if such a teacher desires to be effective in knowledge transmission. Individual growth within the context of one's professional function is considered part of the broader concept of "professional development". Teachers' professional progress or growth is consequential to increased experience and methodical evaluation of their own teaching. It is very essential to get both formal and informal experiences to advance one's career. Formal experiences include things like attending workshops, seminars and conferences, as well as more casual ones like reading academic journals and viewing movies about the field (Yuen, 2012; Ganser, 2000). People often think of teachers as reflective practitioners who join the field with a certain foundation of knowledge and then build on that foundation to learn and grow in their expertise. The goal of professional development is to assist educators in the creation of new educational techniques as well as in the growth of their competence (Dodds, 2001). Professional development for teachers may be broken down into two basic categories: initial preparation and continuing developmental growth. Colleges of education and universities provide full-time residential pre-service programs for intending teachers. Unqualified teachers may also have access to initial training via online education, 'out-of-school' programs during holidays or when they are released from schools for lengthy periods (McMahonand Hines,2008).

The practice of evaluating a teacher's content and pedagogical levels in a teaching/learning setting is known as lesson study. In many cases, teachers use this method by observing colleagues. To help teachers improve their lesson plans and their knowledge of student learning, this model of professional development has been developed and implemented. Other professional development programs for teachers cannot be compared to lesson study. Most teacher professional development is done in a way that encourages teachers to sit back and take notes, rather than actively participating in the learning process. In the end, lesson study is not about preparing and delivering a great lecture. Lesson study is a kind of teacher-led professional development in which educators review and revise their own methods for teaching and learning (Yoshida, 2005). Unlike other forms of teacher cooperation, lesson study provides a logical and seamless way to produce courses to help students learn more quickly and efficiently. Even in the classrooms itself, teachers collaborate with one other to

watch and assess how students are functioning. Teachers use their classrooms as a laboratory to continually enhance their teaching and learning methods.

A lesson study is an in-school teacher education technique that includes pre-collaborative work among teachers, lesson observations, and post-collaborative work (Lewis et al., 2012). Incorporating peer-to-peer professional learning is a powerful method. Teachers and other educators must work together to improve a specific lesson until it has been honed to the maximum extent feasible and then teach it to get strong data about how effectively the lesson performs. After the lesson has been presented, the teacher (who may or may not be a member of the lesson study group) will reflect on the lesson and the other members of the lesson study group will contribute information they obtained during the session. According to Lewis (2000), there are two options available for lesson study groups: the group may either use the field-tested lesson as it is or use what they've learnt in the process for another lesson.

There are four processes involved in Lesson Study in practice: reviewing curriculum and objectives, planning lessons, executing lesson study, and reflecting on observations. With the help of a team of teachers from the same subject area, these phases are accomplished (Lewis & Hurd, 2011).

Figure 1: Teachers' Lesson Study Cycle

The review of the curriculum and objectives to be achieved for the selected topic comes first. This is followed by planning how to execute the lesson; getting all the needed resources. In the third stage, the lesson is executed and during this period observations about the activities that are taking place in the classroom are recorded by the observing teachers. In the fourth stage, the teachers in the team reflect on the lesson stressing out the strength and the

weaknesses as noted by the observing teacher, this is done to improve on the next lesson. This process keeps going on in a cycleto always have a productive presentation of the lesson.

Popoola and Falebita (2016) noted that teacher lesson studies begin with a teacher's preparation for teaching a certain subject and suggestions for teaching are offered by other teachers; this always focuses on the availability of a lesson note, the declaration of lesson objectives, and the organization of information. Another thing to think about while doing a lesson study is how to deliver the contentlogically and sequentially. Inquiry into how well a lesson is set up, how well it is presented and how well students participate are all part of this evaluation. Other factors considered are the quality of the teaching aid, the topic's relevance to the teaching aid, how well students participate and how well the teacher manages time. The teacher's class management is examined in terms of class organization, class layout, and the teacher's ability to recognize and respond to class issues. As part of a teacher's lesson study, the effectiveness of a lesson's evaluation, summary, and follow-up assignment are all assessed. After looking at teachers'appearance (clothing, neatness), motivation to teach, em2otional stability and confidence, the lesson study of teachers also looked into the teacher's personality/professional views and values.

Lesson study provides several advantages, according to various researchers. Lewis, Perry, Foster, Hurd and Fisher (2011) discovered that teachers who participated in lesson study groups were able to "produce broad, sustainable progress" in their teaching approaches. Both inexperienced and experienced teachers benefited from lesson study. To plan a successful class and gather data on students' learning throughout the session, "all participants, regardless of their degree of skill," work together (Lewis et al., 2011). At the end of their research, they concluded that lesson study has the capacity to advance the education profession beyond conventional hierarchical conceptions of coaching and leadership toward a paradigm that both demands and encourages lifelong learning by all participants, from newbie teachers to seasoned leaders of professional learning. Re-teaching a lesson after reflecting on it has been shown in other research to improve teachers' attention to students' thoughts, challenges, and capabilities (Robinson &Leikin, 2011).

In order to better serve students and teachers alike, lesson study is an essential part of professional development (Yoshida, 2005). According to Yoshida (2005), lesson study has played a major influence in altering teaching and improving student learning. According to Lewis (2002), lesson study has had a significant role in fostering educational innovation. According to Matura (2011), it has also helped teachers build a better knowledge of the topic and students' thinking.Popoola and Falebita (2016) found teachers' lesson study to significantly improve students' academic performance in mathematics. According to Lewis (2002),lesson study of teachers improves students' success on achievement tests.According to Ylonen and Norwich (2012), the teaching-learning process improves greatly when teachers engage in lesson study while the performance of students in science also improves. During lesson study, teachers can collaborate to find solutions to learning-related issues, which suggest that student learning outcomes could be significantly enhanced.

Mathematics is important not just because of its contributions to the advancement of science and technology, but also because it is used by both educated and illiterate members of society in their day-to-day interactions. Secondary school students are obliged to take it because of its importance for academic advancement.A lot of students at Nigerian tertiary institutions arenot able to pursue their original choices of courses since they didn't get the requisite SSCE mathematics grade.In addition to being a necessary and compulsory school subject, mathematics is also related to a greater number of academic and career chances (Popoola, 2014).Popoola (2008) argues that different conceptions of Mathematics influence how society views Mathematics. She further stressed that mathematics is perceived by students as 2abstract with little area of application and relevance to an individual's life. Students perceived mathematics to be more difficult than any other science subject and between the sciences subjects, the more mathematics or calculations involved in the subject the more difficult they are perceived (Popoola, 2008).

Biology is a natural science field that focuses on the study of predominantly living things. It is a natural science subject that primarily investigates living things. Biology is also concerned with the structures, functions, development, origin, evolution, distribution, interrelationships, and adaptations of living creatures, among other aspects of their existence. For example, biochemistry may be combined with biology and chemical sciences, astrobiological sciences can be combined with biology and astronomy, and astronomy can be combined with other disciplines.At the secondary school level, biology is supposed to be taught in such a manner that it helps students investigate and understand living and non-living things (Ayeni, 2016). This is expected to enhance their academic performance in both internal and external examinations. According to Ayeni (2016), teachers of biology are required to use effective instructional practices in the classroom to enhance students' performance.

Educators of mathematics and biology need to look for and get involved in ways to equip themselves with shared experiences that will help them construct more systematic pictures of improvements in mathematics and biology education. It appears that severalmathematics and biology teachers do not plan their lessons and those who do tend to be teacher-centred rather than student-centred in their approach to finding effective teaching strategies, instructional materials, and teaching approaches that help their students grasp the concepts they are trying to teach.

Statement of the problem

The connection between students' performance and the teacher has been established by various researches. Researchers have been able to link the poor performance of students in Biology and mathematics back to their teachers. Many students' poor results on their Senior Secondary School Certificate Examinations have been blamed on ineffective classroom management techniques adopted by the teachers. This is a situation where students perform

poorly because of poor planning and instructional materials, avoidance of the teaching of certain topics that are perceived as difficult, and a poor attitude towards mathematics and science among teachers and students.

When it comes to student performance in senior school certificate examinations, little or no progress has been made over the years, particularly in mathematics and biology. Poor performance in Nigerian secondary school mathematics and biology appear not to have been addressed, despite the efforts of stakeholders to promote the teaching of mathematics and science in schools (e.g., seminars and workshops), as well as curricular innovations.It generally appears that most secondary school students see mathematics and science as a problematic or abstract concept. Educators not working together to develop an effective method of teaching mathematics might be blamed for this. Therefore, bringing teachers together to plan, execute, observe and review lessons is critical to gaining experience from one another as the teaching-learning process improves.

Purpose of the study

The main objective of the study is to compare the effectiveness of Mathematics and Biology Teachers' Lesson study on students' academic performance. Specifically, the study examined the;

1. Effect of mathematics teachers' lesson study on students' academic performance
2. Effect of Biology teachers' lesson study on students' academic performance
3. Difference between the academic performance of students whose teachers engage in 2lesson study mathematics and biology

Research Question

1. What is the difference in the performance of students in mathematics and biology when their teachers engage in lesson study?

Hypotheses

1. There is no significant effect of mathematics teachers' lesson study on students' academic performance
2. There is no significant effect of Biology teachers' lesson study on students' academic performance
3. There is no significant difference between the academic performance of students whose teachers engage in lesson study in mathematics and biology

Methods

The research design adopted for this study is a quasi-experimental design that employed a pre-test, post-test, control group design. The experimental group was exposed to Teacher Lesson Study while the control group was exposed to the conventional teaching method. The population consisted of Senior Secondary School Two (SSS II) students, and Mathematics and biology teachers from public secondary schools in Ekiti State. The sample for this study was102 Senior Secondary School Two (SSS II) students and 10(5 mathematics and 5 biology) teachers randomly selected from two Secondary Schools in Ekiti State.The two

schools were purposively selected; the school selected must have more than four mathematics and four biology teachers who can collaboratively engage in lesson study. The intact classes of the selected schools were used in the study.

Three research instruments were used for data collection. These include the Mathematics Performance Test (MPT), Biology Performance Test (BPT) and Lesson Study Inventory (LSI). The MPT and BPT consisted of two sections (A and B); section A sought the demographical information of the students while section B consisted of 30 multiple choice questions optioned A to D adopted from the WAEC past questions, based on the topics taught in the study. The LSI is the instrument used by the observing teachers to take the inventory of the activities carried out during the execution of the lesson study which is later used to discuss, plan, and prepare for subsequent lessons. WAEC examiners assisted in ensuring the face and content validity of the MPT and BPT. The MPT and BPT were administered to 20 students outside the study area, and the data gathered from their responses were analysed using Kudar-Richardson 20 (KR-20) to determine the reliability coefficient of the instruments. The analysis yielded a reliability coefficient of 0.741 and 0.796 for MPT and BPT respectively.

Procedure

At the pre-treatment stage, the MPT and BPT were administered to the students in both the experimental and the control groups as the pretest. The teachers in the lesson study group were trained on how to plan, prepare and observe the lesson using the LSI. They were also trained on how to discuss the outcome of the lesson with the aid of the LSI in order to improve the subsequent lessons. This lasted for a week. At the treatment stage, the experimental group was exposed to lesson study while the control group was exposed to the conventional teaching method; both groups were taught the same academic content for six weeks. After six weeks of administering the treatment, the MPT and BPT were administered to the experimental and the control group after rearranging the options of the questions as a posttest. The data (scores) gathered from the pretest and posttest were analysed using mean, standard deviation, ANCOVA, t-test and estimated marginal mean. The hypotheses were tested at a 0.05 level of significance.

Results

Research Question One*:* What is the difference in the performance of students in mathematics and biology when their teachers engage in lesson study?

Table 1:

Students' Performance Means Score Difference Between Mathematics And Biology Teachers' Lesson Study Groups

Teachers Lesson Study	N	Pretest	Posttest	Mean Gain	SD	Mean Difference
Mathematics	46	4.37	19.43	15.06	1.99	4.87
Biology	46	8.02	24.30	16.28	1.72	

Table 1 shows a performance score of 19.4348 and 24.3043 for students in mathematics and biology whose teachers engage in lesson study, while the standard deviations also show 1.9850 and 1.7239 respectively. The difference between the students' performance mean scores in mathematics and biology when their teachers engage in lesson study is 4.8695.

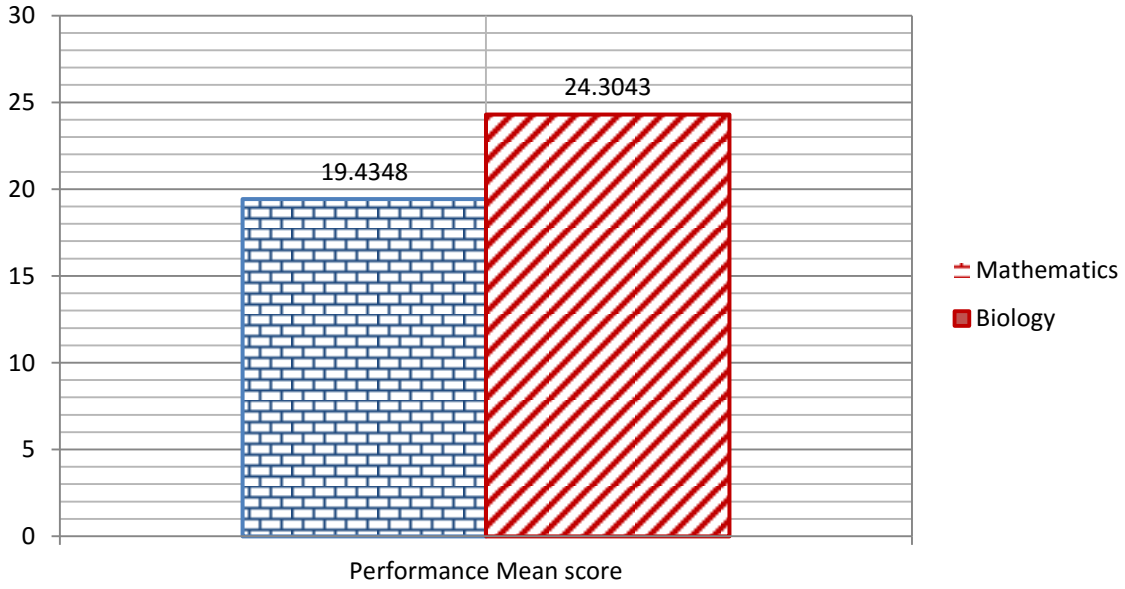

Figure 2: Students' Performance scores in Mathematics and Biology

The chart in Figure 2 showed the performance mean score of students in Mathematics and Biology when their teachers engage in lesson study. This further supports the results in Table 1.

Hypothesis one: There is no significant effect of mathematics teachers' lesson study on students' academic performance.

In determining teachers' lesson study effect on the mathematics performance of students, ANCOVA statistics was used to analyze the pretest and posttest scores of the students and the result is as presented in Table 2.

Table 2:
Analysis of Covariance (ANCOVA) of Mathematics Performance of Students exposed to Teacher's Lesson Study

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1129.105[a]	2	564.553	92.958	.000
Intercept	2906.078	1	2906.078	478.508	.000
PRE_MPT	.557	1	.557	.092	.763
GROUP	1129.100	1	1129.100	185.915	.000
Error	601.248	99	6.073		
Total	27080.000	102			

Corrected Total	1730.353	101

a. R Squared = .653 (Adjusted R Squared = .646)

Table 2 shows that the group were homogenous before the commencement of the experiment (F=0.092 and p=0.763). The table also indicates that teachers' lesson study significantlyaffects the students' mathematics performance (F(2, 99) = 185.915; p<0.05). Hence, hypothesis 1 is rejected. This implies that there is a significant effect of mathematics teachers' lesson study on students' academic performance.

Also, to determine the magnitude of the mean scores of students in the Mathematics Teacher Lesson Study(MTLS) and control groups, Estimated Marginal Mean (EMM) was used,Table 3 shows the result.

Table 3:

Estimated Marginal Mean of Students' Mathematics Performance

			95% Confidence Interval	
GROUP	Mean	Std. Error	Lower Bound	Upper Bound
Conventional	12.748[a]	.329	12.095	13.402
MTLS	19.437[a]	.363	18.716	20.158

a. Covariates appearing in the model are evaluated at the following values: PRE_MPT = 4.4118.

As presented in Table 3, the Estimated Marginal Mean (EMM) of students' mathematics performance in the MTLS and conventional group are 19.437 and 12.748 respectively; this is an indication that MTLS group has a higher EMM than the conventional group. This implies that mathematics teachers' lesson study contributes immensely to the difference in the academic performance of students between the BTLS and conventional groups in mathematics.

Hypothesis two: There is no significant effect of Biology teachers' lesson study on students' academic performance

To determine the effect of teachers' lesson study on the performance of students in biology, the ANCOVA statistics were used to analyze the pretest and posttest scores of the students and the result is as presented in Table 4.

Table 4:

Analysis of Covariance (ANCOVA) of Biology Performance of Students Exposed to Teacher's Lesson Study

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1611.189[a]	2	805.595	332.054	.000
Intercept	818.025	1	818.025	337.178	.000
PRE_BPT	1.770	1	1.770	.730	.395
GROUP	1495.287	1	1495.287	616.335	.000
Error	240.183	99	2.426		
Total	42332.000	102			
Corrected Total	1851.373	101			

a. R Squared = .870 (Adjusted R Squared = .868)

It is shown in Table 4 that the group were homogenous before the initiation of the treatment (F=0.730 and p=0.395). The table also indicates that teachers' lesson study significantly affects the students' biology performance (F(2, 99) = 616.335; p<0.05). Hence, hypothesis 2 is rejected. This implies that there is a significant effect of biology teachers' lesson study on students' academic performance Also, to determine the magnitude of the mean scores of students in the Biology Teacher Lesson Study (BTLS) and control groups, Estimated Marginal Mean (EMM) was used, Table 5presents the result.

Table 5: 2
Estimated Marginal Mean of Students' Performance In Biology

			95% Confidence Interval	
GROUP	Mean	Std. Error	Lower Bound	Upper Bound
Conventional	16.350[a]	.211	15.932	16.769
BTLS	24.269[a]	.233	23.806	24.732

a. Covariates appearing in the model are evaluated at the following values: PRE_BPT = 7.7157.

Table 5 shows the Estimated Marginal Mean (EMM) of students' performance in Biology in the BTLS and conventional groups are 24.269 and 16.350 respectively; it is an indication that BTLS group has a higher EEM than the conventional group. This implies that biology teachers' lesson study contributes immensely to the difference in academic performance of students between the BTLS and conventional group in Biology.

Hypothesis three: There is no significant difference between the academic performance students whose teachers engage in lesson study in mathematics and biology.

Table 6:
t-test Comparison of the Mathematics Interest Mean Scores of Male and Female Students

SUBJECT	N	Mean	SD	Df	t-value	p
Mathematics	46	19.4348	1.9850	90	12.562	.000
Biology	46	24.3043	1.7239			

According to table 6, students in the mathematics teachers' lesson study hada mathematics performance mean score of 19.4348 and a standard deviation of 1.9850 while the biology teachers' lesson study had a biology performance mean score of 24.3043 and a standard deviation of 1.7239. The table revealed a t-test significant result at 0.05 significant level: (t = 12.562; df = 90; P < 0.05). Hypothesis 3 is therefore rejected. This shows that there was a significant difference between the academic performance of students whose teachers engage in lesson study in mathematics and biology.

Discussion

The result from the study indicated that there is a significant effect of mathematics teachers' lesson study on students' academic performance. This is an indication that when teachers

collaboratively work together to engage in lesson study by planning the lessons together, where the concept that is not clear or difficult can be explained or solved together; lessons' delivery ca2n be observed to identify the strength and weaknesses of the teaching method, instructional materials used, classroom management among others to improve on the subsequent lessons, students' performance is enhanced. Teachers reflect on a lesson and re-teach to give adequate attention to students' needs. This agrees with the opinion of Robinson and Leikin (2012), that re-teaching a lesson after reflecting on it improves teachers' attention to students' thoughts, challenges, and capabilities. The finding is also in line with that of Lewis (2002) who revealed that there is a significant improvement to student performance on Mathematics achievement tests under the lesson study.

The study also found a significant effect of biology teachers' lesson study on students' academic performance. This is an indication that teachers' lesson study has the potency of 2improving the teaching and learning of sciences particularly biology and invariably improve the academic performance of students. This concurs with the findings of Matura (2011) and Ylonen and Norwich (2012) who all at different times found that the performance of students in science greatly improves when the teachers engage in lesson study.

The finding of the study revealed that there was a significant difference between the academic performance of students whose teachers engage in lesson study in mathematics and biology. The finding shows that the students had higher performance mean scores in biology than mathematics. This could be an indication that the students find biology more interesting than mathematics. This could also own to the abstract nature of mathematics. This agrees with the opinion of Popoola (2008) who revealed that students perceived mathematics to be more difficult than any other science subject and between the science subjects, the more mathematics or calculations involved in the subject the more difficult they are perceived.

Conclusion

Teachers' Lesson Study is effective in bringing improvement to every lesson, enhancing the effectiveness of the teacher and bringing about general professional development in the teacher. It was concluded in this study that mathematics teachers' lesson study improves the academic performance of students. Also, the biology teachers' lesson study greatly improves the performance of students in biology. It was also concluded that the biology teachers' lesson study is more effective in improving students' performance than the mathematic teachers' lesson study.

Recommendations

Based on the finding of this study, it is hereby recommended that the;

1. Mathematics and biology teachers should engage in lesson study for a long period; at least a period of one academic session.
2. Mathematics teachers should look into students' attitudes towards mathematics while involved in lesson study so that it can be improved.

3. Mathematics and science teachers should regularly attend seminars, workshops or training that focus on lesson study to be more skilful in the implementation of lesson study.
4. Education policymakers should make policies that give room for the adoption of lesson study by mathematics and science teachers. Government officials and school administrators should monitor the implementation of teacher lesson study in schools.

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EFFECTS OF BRAINSTORMING AND THINK-PAIR-SHARE INSTRUCTIONAL STRATEGIES ON SECONDARY SCHOOL STUDENTS ACHIEVEMENT IN BIOLOGY IN AWKA EDUCATION ZONE

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ABSTRACT

The study investigated the effects of brainstorming and Think-pair-share instructional strategies on secondary school students' achievement in Biology in Awka Education Zone. Three research questions guided the study and three hypotheses were tested at 0.05 alpha level of significance. A quasi- experimental design using 3×2 factorial was adopted, specifically the pretest-posttest non-equivalent control group was used. Population of the study was 4023 SS 2 students offering Biology for 2019/2020 academic section in the zone. A sample of 139 SS2 Biology students from three schools obtained using purposive and random sampling were involved in the study. The instrument used for data collection was Biology Achievement Test (BAT), validated by two lecturers in Departments of Science Education and Educational Foundations of Nnamdi Azikiwe University, Awka and one experienced secondary school Biology teacher. Reliability was established using Kuder Richardson 21(KR-21) for BAT which yielded coefficient of 0.71. The two experimental groups were taught using Brainstorming and think-pair-share instructional strategies respectively while the control group was taught using conventional strategy. This treatment lasted for six weeks. The students were given pretest, posttest and delayed posttest after two weeks of treatment. The data collected were analysed using mean and standard deviation to answer the research questions while analysis of covariance was used to test the null hypotheses. Findings of the study revealed that there was significant differences in the mean academic achievement scores of students taught using brainstorming and think-pair-share strategies than those taught using conventional strategy, but had no significant effect on male and female students. It was recommended among others that seminars, workshops and conferences should be organized by school heads to orient Biology teachers on how to use brainstorming and think-pair-share instructional strategies in teaching.

Keywords: Biology, Brainstorming, Think Pair Share, Achievement

Introduction

The massive growth in technology and scientific outburst is posing great pressure on the education system. The advancement of any nation depends to a large extent on the rate of her scientific and technological development especially in developing countries like Nigeria. Prior to this, the education system of Nigeria should be based on science and technology development because the future of any nation depends on her ability to provide science and technology products to outside world (Ogunyebi, 2018). According to Obikezie, Okpala and Amobi (2022) science is seen as a body of knowledge, a way of investigation and thinking in pursuit of an understanding of nature. The authors further stated that science is studied in school as science which plays a vital role in the lives of individuals and the development of a nation. Obikezie and Abumchukwu (2021) stated that sciences in senior secondary schools are done in three major subjects namely 2Biology, Chemistry and Physics.

Biology as a science subject describes how living organism carry out their life activities and how they interact with their environment (Obialor, Ezeobi & Ezenwabuchili, 2020). It is the study of living things which includes plants and animals (Michael, 2015). Biology curriculum is designed to continue students' investigation into natural phenomena, deepening their understanding into biological science and also encourage their ability to apply scientific knowledge to everyday life because of its importance to humanity. Biology also helps the individual to understand himself, his/her environment, appreciate the nature and also control environmental pollution. It exposes man on how to maintain good health through clean water, clean air, good hygiene and sanitation, balanced diet, vaccination against infection diseases, exercise and adequate rest (Obialor, 2016). Despite all these importance of Biology to humanity, the achievement of secondary school students in Biology in West African Examination Council showed poor achievement in more than a decade.

According to Ogbaga (2022) the percentage results of secondary school Biology students that got $C_6 – A_1$ in the subject from 2007 to 2018 are as follows; 2007 = 33.37%, 2008 = 33.97%, 2009 = 33.87%, 2010 = 32.88%, 2011= 38.5%, 2012 = 35.66%, 2013= 51.76%, 2014= 56.17%, 2015 = 257.42%, 2016=61%, 2017 = 41.11% and 2018= 39.11%. From the results above it could be observed that out of twelve years, students that enrolled for Biology subject where able to have above average in grade $C_6 – A_1$ in year 2013, 2014, 2015 and 2016 respectively in the subject while other eight years where below average. This shows that students that got admission in science related areas especially in medicine and other medical fields in various higher institutions in the country were small because no institution admits students that got below C_6 in any medical department in Nigeria (Ogbaga, 2022). Similarly, according to West African Examination Council Chief examiners' reports from year 2007 to 2018, individually all there reports are centered on the weaknesses of students in these areas of Biology concepts which includes (i) poor performance in ques8tions that require application knowledge (ii) inability to identify the samples skeleton parts (iii) poor knowledge in cell structure and functions of the cell (iv) poor knowledge in forms in which living cell exist (v) Basic ecological concepts,

Ecosystem: components and sizes, (vi) Local biotic communities or biomes: tropical rain forest, Northern guinea savanna, Sahel, desert, (vii) Population studies by sampling method: population size, dominance, density, factors that affect population (viii) inability to indentify concept in ecological factors: aquatic, terrestrial and factors common to all habitats (ix) transport system (Blood circulation) (x) respiration and (xi) respiratory mechanism in man. One could be imagining while WAEC Chief Examiners' are reporting weaknesses in this Biology concepts every year from 2007 to 2018. The question now is what could be the causes of these under achievement in grade and weaknesses among secondary school Biology students in the subject for these twelve years?

Osuafor and Ogbaga (2016) opined that the major causes of under achievement and weaknesses of secondary sch2ool Biology students in senior secondary school examination is lack of innovative instructional strategy in teaching the students. The authors stated that innovative instructional strategies like brainstorming and think-pair-share can help to improve the achievement of secondary school students in science related subject especially in Biology. Brainstorming involves thinking freely without restriction hence guided by the following rules according to Dehghan (2013): Withhold criticism within the session, Focus on the number of ideas generated by its group or individual members, Documentation of ideas generated. Combine and improve ideas. These rules help it to be more effective when used (Dehghan, 2013). Jacob, Johnson & Smith (2016) opined that brainstorming encourages learner to express their suggestion or ideas quickly and easily without much processed thought or reflection. Osuafor and Ogbaga (2016) revealed that nominal group in technique NGT of brainstorming was effective in enhancing students' achievement and interest in Biology, but had no significant effect on male and female students. Based on the findings, the researchers concluded that brainstorming is effective in improving students' achievement in Biology. Bilal-Adel (2012) observed that there are statistical significant differences at the level of ($\alpha = 0.05$) between the experimental group and the control group in the total score and the sub scores of the creative thinking in the favor of the experimental group indicating the effectiveness of using brainstorming strategy in developing creative thinking skills. Owo, Idode & Ikwut (2016) revealed there was a statistically significant difference in both mean knowledge and mean academic performance in favour of the brainstorming group and there was no statistically significant difference in the mean academic achievement of male and female students taught Biology using brainstorming instructional strategy

On other hand Think-Pair-Share (TPS) strategy is one of the group discussion strategies and diverse method of learning collaboratively. This strategy was developed by Frank Lyman in 1981. Andrew and Alexandra, (2015) defined think-pair-share as a cooperative learning strategy that encourages students to work toge8ther to solve problems or answer questions on an assigned topic. TPS is used to keep all students actively involved in class discussion and provides an opportunity for everyone to share their idea and answer to every question posed by the teacher. Some researchers believed that think pair share effectively enhances students' achievement in

science subject and in Biology most importantly. According to Ogunyebi (2018) who observed that there was a significant difference between the posttest means scores of students exposed to think-pair share and conventional strategies. The researcher revealed that there was no significant differen2ce between the posttest means scores of male and female students exposed to think-pair and conventional strategies. Bamiro (2015) observed that students taught with guided discovery and think-pair-share strategies obtained significantly higher posttest mean scores than those in the lecture strategy, $F(4,223) = 51.66$, $p < .05$. The researcher concluded that the use of guided discovery and think-pair-share strategies had great potential for improving achievement in Chemistry and other science subjects like Biology.

Most of the study studies reviewed where done under other science subject areas that are not Biology. Biology is seen by science educators to be one of the important science subjects as it cuts across several disciplines. However, despite its importance and usefulness, the achievement of Biology students at senior secondary school level has been below average. The evidence of poor and below average results is shown by the WAEC chief examiner's report (2007-2018) were only four years out twelve years can boost of crossing 50% of grade point $C_6 – A_1$ which is the only acceptable grade to be admitted in any Nigeria university to study medicine other medical related courses. One of the major contributing factors to this ugly state of learning as revealed by most studies and WAEC chief examiner's report is the teachers' instructional strategy of instruction. The conventional instructional strategies adopted by most Biology teachers fail to help students make connections between what is learnt and the real. The resultant effect is further decline in academic achievement after learning Biology. Brainstorming and TPS instructional strategies have been found effective in improving students' achievement of learning materials in some subjects like Mathematics, Chemistry, Nutrition science, Computer science and Integrated Science but no such study known to the researchers has been carried out in Biology. The need therefore arose to determine the effects of brainstorming and TPS instructional strategies on students' achievement in Biology in Awka Education zone of Anambra State.

Purpose of the Study

This study determined the effects of brainstorming and Think-pair-share strategies on secondary school students' achievement in Biology in Awka education zone. Specifically, the study determined the;

1. Difference in the mean achievement scores of three groups of students taught Biology using brainstorming strategy, think-pair-share (TPS) strategy and those taught using conventional strategy.

2. Difference in the mean achievement scores of male and female students taught Biology using brainstorming strategy.

3. Difference in the mean achievement scores of male and female students taught Biology using TPS strategy.

Research Questions

The following three research questions guided this study;

1. What is the d2ifference in the mean achievement scores of three groups of students taught Biology using brainstorming strategy, think-pair-share (TPS) strategy and those taught using lecture instructional strategy?

2. What is the difference in the mean achievement scores of male and female students taught biology using brainstorming strategy?

3. What is the difference in the mean achievement scores of male and female stude8nts taught Biology using TPS strategy?

Hypotheses

The following null hypotheses were tested in this study at 0.05 alpha level of significance. They are2:

1. There is no significant difference in the mean achievement scores of three groups of students taught Biology using brainstorming, think-pair-share methods and that of those taught using lecture instructional strategy.

2. There is no significant difference in the mean achievement scores of male and female students taught Biology using brainstorming.
3. There is no significant difference in the mean achievement scores of male and female students taught Biology using TPS.

Methods

This study employed a quasi-experimental design that involves 3X2 factorial study. Quasi-experimental design is an experiment where a random assignment of subjects to experimental or control group is not possible (Nworgu, 2015). In this case, intact classes were used. The 3×2 factorial indicates the three levels of treatment (brainstorming, think-pair-share and conventional strategies) and two levels of gender (male and female). The sample consists of 139 SS 2 Biology students selected from Awka education zones. Multi-stage sampling technique was used to draw three co-educational public secondary schools from the sixty co-educational public secondary schools in Awka Education Zone. First, the co-educational was listed out according to locations. Secondly, three co-educational schools were purposively selected. The purpose of selection choice of school was based on coeducational to ensure a balanced representation of gender variable in study. Finally using three ballot papers representing each of the three schools,

one of the schools was used as the first experimental group , second one was used as the second experimental group, while and the third was used as control group. First School was assigned as the brainstorming (1st experimental group, 28 male and 26 female). Second was assigned as TPS (2nd experimental group, male 21 and female 25) and third was assigned as control group (20 male and 25 female) using flip of a coin. The study covered a period of five weeks. First week was for familiarizing visit and training of the Biology teachers in the selected schools who act as research assistants. First day of the second week was used to administer a pretest achievement test of the Biology students involved in the study. Second day of the second week was used to teach the Biology co2ncepts of transport system (Blood circulation), respiration and respiratory mechanism in man in three selected schools using brainstorming instructional strategy, TPS instructional strategy and control group using lecture instructional strategy for three weeks. The Biology teachers were given detailed information and instructions concerning the study. The teachers in the three groups used lesson plan prepared by the researchers for brainstorming, TPS and lecture instructional strategies. At the end of the fifth week, both experimental groups and control group was post tested base on what they are taught. Marks were awarded to each question prepared for both experiment test groups and control group achievement test which constituted twenty five (25) multiple choice questions. If all the questions were answered correctly by the student, his/she is entitled to hundred (100) marks that is four marks per questions. The pretest score as well as post test scores in two experimental groups and one control group in each sitting had 100 marks. The pre test scores were recorded as achievement of the students in the three groups. Post test scores were recorded also as achievement of the students when taught with brainstorming, TPS and lecture instructional strategies in the three groups.The instrument for data collection was designed by the researchers named Biology Achievement Test (BAT) which was adopted from West Africa Examination Council (WAEC) past questions from (June2007 -June 2018). The BAT was produced base on the Biology concept of transport system (Blood circulation), respiration and respiratory mechanism in man. To ensure the reliability of the instrument, the twenty five (25) objective achievement questions were administered on a group of twenty five students in Aguata education zone which is outside the place of study. The results were subjected to Kuder- Richardson 21 (KR-21). A mean coefficient of 0.71 was obtained indicating that the instrument was reliable. The date obtained from the pretest and post test were analyzed using mean, standard deviation for research questions and Analysis of Covariance (ANCOVA) to test the hypotheses.

Results

The result of this study was presented in line with the research questions and the hypotheses as follows.

Research Questions One: What is the difference in the mean achievement scores of three groups of students taught Biology using brainstorming strategy, think-pair-share (TPS) strategy and those taught using lecture instructional strategy?

Table 1: Mean and Standard Deviation of the Mean Achievement Scores among the Groups

		Pretest		Posttest		
Groups	N	Mean	SD	Mean	SD	Mean Gain
Brainstorming	48	47.08	10.48	61.33	11.03	14.25
Think-Pair-Share	46	44.00	9.03	63.30	11.94	19.30
Conventional	45	43.33	9.84	50.20	5.38	6.87

2

The result presented in Table 1 reveals the pretest and posttest mean achievement scores of the students taught Biology using think-pair share, brainstorming and conventional strategies. The pretests mean scores for the groups in the brainstorming, think-pair share, and conventional strategies are 47.08, 44.00, and 43.33 respectively. The posttest mean scores are 61.33, 63.30, and 50.20 respectively. The mean gain for the three groups are 14.25, 19.30, and 6.87 respectively, which depicts that the students in the think-pair share strategy have the highest mean achievement score, followed by those in the brainstorming strategy; while the students in the conventional method have the lowest mean achievement score.

Research Questions Two: What is the difference in the mean achievement scores of male and female students taught Biology using brainstorming strategy?

Table 2: Mean and Standard Deviation of the differences in the mean Achievement Scores of Students in the Brainstorming group based on Gender

		Pretest		Posttest		
Gender	N	Mean	SD	Mean	SD	Mean Gain
Male	28	47.14	12.29	61.93	12.43	14.79
Female	20	47.00	7.55	60.50	8.94	13.50

Table 2 reveals the mean pretest and posttest scores of the male and female students taught Biology with brainstorming methods. The pretest mean score for the male and female students in the group are 47.14 and 47.00 respectively. The posttest mean scores are 61.93 and 60.50 respectively. The mean gains for male and female students are 14.79 and 13.50 respectively. This

implies that the male students have higher mean achievement score than the female students in the brainstorming strategy.

Research Questions Three: What is the difference in the mean achievement scores of male and female students taught Biology using TPS strategy?

Table 3 :Mean and Standard Deviation of the differences in Pretest and Posttest Scores of Students in the Think-Pair-Share Group based on Gender

		Pretest		Posttest		
Gender	N	Mean	SD	Mean	SD	Mean Gain
Male	21	44.48	8.76	61.71	12.43	17.23
Female	25	43.60	9.42	64.64	11.59	21.04

Table 3 reveals the differences in the pretest and posttest mean scores of the male and female students taught Biology with think-pair-share instructional strategy. The pretest mean score for the male and female students in the group are 44.48 and 43.60 respectively; while the posttest m2ean scores are 61.71 and 64.64 respectively. The mean gain for male and female students are 17.23 and 21.04 respectively, which indicates that the female students have the higher mean achievement score than the male students taught Biology with think-pair share instructional strategy.

Hypothesis 1

There is no significant difference in the mean achievement scores of three groups of students taught Biology using brainstorming, think-pair-share methods and that of those taught using lecture instructional strategy.

Table 4: The ANCOVA Results of Achievement Scores among the Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4637.023[a]	3	1545.674	15.685	.000	.258
Intercept	18524.945	1	18524.945	187.982	.000	.582
Pretest	91.838	1	91.838	.932	.336	.007
G2roup	4402.099	2	2201.049	22.335	.000	.249

Error	13303.768	135	98.546
Total	491705.000	139	
Corrected Total	17940.791	138	

Data shown in Table 4 reveals the ANCOVA results on the effect of brainstorming, think-pair 8share and lecture strategies on students' academic achievement in Biology. The results show a significant difference F (2, 135) = 22.335, p = .000< .05, η^2_p = .249 in pretest and posttest mean scores of the students taught Biology with the three strategies. In all, the null hypothesis is rejected. The result shows that there is a significant difference in the effect of the three strategies on the students' academic achievement in Biology.

Hypothesis 2

There is no significant difference in the mean achievement scores of male and female students taught Biology using brainstorming.

Table 5

The ANCOVA Results of Mean Achievement Scores of Students in the Brainstorming Group based on Gender

So2urce	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	48.968[a]	2	24.484	.194	.824	.009
I8ntercept	7442.278	1	7442.278	59.111	.000	.568
BS Pretest	25.159	1	25.159	.200	.657	.004
BSGender	23.477	1	23.477	.186	.668	.004
Error	5665.698	45	125.904			
Total	186280.000	48				
Corrected Total	5714.667	47				

The data presented in Table 5 shows the ANCOVA results on the effect of brainstorming between male and female students in Biology. The results reveal no significant difference in the pretest and posttest mean scores of between the male and female students taught Biology with

brainstorming strategy $F(1, 45) = .186$, $p = .668 > .05$, $\eta^2_p = .004$. Therefore, the null hypothesis is not rejected. Hence, the result shows that there is no significant difference in the pretest and posttest mean cores be8tween male and female taught biology with brainstorming method

Hypothesis 3

There is no significant difference in the mean achievement scores of male and female students taught Biology using TPS.

Table 6: The ANCOVA Results of Mean Achievement Scores of Students in the Think-Pair Share Group based on Gender

Source	Typ8e III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	295.268[a]	2	147.634	1.038	.363	.046
Intercept	9773.396	1	9773.396	68.731	.000	.615
TPS Pretest	197.575	1	197.575	1.389	.245	.031
TPS Gender	84.375	1	84.375	.593	.445	.014
Error	6114.471	43	142.197			
Total	190752.000	46				
Corrected Total	6409.739	45				

The data presented in Table 6 shows the ANCOVA results on the effect of think-pair share strategy between male and female students in Biology. The results reveal no significant difference in the pretest and posttest mean scores of between the male and female students taught Biology with think-pair share strategy, $F(1, 43) = .593$, $p = .445 > .05$, $\eta^2_p = .014$. Therefore, the null hypothesis is not rejected. Hence, the result shows that there is no significant difference in the pretest and posttest mean cores between male and female taught Biology with think-pair share strategy.

Discussion

The result in table 1 shows that the students taught Biology using brainstorming and think-pair-share strategies achieved significantly better in Biology Achievement Test (BAT) than those

taught with conventional method. The difference may be as a result of the fact that both brainstorming and TPS provides an opportunity for students to take active role in building their own knowledge. This finding is in consonance with the research of Bilal-Adel (2012) who view brainstorming as a lateral thinking process by which students develop ideas or thoughts on solution to problems based on layout criteria. It may also be as a result of new useful ideas and creative thinking that the techniques bring to problems. The result from the lecture strategy suggested the need to also adopt other teaching strategies in addition that would likely develop adequate content understanding in Biology in our secondary schools. This implies that the students in the treatment groups have significant higher gain in their content understanding than those in the control group. Also, the ANCOVA analysis indicated that there is a significant difference between the treatment groups and control group. The findings of this study is not surprising because brainstorming and think-pair-share encourages students to move from one leve2l of understanding to another as they think out the solution to their problem. Hence, one would be in a position to say that the students taught using brainstorming and think-pair-share shifted in their level of understanding as they construct their own knowledge of Biology concepts.

The result of this study also indicated that gender is not significant difference in the performance of male and female students taught Biology using brainstorming. The finding is in line with some researchers' assertion who observed that there was no significant effect on male and female students when taught with brainstorming instructional strategy (Hidayanti et al 2018; Osuafor and Ogbaga 2016). While the mean gain score of males taught with brainstorming in this study is presenting a slight mean difference of 1.29 in favour of male student, the slight difference may be as a result level of interaction between the male while learning. But then, brainstorming has reduced the male domination to the barest minimum by encouraging equal participation.

The result of this research also shows that there is no significant difference in the performance of male and female students taught Biology using Think-pair-share. The finding is in consonance with Ogunyebi (2018) observation who revealed that there was no significant difference between the posttest means scores of male and female students exposed to think-pair and conventional strategies. Also the findings of this study is in line with that of Nwaubani et al (2016) who revealed that both the Think-pair-share (TPS) and student teams-achievement (STAD) significantly improved students' achievement in some subjects. While the mean gain score of males taught with TPS in this study is presenting a slight mean difference of 2.81 in favour of female students, the slight difference may be as a result level of interaction between the male while learning. But then, think-pair-share has reduced the male domination to the barest minimum by encouraging equal participation.

Conclusion

The findings of the study revealed that brainstorming and think-pair-share significantly improved achievement of students in Biology irrespective of gender. The conclusion is that both brainstorming and think-pair-share strategies are effective strategies for the teaching and learning of Biology concept. It can also be concluded that when Biology teachers adopt any or both strategies, student to student interaction increases thereby making students to take responsibility for their learning.

Recommendations

The researcher formulated the following recommendations based on the findings and conclusions made from the study.

1. Teachers should be encouraged by curriculum planners to employ brainstorming and think-pair-share more often in teaching and learning situation.
2. Higher Institutions involved in teacher education should help to propagate these instructional strategies so as to promote brainstorming and think-pair-share among the student-teachers of science
3. Curriculum planners and developers in science should include brainstorming and think-pair-share strategies in restructuring Biology curriculum in our secondary schools in order to help the students to be creative and retentive in learning.
4. Ministry of education should help teachers through seminars, conferences, support supervision and journal publication to improve their competencies in the use of brainstorming and think-pair-share strategies for effective teaching of Biology.
5. Teachers should direct the presentation of Biology lessons away from the traditional methods to a more students-centered approach like brainstorming and think-pair-share strategies.

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ACHIEVEMENT MOTIVATION AND SELF-CONCEPT AS PREDICTOR OF ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN BIOLOGY IN ANAMBRA

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Abstract

The study investigated Achievement motivation and self-concept as predictor of academic achievement of secondary school students in biology in Anambra state. Three research questions and three hypotheses guided the study. The correlational survey design was adopted for the study. The population of the study was 4,603 senior secondary school year two (SS2) biology students in Awka Education Zone. A sample of 720 SS2 biology students was involved in the study. The instrument for data collection were Achievement Motivation Scale (AMS) and Self-concept Questionnaire (SCQ) validated by three experts in Department of Science Education and Measurement and Evaluation. The student's achievement scores were obtained from school's biology student's diary. The reliability was established using Cronbach Alpha which yielded 0.713and 0.701 for achievement motivation scale and Self-concept Questionnaire respectively. The data were analyzed using Pearson Correlation Coefficients and multiple regressions. The findings of the study revealed achievement motivation and self-concept correlated students' academic achievement in biology significantly. The implication of the study was stressed. The study recommended that achievement motivation and self-concept should be enhanced by using appropriate teaching and counseling strategies.

Keywords: achievement motivation, academic achievement, self-concept, biology

Introduction

Education is no doubt the bedrock of human and national development. A nations' position in today's highly competitive global knowledge economy is directly dependent on the quality of its human capital this includes, the aggregate of skills and knowledge imparted to its citizen by its educational system (Adamu, 2017). The process of acquiring knowledge can be formal or informal. Informal education takes place in a natural setting like the home environment and it is the first type of education one is exposed to immediately after birth while formal education takes place in a consciously organized setting such as school with specified contents, objectives and skills. The relevance of education well emphasized and science oriented courses has identified biology as an important science subject towards the nations' development.

Biology has been identified as a very important subject and as a core subject taught at the secondary schools in Nigeria and prerequisite for medical field such as medicine, nursing and medical laboratory science. Biology is a natural science concerned with the study of life and living organism including the structure, function, growth, reproduction, metabolism, evolution, taxonomy and their interrelationship of all living and non-living things in our environment. Nwanguma (2011) viewed biology as the epicenter of most of all the studies in the faculties of science, health and technology. Biology is a mandatory subject for any medical science oriented course, thus it has development advancement as it concerns the field of forensic sciences, genetic engineering and medicine. Despite the importance of biology compared to other science subjects, it is very alarming to note that students' performance in the subject in both internal and external examination have continue to fluctuate over the years according to the West African Examination Council's Chief Examiners Report (2015-2019). This shows clearly that academic achievement of students' in biology has not improve, according to the percentile rating of biology students from 2015-2019 by the Chief Examiners report 57.42%, 61.68%, 55.57%, 55.10% and 55.63% respectively.

Academic achievement itself is the amount of knowledge derived from learning by the learners. Academic achievement is referred to be the observed and measured aspects of students' mastery of skills and subject contents as measured with valid and reliable test (Joe, Kpolovie, Osonwa & Iderima, 2014). It is the results of intellectual performance in schools and as an educational parameter. Academic achievement is said to be poor when the achievement falls below the expected standard (Hassan, Alasmari and Ahmed. 2015). On the other hand, an achievement that is equal to or above the standard expected of a student ca2n be termed high academic achievement. Answers (2010) stated that academic achievement is the ability to study and remember facts and being able to communicate ones' knowledge

either verbally or written on paper. In any school system, academic achievement is a priority to the student as well as the teacher. The teacher, students and the school administration must put effort to see that high academic achievement is attained. However, psychological attributes such as achievement motivation could play an important role in students' academic achievement in learning.

Achievement motivation as the drive to work with diligence and vitality, to constantly steer towards targets, to obtain dominance in challenging a difficult task and create a sense of achievement as a result (Muola, 2010). Achievement motivation is the motivation to engage achievement behaviors based on the need for achievement, expectancy of success and incentives values of success. Akpan and Umobong (2013) noted that achievement motivation is a force which encourages and stimulate the person for doing action to get success. A study carried out by Villa and Sebastian (2021) revealed that there was a significant relationship between achievement motivation and mathematics achievement also; achievement motivation was found to be the only predictor of mathematics achievement.

Mayers (2018) believes that individual who has low achievement motivation tend to choose tasks in which their probability of success is either very high or very low and by choosing this, the probability of their success in easy task is guaranteed, so that they avoid the feeling of failure of shame and remorse, they are not choosing the difficult task. While individuals with high achievement motivation are characterized by being able to compete in various circumstance, as well as bearing responsibility entrusted to them, and they expect their success to their personal effort compared to those with low achievement motivation and they put themselves in challenging situations, but within the limits of realistic and possible goals. Achievement motivation occurs within the mind of an individual, which when channeled into academic achievement produces a positive result and a feeling of one's self-concept.

Self-concept is a general term used to refer to ones' self. Self-concept is personal and every individual whether with special needs or not has concept which is usually as a result of the extent of cognitive development for adequate perception of self and one's interactions with his or her environment (Shrestha, 2014; Marshal, 2015). An individual physical and psychological well-being can be connected as fully taking ownership as a person. Shrestha (2014) observed that what we think of ourselves is greatly influenced by what others think of us and that, self-concept is built upon the social interaction with family, friend and society. Guay, Ratella, Soy and litalien (2010) in a study found that students who perceived themselves as academically competent obtained higher grades because their academic self2-concept led them to be more autonomously motivated at school. In another study carried out by Crawford (2013) found out in his study that student's self-concept influences their

academic performance; however, the level of effort exerted by students in learning to a large extent contributes significantly to students' self-concept in boosting their academic performance. The proximity of students obtaining a high academic achievement in biology could be attributed to some psychological variables (achievement motivation and self-concept). Studies have not showed how achievement motivation and self-concept may affect students' academic achievement in biology, thus this present study seeks to determine the extent psychological variable such as achievement motivation and self-concept can predict academic achievement of secondary school students in biology in Anambra state.

Purpose of the Study

The purpose of the study was to investigate Achievement motivation and self-concept as predictor of academic achievement in biology, specifically the study sought to determine,

1. Relationship between achievement motivation and academic achievement among senior secondary school students in biology in Anambra state.
2. Relationship between self-concept and academic achievement among senior secondary school students in biology in Anambra state.
3. The joint correlation between achievement motivation, self-concept and academic achievement of secondary school students' in biology.

Research Questions

The following research questions guided the study.

1. What is the relationship between achievement motivation and academic achievement among senior secondary school students in biology in Anambra state?
2. What is the relationship between self-concept and academic achievement among senior secondary school students in biology in Anambra state?
3. What is the relationship among achievement motivation, self-concept and academic achievement of secondary school students' in biology?

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. There is no significant relationship between achievement motivation and academic achievement in biology among senior secondary school students in Anambra state.
2. There is no significant relationship between self-concept and academic achievement in biology among senior secondary school students in Anambra state.

3. There is no significant relationship among achievement motivation, self-concept and the academic achievement scores of students' in biology.

Methods

The design adopted for the study was correlational survey. The population of the study consists of 4,603 SS 2 biology students in Awka education zone. The sample for the study is 720 SS2 biology students obtained through multi stage sampling technique. The instruments for data collection were achievement motivation scale and self-concept Questionnaire. The achievement motivation scale which was developed and standardized by Prof Pratibha Deo and Dr Asha Mohan (1985) as suggested by McCelland and Akinson was adapted for this study. AMS is a 50item scale and self-concept questionnaire was designed and standardized by Robson (1989) which consists of 30 items was also adapted for the study. The instruments were validated by three experts. The reliability of instruments was established using Cronbach's Alpha. The instrument was administered to 30 students in Onitsha North Education Zone. The scores generated were subject to Cronbach's Alpha computation. The reliability coefficient obtained for n-Ach and SCQ was 0.713 and 0.701 respectively. The instrument was administered to the student through the help of research assistant. Data generated from the study was analyzed using Pearson Product moment correlation and multiple regressions. The null hypothesis was tested at 0.05 level of significance.

Coefficient (r)	relationship
0.80 and above	high
above 0.30 –below 0.80	moderate
0.30 and below	low

Result

Research Question One: what is the relationship between achievement motivation and academic achievement among secondary school students in biology.

Table 1: Pearson Product moment correlation coefficient (r) between students' Achievement Motivation and their Academic Achievement in Biology.

Variable	N	Academic Achievement (r)	Remark
Achievement motivation	720	.080	low positive relationship

Table 1 shows a low positive relationship between achievement motivation and academic achievement of secondary school students' in biology. This is evident in the Pearson product moment correlation coefficient of r =.080

Research Question Two: what is the relationship between self-concept and academic achievement among secondary school in biology.

Table 2: Pearson product moment correlation coefficient (r) between students' Self-concept and their academic achievement in biology.

Variable	N	Academic Achievement	Remark
Self-concept	720	.078	low positive relationship

Table 2 shows a low positive relationship between secondary school students' self-concept and academic achievement in biology. This is the evident in the Pearson product moment correlation coefficient of r = .078.

Research Question Three: What is the relationship among achievement motivation, self-concept and academic achievement of secondary school students' in biology?

Table 5: Multiple correlation coefficient of students' achievement motivation, self-concept and their academic achievement in biology.

Model	**R**	**R square**	**Adjusted R square**	**Remark**
`1	.091	.008	006	low positive relationship

The multiple correlation coefficient R=.091 in table 5 suggests that students' achievement motivation and their self-concept in the academic achievement have a low relationship.

Hypothesis 1: there is no significant relationship between achievement motivation and academic achievement of secondary school students' in biology.

Table 3: Significant Relationship between achievement motivation and academic achievement of secondary school. Students' in biology.

Variable	N AcademicAchievement (r)	α-level	p-value	Decision
Achievement motivation	720 .080	0.05	.033	significant

Table 3 revealed that there is a statistical significant relationship between achievement motivation of students and their academic achievement in Biology. This is so because the p-value .033 is less than the level of significant 0.05, therefore the researcher rejected the null hypothesis and concluded that, there is a significant relationship between them.

Hypothesis 2: There is no significant relationship between self-concept and academic achievement of secondary school students' in Biology.

Table 4: Significant Relationship between Self-concept and academic achievement of secondary school students' in Biology.

Variable	N	Achievement (r)	α-level	p-value	Decision
Self-concept	720	.078	0.05	.038	significant

Table 4 revealed that there is a statistical significant relationship between self-concept of students and their academic achievement in Biology. This is so because the p-value, .038 is less than the level of significant 0.05, therefore the researcher rejected the null hypothesis and concluded that, there is a significant relationship between them.

Hypothesis 3: There is no significant relationship among achievement motivation, self-concept and the academic achievement score of students in biology.

Table 5: multiple regression analysis of achievement motivation, self-concept and the academic achievement score of students in biology.

Model	unstandardized Coefficient	standardized coefficient	T	Sig	decision
	B	Std Error beta			

(constant)	37.384	7.831		4.774	.000	
Achievement Motivation	.090	.69	.055	1.304	1.93	not signi
Self-concept	.81	.67	.51	1.215	.225	not signif
Df	2,717					
F	3.024					
p-value	.498					
R^2	.008					Significant

A multiple regression was run to ascertain the joint relationship of achievement motivation and self-concept on the academic achievement of secondary school students in Biology. These variables statistically significantly jointly related to the contribution of students' academic achievement, F (2,717)= 3.024, p= .049<0.05, R^2= .008. Independently, both variables did statistically significantly contribute to the students' academic achievements since their respective p-values .193 and .225>0.05 and the unstandardized coefficient B=.090 and .081 which means that for each increase in achievement motivation and self-concept there is an increase in the academic achievement of the students.

Discussion

The findings of the study revealed that achievement motivation and academic achievement shows a low positive relationship. Hence, there is a significant relationship between achievement motivation and academic achievement. The positive and significant relationship between achievement motivation and academic achievement can be attributed to little effort of motivation imputed by each student's desire for significant accomplishment, mastering of skills and setting high standard goals can contribute to their academic achievement in biology and other science subjects. The findings of the study support that of Anaya (2015) that achievement motivation is positively related to academic achievement. The findings of the study also lend credence to the findings of Villa and Sebastian (2021) that there is a relationship between achievement motivation and academic achievement.

The findings of the study revealed that self-concept and academic achievement shows a low positive relationship. The result of the study is better explained by the theory of self-concept by Karls Rogers, that self-concept is a social product and central ingredient in personality and personal adjustment, developing out of interpersonal relationships andcontinuously striving for consistency. He also believed that for every individual, there is a tendency towards self-actualization and development as long as this is permitted and encourages by an inviting environment. Academic achievement of a student can be attributed to little effort of the self-confidence towards self. The finding of the study is in line with the study of Sulaiman, Aqeel &Adibah Binti (2019) that self-concept is related to academic achievement. The finding of the study is in credence with the findings of Okafor, Obialor& Osuafor (2020) that there is positive significant relationship between secondary school student's self-concept and academic achievement in biology.

The findings of the study revealed that achievement motivation and self-concept have a low positive relationship on academic achievement. The result of the study can be attributed to the fact that high self-confidence and persistence employ by the students' can help in the high academic achievement of students in biology. The finding of the study is in line to the findings of Eirene & Somuya (2017) that achievement motivation and self-concept has a significant positive relationship to academic achievement. The findings of Awan, Noureen & Naz (2011) support the 2findings of the present study that achievement motivation and self-concept are significantly related to academic achievement.

Conclusion

The study concluded that achievement motivation and self-concept are significantly related to the academic achievement of students in biology. The study also establishes that achievement motivation and self-concept cannot be treated as separate entities, but as an independent collective.

Recommendations

In the light of the study, the following recommendations were made.

1. Biology teachers should encourage the development of achievement motivation and self-concept in biology by using of appropriate teaching and counseling strategies.
2. Well- package seminars and workshop should be organized regularly for teachers, students and counselors on achievement motivation and self-concept. This will create opportunities for exchange of ideas among them

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PERCEPTION OF CHEMISTRY TEACHERS ON SECONDARY SCHOOL CHEMISTRY CURRICULUM: THE NEED FOR ITS REFORM

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Abstract
The study investigated the perception of chemistry teachers on secondary school chemistry curriculum in terms of its content, relevance, adequacy and the need for reform. Four research questions guided the study. The design for the study was a descriptive survey. A sample of 148 chemistry teachers randomly sampled from 86 secondary schools drawn out of the 229 government owned secondary schools in Anambra state was used for the study. A validated questionnaire which had a reliability index of 0.89 using Cronbach Alpha technique was used to collect data for the study. The data collected were analyzed using mean, standard deviation, frequency and percentages. The results revealed that the chemistry teachers used for the study perceived that the chemistry curriculum used in secondary schools is overloaded with many contents that cannot be covered within the stipulated time, some topics are too abstract for the students to understand so they suggested that some of the contents need to be reformed to make the teaching of chemistry relevant, adequate and one that can instill skills in students. They also suggested that concepts on environmental changes and of our immediate societal concerns should be included in the curriculum to prepare students to be able to solve the problems of their immediate environment and that of the society as the need arises when they graduate. The researchers recommended among others that the topics in the chemistry curriculum should be reduced and topical issues relevant to our environment should be included in the curriculum.

Key words: Chemistry Teachers, Perception, Curriculum, Chemistry Curriculum, Reform

Introduction

One of the most rewarding things about teaching science is doing it in ways that cause effective communication and confidence with a willingness to try anything to make a fact or principle memorable. Chemistry is an important science subject and a prerequisite for further studying of a number of science related professional courses such as medicine, pharmacy, nursing, food technology, chemical engineering, agriculture and so on. Chemistry is central to everything. Asiyai (2005) observed that the failure rate in sciences and chemistry in particular at the Senior School C2ertificate Examination (SSCE) and other external examinations is high. Atherton (2011) opined that the main hurdle lies in student's inability to demonstrate a good understanding of the very basic concepts of the subject. Egolum and Igboegwu (2020); Eya (2011); Offiah and Egolum (2007) attributed the high failure rate in chemistry to a number of factors such as lack of well–equipped laboratory and other facilities, lack of qualified personnel, lack of prior knowledge of relevant mathematical concepts, alternative conceptions held by chemistry students, poor teaching methods and over-loaded curriculum.

Curriculum is an instrument that dictates the affairs of every educational system (Alebiosu, 2005). It is the vehicle through which knowledge and other learning activities are disseminated. Curriculum is a pilot on which economic, political, social and educational development challenges of a nation hinge (Ajewole, Nzewi & Aganga, 2001). Wasagu (2008) defined curriculum as a course of study that embrace the total spectrums of content, resources, materials and methods of teaching through which the purposes of education are achieved. Offorma (2005) regarded curriculum as the process of determining and pursuing set societal objectives through the instrumentality of the school. Curriculum is the totality of the environment in which education takes place. According to Adeyegbe (2004), curriculum generally is the number of activities in any educational endeavor since it dictates what is to be taught, at what level, by whom, with what materials and equipment, for what purpose and assessed by what means. Functional curriculum is determined by the quality of the curriculum content and its implementation (Offorma, 2005).

The success of any curriculum will depend on the availability of trained manpower for without proper development of human resources to implement the chemistry curriculum, chemistry education will continue to experience pit falls in the attainment of its goals. Chemistry teachers according to Ochu (2010), are crucial elements in chemistry curriculum delivery. The teacher plays a very important role in curriculum content implementation and dissemination by acting as a bridge that connects the curriculum to the learners i.e. he translates the content of the curriculum to the learners. Ogunkunle and Mbelede (2008) noted that no matter how well the curriculum is planned, it is useless if it is not implemented effectively. This is because the manner in which the teacher perceives the contents of the curriculum influences the way and manner the teacher relays it to be learner. This can of course influence the performance of the students.

The secondary school chemistry curriculum should be dynamic and move with the current developments all over the world. It therefore needs to be reviewed from time to time to make room for changes to content and form and also in the techniques of pedagogy so that

chemistry teaching will be relevant. In view of the need to address the problems on chemistry education curriculum and make it more relevant and exciting, curriculum reform is called for. There is need to reform the chemistry curriculum to meet the emerging challenges. Reform refers to improvement by alteration, a correction of an error or removal of defects. Reforms are changes or amendments made to a system or organization in order to improve it. According to Yusuf and Yusuf (2009), reform in Nigerian education is a federal government induced and directed substantial alteration of the Nigerian educational system, program, curriculum, agencies, education levels etc. Curriculum reform may be seen as a deliberate attempt to improve existing practices or conditions in an educational institution in relaxation to certain desired objectives. Akpan (2007) observed that reform is much more than a crucial change; it is a drastic and extensive replacement of the former situation with a newer one whose effects could be difficult or even painful to accept. Curriculum reform can take the form of inclusion of new pedagogies, new assessment methods and change in leadership, teacher training, language policy, co- curricular activities or even matters of administration.

The concern for curriculum reform is largely created by the increasing gap between what is taught and what is learnt. Simply put when students are increasingly unable to apply the knowledge taught in the school to practical settings that require problem solving skills, creativity and critical thinking skills. The curriculum that we have that is not providing such knowledge needs to be reviewed. The major goals of reforming chemistry curriculum according to Eya, (2011) is to enable chemistry students to

- Acquire basic theoretical and practical knowledge and skills.
- Develop interest in the subject of chemistry.
- Acquire competences that will help them be self reliant upon graduation
- Develop reasonable level of competence in ICT applications.
- Develop skills for creativity, problem solving and entrepreneurship and thus be useful to their society upon graduation

According to Kolade, (2010), reforms in Science, Technology, Engineering and Mathematics (STME) education is a sine- quanon for attaining economic independence. To keys and Bryan (2001), the efficiency of educational reform rests largely with the teachers. To truly reform our chemistry curriculum and teaching, the teachers must be involved. Therefore the researchers investigated the perception of chemistry teachers on secondary school chemistry curriculum and the need for its reform.

Purpose of the study

The purpose of the study was perception of chemistry teachers on secondary school chemistry curriculum and need for its reform. Specifically, the study investigated.

1. The perception of chemistry teachers on the secondary school chemistry curriculum in terms of quality and relevance
2. The perception of chemistry teachers on the contents of the secondary school chemistry curriculum that needs reform.

3. The people chemistry teachers in secondary schools think should bring about reform in chemistry curriculum
4. The strategies that will enhance the reform of the secondary school chemistry curriculum

Research Questions

The study was guided by the following research questions

1. What are the perception of chemistry teachers on secondary school chemistry curriculum in terms of quality and relevance?
2. What are the perceptions of chemistry teachers on the content of the secondary school chemistry curriculum that needs reform?
3. Who do chemistry teachers in secondary schools think should bring about reform in secondary school chemistry curriculum?
4. What are the strategies that will enhance the reforms of the secondary school chemistry curriculum?

Methods

The research design is a descriptive survey; the study was carried out in government owned secondary schools in Anambra state of Nigeria. The population for the study comprised of all the chemistry teachers in government owned secondary schools in Anambra state. 86 secondary schools were randomly selected out of the 229 gove2rnments owned secondary schools in the state. A total of 148 chemistry teachers formed the sample for the study. The instrument for data collection was a structured questionnaire developed by the researchers. The instrument titled ‘‘Questionnaire on perception of chemistry teachers on the secondary school chemistry curriculum and the need for its reform was made up of two parts 1 and 2. Part 1 contained items on personal data of the respondents. Part 2 had four sections A, B, C and D. Section A had 11 items that addressed teachers on their perception of the chemistry curriculum in terms of its content, relevance and quality. Section B had 46 items and sought information on the teacher’s perception of the contents of the chemistry curriculum that needs reform. Section C had seven (7) items and sought information on who secondary school chemistry teachers think should bring about reform in chemistry curriculum. Section D had ten (10) items and sought information on the strategies that will enhance reform of the secondary school chemistry curriculum.

The respondents were to indicate their level of agreement or disagreement based on a four point scale of Stron2gly Agree (SA) – 4 points, Agree (A) – 3 points, Disagree (D) – 2 points and Strongly Disagree (SA) – 1 point for research questions 1, 2 and 4. The respondents were asked to indicate either agree or disagree for research question 3. The validated questionnaire (by two 2lecturers in science education department and one from measurement and evaluation all from Nnamdi Azikiwe University Awka) was trial tested on 30 chemistry teachers from secondary schools in Delta state. The result obtained was used to determine the reliability of the instrument using Cronbach Alpha technique. A reliability index of 0. 89 were established and this indicated that the instrument was reliable for the study. The questionnaire was administered to the teachers in their various schools with the help of four

research attendants. A total of 148 copies of questionnaire were returned. The research questions were answered using mean, standard deviation, frequency and percentages. The criterion mean value was 2.50. Items with mean scores of 2.50 and above were regarded as agreed while those with mean of 2.49 and below were regarded as disagreed. Also for research question 3, items with percentages 50 and above were accepted while those with below 50% were not accepted.

Results

The results were presented according to the research questions below.

Research Question One: What are the perceptions of chemistry teachers on the secondary school chemistry curriculum in terms of quality and relevance?

Table 1: **Mean ratings and Standard Deviations (SD) on the perception of chemistry teachers of the secondary school chemistry curriculum2**

S/N	Questionnaire Items	Mean	SD	Decision
1.	The curriculum is adequate for achieving the objectives of the national policy on education	2.52	0.81	Agreed
2.	It prepares the learner to be functional in the society	2.10	0.97	Disagreed
3.	The contents is relevant to the Nigerian child	2.20	1.52	Disagreed
4.	The contents is relevant to the learner in terms of acquisition of skills	2.32	1.11	Disagreed
5.	It prepares the learner for further study in higher institution	3.18	1.60	Agreed
6.	It specified clearly the practical work to be done at each level	3.47	0.23	Agreed
7.	It has enough practical's to make chemistry students self reliant	2.17	1.44	Disagreed
8.	It contains current issues that is useful to the learner and the society	2.23	1.12	Disagreed
9.	It contains so many topics that cannot be covered within the specified period	3.87	1.24	Agreed
10.	Some contents in the curriculum are two abstract for the students	3.30	1.21	Agreed
11.	All the topics in the curriculum can be taught effectively without laboratory equipments	1.10	0.84	Disagreed

In table 1, items 2, 3, 4, 7, 8 and 11 scored below the acceptable mean of 2.50 and above. Thus the respondents disagreed with those statements on the table. Items 1, 5, 6, 9 and 10 had mean ratings above the cut-off points of 2.50. Thus the respondents agreed with the statements on the questionnaire.

Research Question Two: What are the perceptions of chemistry teachers on the contents of the secondary school chemistry curriculum that needs reform?

Table 2: Perception of chemistry teachers on the content of the secondary school chemistry curriculum that needs reform

SN	Questionnaire Items	Mean	SD	Remark
1	Concept of matter, elements, compounds and mixtures	2.92	0.66	Agreed
2	Particulate nature of matter: atoms and molecules 2	2.87	0.57	Agreed
3	Daltons atomic theory, atomic& mass no, isotopes	1.60	0.53	Disagreed
4	Separation techniques for mixtures	3.06	0.80	Agreed
5	Chemical symbols, empirical & molecular formula	2.64	1.02	Agreed
6	The periodic table	2.62	0.87	Agreed
7	Laws of chemical combination	1.82	0.67	Disagreed
8	Chemical bonding	2.50	0.83	Agreed
9	Kinetic theory, diffusion, osmosis	2.68	0.65	Agreed
10	Gas laws; Boyles, Charles laws etc	2.10	0.54	Disagreed
11	The mole, molar volume of gases	2.95	0.70	Agreed
12	Acids, bases and salts	3.19	0.55	Agreed
13	Water and solutions	3.12	0.45	Agreed
14	Solubility	2.64	0.68	Agreed
15	Treatment of water and pollution	2.50	0.53	Agreed
16	Carbon and its compounds, allotropes of carbon	2.72	0.71	Agreed
17	Hydrocarbons and its classes	2.68	1.01	Agreed
18	Petroleum and its fractions	2.56	0.84	Agreed
19	Cracking and reforming	2.92	0.70	Agreed
20	Industrial chemistry; heavy & fine chemicals	2.88	0.93	Agreed
21	Mass- volume relationship – stoichiometry	2.57	0.67	Agreed
22	Electrolysis	2.81	1.17	Agreed
23	Electrolysis of compounds	3.00	0.32	Agreed
24	Redox reactions; electrochemical cells	3.89	0.87	Agreed
25	Rates of chemical reactions	2.51	1.10	Agreed
26	Energy profile; exothermic & endothermic reactions	3.81	0.29	Agreed
27	Heat of formation, combustion e.t.c	3.17	0.71	Agreed
28	Enthalpy, entropy, free energy	2.02	0.49	Disagreed
29	Chemical equilibrium	3.30	0.48	Agreed
30	Non metals and their compounds, hydrogen	2.80	0.42	Agreed

31	Oxygen; preparation, properties, oxides, air pollutants	2.83	0.53	Agreed
32	Halogens, chlorine preparation, properties, reactions	2.83	0.65	Agreed
33	Nitrogen; laboratory and industrial preparation, properties and uses	3.03	0.72	Agreed
34	Sulphur – allotropes, uses, oxides, preparation, properties and uses of H_2SO4	2.90	0.52	Agreed
35	Organic chemistry, classification and nomenclature of organic compounds 2	3.06	0.50	Agreed
36	Homologous series; alkanes, alkenes, alkynes, alkanols, alkanoic acid, alkanoates	3.80	0.63	Agreed
37	Detergents, amino acids, aromatic hydrocarbon	2.80	0.32	Agreed
38	Polymers and giant molecules	3.38	0.78	Agreed
39	Carbohydrates; classification, properties and uses	3.33	0.59	Agreed
40	Quantum numbers, rules and principles of filling electrons	2.63	0.57	Agreed
41	Electronic structure of the atom	2.60	0.49	Agreed
42	Orbital's , s, p, d & f	3.37	0.52	Agreed
43	Radioactivity	2.90	0.56	Agreed
44	Qualitative analysis; identification of cations and anions	3.75	0.74	Agreed
45	Quantitative analysis: Acid-base titrations	3.12	0.74	Agreed
46	Preparation of standard solutions	3.83	0.62	Agreed

Results in table 2 indicated that only four items out of the whole items on the table had mean scores of less than 2.50 meaning that the chemistry teachers indicated that only four of the items should not be reformed in the secondary school chemistry curriculum while they agreed that all of the other items should undergo reform

Research Question Three: Who do chemistry teachers in secondary schools think should bring about reform in secondary school chemistry curriculum?

Table 3: Those that secondary school chemistry teachers thought that should bring about reform in secondary school chemistry curriculum

S/N	Questionnaire Items	Agreed Frequency	%	Disagree Frequency	%
1.	Teachers	121	81.8	27	18.2

2.	Government	104	70.3	44	29.7
3.	Society	82	55.4	66	44.6
4.	Curriculum planners	138	93.2	10	6.8
5.	STAN (science Teachers association)	95	64.2	53	35.8
6.	Researchers	89	60.1	59	39.9
7.	Employers of labour	56	37.8	92	62.2

In table 3, chemistry teachers used for the study agreed that all the items except item 7 were those that should bring about2 reforms in secondary school chemistry curriculum hence all have percentage scores of more than 50% except item 7 who's Percentage is 37.8

Research Question Four: What are the strategies that will enhance the reforms of the secondary school chemistry curriculum?

Table 4: Mean ratings and standard deviations of the strategies for the reform of chemistry curriculum.

S/N	Questionnaire Items	Mean	SD	Decision
1.	The content of the curriculum should be reduced	3.10	1.12	Agreed
2.	The contents should be one that will meet the needs of the learner and that of their community	2.94	0.97	Agreed
3.	Chemistry teachers should be involved in planning the curriculum	3.17	0.81	Agreed
4.	It should be one that will impart skills in students	2.82	1.01	Agreed
5.	Chemistry teachers should be motivated for better implementation of the curriculum	3.04	0.96	Agreed
6.	Issues like computer studies and internet applications should be included in the curriculum	2.75	0.66	Agreed
7.	Teachers skills should be improved through seminars, conferences and workshops	3.86	1.21	Agreed
8.	The curriculum should be learner centred	3.10	0.64	Agreed
9.	It should be problem – solving oriented	2.88	0.97	Agreed
10.	It should enable secondary school learners know the topical issues in their environment and how to tackle them	3.23	1.25	Agreed

Result in table 4 above showed that all the respondents agreed that all the strategies listed in the table can help in reforming of the chemistry curriculum hence their mean ratings were above 2.50.

Discussion

The findings of the study revealed that chemistry teachers perceived the chemistry curriculum as one that cannot prepare the learner for the world of work and one that is over loaded with so many topics that cannot be covered within the specified period. They believed that some in

the curriculum are abstract and so the students find them difficult to learn. This study is in agreement with the work of Akpan (2012) who opined that the science curriculum is outdated, not relevant, not- co2ntent driven and overloaded, and it does not prepare students for the world of employment. Also Adeyegbe and Oke (2004) lamented that the SSCE syllabus in each of the science subjects, chemistry inclusive are highly loaded in terms of contents

Findings in table 2 revealed that the chemistry teachers used for the study agreed that almost all the items in table 2 are contents in the chemistry curriculum that needs to be reformed so that chemistry teaching should be relevant and develop both entrepreneurial and creativity skills in both teachers and students. Teachers used for the study also agreed that the contents of the curriculum should be reformed to accommodate concepts on environmental changes and our immediate societal concern. This is in agreement with the study of Blades (2020) that focused on the need for reformation of the school science curricular to include issues on social changes such as the rising societal concern about the environment, environmental responsibility, and economic prosperity and so on.

Table 3 revealed that the chemistry teachers used for the study believed that the teachers, society, government, curriculum planners, organizations such as STAN and researchers should help bring about reforms in chemistry curriculum. The result of the study indicated that teachers (81.8%) and curriculum planners (93.2%) are the most important people in curriculum reform. This is in agreement with the study of keys & Bryan (2001) who posited that the efficiency of educational reform rests largely with the teachers.

Table 4 revealed that all the items on the table were among the strategies for the reform of chemistry curriculum. Hence the chemistry teachers agreed that secondary school chemistry curriculum can be reformed by reducing the content of the curriculum, making it student centered, putting only contents that will be of relevance to the leaner and his/her society and so on. This is in agreement with the study of Sewell (2003), who opined that the contents of the curriculum should be reduced to enable student's time to have thorough understanding of essential concepts. He also suggested that our science classroom should be made to be student centered and also problem solving method should be used in teaching science students to develop essential skills. Teachers used for the study also agreed that opportunities should be given to them for re-training through seminars, workshops and conferences to improve on their method of implementing the curriculum. They also agreed that topical issues should be included in the curriculum to make the teaching and learning of chemistry exciting, relevant and meaningful to the students. Such topical issues solid waste management, solutions to environmental issues, global warming, climate change, ozone layer depletion, over population and pollution.

Conclusion

The results of the study showed that the chemistry teachers perceived chemistry curriculum as containing too many topics (contents) that cannot be covered within the specified period and some of these contents are abstract and can only be taught using laboratory equipments

which are not available in the school laboratories. They also believed that the teachers should be involved in curriculum reform because they implement the curriculum and that the curriculum should be planned to inculcate entrepreneurial skills, creativity skills and problem – solving skills in students to help them become self-reliant when they graduate.

Recommendations

Based on the findings, the following recommendations were made

1. The content of the chemistry curriculum should be reformed to include contents relevant to a developing nation to help solve the needs of the learner and problem of the society as the need arises.
2. The topics in the chemistry curriculum should be reduced so that it can be covered within the specified period with enough practical.
3. It should be learner centered, problem based and project driven.
4. Contents that will help to develop creativity, problem-solving and entrepreneurial skills should be included in the reformed curriculum.
5. Serving chemistry teachers should be sponsored regularly to seminars, workshops and conferences to update their knowledge and learn innovative method of teaching for the reformed curriculum
6. School laboratories should be provided with enough materials and equipments for practical.
7. Curriculum planners should reform the chemistry curriculum by bringing in the use of mother tongue during linguistic difficulties.

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Effect of Integrative Teaching Approach on Senior Secondary School Students Attitude towards Mathematics in Ijebu ode Local Government of Ogun State

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Abstract

In this paper the effectiveness of integrative teaching method on senior secondary school students' attitude towards where examined. The sample was made up of eighty (80) SS2 students selected from two intact classes from different schools, where one served as experimental group and the other control group. Mathematics Attitude Scale was used to collect data on the attitude of the students alongside the treatment package for the experimental group and conventional approach for the control group. Data collected were analyzed using ANCOVA and results showed that integrative teaching method had significant effect on the attitude of students towards mathematics in the senior secondary school while gender and the interaction effect between gender and treatment had no significant effect on the attitude of students towards mathematics.It is concluded that the treatment is of main significant to the positive attitude of students towards Mathematics, therefore it is recommended among others that teachers and other stake holders should ensure the appropriate use of integrative teaching approach to bring about positive attitude of students towards Mathematics.

Keywords: Integrative teaching strategy, attitude, Mathematics, conventional approach, Students

Introduction

Learning is a lifelong process of transforming information and experience into knowledge, skills, behaviour and attitudes. It is a mechanism through which the society generates the knowledge and skills required for its survival and sustenance (Kazeem & Ige, 2010). Mathematics is a branch of information that manages estimations, numbers and amounts. For understudies to move ahead in their coveted scholarly vocation, they must pass the subject legitimately with no less than a credit, Wachikwu, Kevwe, Eseose & Nwaukwu (2017). Also, Gal (2014) emphasized that some contributing factors to students' lack of mathematics achievement are poor study habit and attitude towards the subject which is as a result of fear and the general impression created by the society, who believe that mathematics is difficult to comprehend. Ogunfowote&Asanre (2019) opined that to facilitate the process of knowledge transmission, teacher's needs to apply appropriate teaching methods that is suitable for a

specific objective and outcomes. Today, questions about the effectiveness of teaching methods on students learning have consistently raised considerable interest in the thematic field of educational research Hightower (2011)research on teaching and learning constantly endeavour to examine the extent to which different teaching methods enhance growth in student learning.

The present practice of mechanically applying the same methods to dull, average as well as the bright students could be responsible for much of the ineffectiveness of instruction given in schools. Furthermore, Overmayer (2010) reported that the challenge of covering the entire mathematics syllabus in classroom while accommodating the needs of struggling students creates an almost impossible situation for the teacher to pass across the required attribute to the students. Consequently, many students move through the mathematical curriculum with deficiencies. Students stumble through the mathematics curriculum with these gaps in learning, gaps that seem to grow exponentially, until finally, frustrated by continuous failure bringing about attitudinal change towards the learning of mathematics which then leads to many students dropping out of school. Hence, each student learns best using strategies and objectives that reflect his experiences, abilities and attitude. Despite the recognition accorded to mathematics due to its relevance, Elekwa (2010) remarked that students exhibit non-chalant attitude towards mathematics, even when they know that they need it to forge ahead in their studies and in life. Such students who have already conditioned their minds that mathematics is a difficult subject are usually not serious in the learning of mathematics and therefore perform poorly in mathematics tests and examination. Asanre*et al., (2019)* reported that students' attitude towards Mathematics are measured based on their academic achievement, that those whose achievement are low lack positive attitude towards the subject. Over the years, there has been a loud cry by researchers that the academic achievement of secondary school students in mathematics as drastically reduced.

Omole (2019) reported that gender differences in learning mathematics cannot be explained in a simplified manner because there is multiplicity of forces and environments that operate apart from gender which influences a child's learning of mathematics Gender differences in mathematics may vary due to socioeconomic status and ethnicity, school environment, the mind-set of the teacher towards the learners. Omole further reported that middle school and high school girls have positive attitudes toward school but negative attitudes toward the learning of mathematics, it is also noticed that girls' positive attitudes towards mathematics decline as they grow older.

Education cannot be of quality without effective teaching. The instructional method employed by teachers plays an important role in the acquisition of instructional contents for meaningful learning and development of necessary skills. Teacher-centered instructional methods make students passive with less interaction, Asanre*et al.,* (2018). An integrated approach allows learners to explore, gather, process, refine and present information about the topics they want to investigate without the constraints imposed by traditional subject barriers. It also allows students to engage in purposeful, relevant learning and encourages students to see the interconnectedness and interrelationships between the curriculum areas, (Ogunfowote&Asanre, 2019). Based on the above it is important to explore the effect of

integrative teaching approach on senior secondary school students' attitude towards mathematics.

Purpose of the Study

The purpose of this study was to examine the effect of integrative teaching approach on senior secondary school students' attitude towards Mathematics, specifically the study examined:

1. The effect of integrative teaching approach on students' attitude toward Mathematics in secondary school.
2. The effects of gender on students' attitude toward Mathematics in secondary school.
3. The interaction effect of integrative teaching approach and gender on students' attitude toward Mathematics in secondary school.

Hypotheses

H_{o1}: There is no significant effect of integrative teaching approach on students' attitude toward Mathematics in secondary school.

H_{o2}: There is no significant effect of gender on students' attitude toward Mathematics.

H_{o3}: There is no significant interaction effect of integrative teaching approach and gender on students' attitude toward Mathematics in secondary school.

Methods

This paper adopted a Pre – test, Post – test and Control group quasi experimental design for the study. This design and method is considered appropriate because it takes care of any form of biases and students' opinions are recorded at different stages of the study. The data for the study were collected through the use of Mathematics Attitude Test (MAT) adapted from the work of Fennema-Sherman Mathematics attitude scale (2010) which revalidated and the reliability was done. First section of the instrument consists of the student's bio–data, while the second part consists of the items on the attitude of students towards mathematics. The instrument was revalidated by the senior colleague in the department of mathematics, Tai Solarin University of Education as well as mathematics teachers in secondary schools for face and content validity. The reliability of the instrument was ascertained by using split half method and the reliability co–efficient of 0.82 were obtained. The population of the study comprised of 80 junior secondary school students in ijebu ode local government area of Ogun State, Nigeria, selected from two 2junior secondary schools by purposive sampling. From each school intact class of 40 students' was selected using simple random sampling. One of the schools served as the experimental group while the other serve as the control group. Both groups were given a pre-test before the introduction of the teaching strategy in the experimental group while conventional approach was used in the control group. Data obtained were analyzed using Analysis of Covariance.

Results

Table 1: One way analysis of Covariate (ANCOVA) of students' attitude toward mathematics scores on treatment, gender and interaction.

Source	Type III sum of squares	Df	Mean square	F	Sig.
Corrected Model	14.123	4	3.531	.461	.763
Intercept	1537.788	1	1537.788	200.998	.000
Covariate	6.445	1	6.445	.842	.356
Strategy	.854	1	.854	.112	.020
Gender	3.278	1	3.278	..428	.517
2Strategy * Gender	2.798	1	2.798	.366	.549
Error	267.777	75	7.651		
Total	18656.000	80			
Corrected Total	281.900	79			

R-Squared = .378 (Adjusted R Squared =.229)

The ANCOVA table revealed that the effect of integrative teaching Method on the attitude of students towards Mathematics at .05 level of significant of the F- value of .112 for treatment is significant at .02 which is less than .05 alpha level and thus the null hypothesis was rejected. The researchers conclude that there is significant main effect of integrative teaching approach on students' attitude toward Mathematics in secondary school. This implies that there is a significant difference between the mean attitude scores of students taught using integrative teaching Method as instructional guide and those taught using the conventional method as an instructional guide.

Hypothesis Two: There is no significant main effect of gender on students' attitude toward Mathematics.

From **table 1**, the F- value of 0.428 for gender difference is not significant at .517 which is greater than .05 alpha levels and thus the null hypothesis was accepted. Thus there is no significant main effect of gender on students' attitude toward Mathematics.

Hypothesis Three: There is no significant interaction effect of integrative teaching method 2and gender on students' attitude toward mathematics in secondary school.

From **Table 1**, the F- value of .366 values for treatment and gender difference interaction is significant at 0.549 which is greater than .05 alpha levels and thus the null hypothesis was accepted and we then conclude that there is no significant interaction effect of integrative teaching approach and gender on students' attitude toward mathematics in secondary school.

Conclusion

The following conclusion were drawn based on the findings of this study that integrative teaching approach has effect on the students' attitude towards mathematics in secondary school level that is the strategy improved the academic attitude of the learners. It is also concluded that there is no interaction effect of treatment and gender on the Attitude of

students towards mathematics in the senior secondary schools in Ijebu ode local government area of Ogun State, Nigeria.

Recommendations

The following recommendations were made based on the finding from the study:

1. Teachers should ensure the use integrative teaching approach as alternate method in the process of teaching and learning of Mathematics at secondary level(especially junior sections) of education in other to encourage the students towards having positive attitude towards Mathematics.
2. Educational Ministries and all stakeholders should step-up both learner's and teachers' supervision to curb laziness and sluggishness on the part of teachers and learners to ensure proper usage of the integrative instructional strategy in schools.

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SCIENCE EDUCATION FOR NATIONAL DEVELOPMENT AND SCIENETIFIC CREATIVITY AMONG SECONDARY SCHOOL STUDENTS IN NIGERIA

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Abstract

This paper discussed science education for national development and scientific creativity among secondary school students in Nigeria. It examined the concepts of science education, scientific creativity and national development. It also highlighted the importance of science education to national development and strategies for enhancing scientific creativity development through science education in Nigeria. The paper recommended among others that Science teachers should adopt activity- oriented teaching strategies in teaching of secondary school science subjects in order to inculcate in the students the necessary skills and knowledge needed for scientific creativity and national development.

Key words: Science education, scientific creativity, national development, secondary school

Introduction

Education is the bedrock for human development. Education is one of the essential instruments which a nation uses to facilitate total enlightenment of its citizens and enhance all its socio-economic and political parameters for sustainable development. No wonder Okonkwo (2010) asserted that education is the fulcrum to which all other development revolves. This means that the management and planning of education must be given adequate consideration for any nation to advance rapidly. According to Uwazurike and Anokam in Obialor (2022), education is any act or experience that has a formative effect on the minds, character or physical ability of an individual. It is the act or process of impacting or acquiring knowledge, skills, values, belief and habits. It is also the aggregate of all the process by which children develop abilities, attitude and other forms of behaviour which are of the value to the society. This is why education i2s a formidable tool for man's survival and it also requires a top priority in the scheme of things among the comity of nations, Nigeria inclusive.

In Nigeria, the educational system is categorized into pre-primary schools, primary scho8ols, secondary schools and tertiary education. Secondary school level which is also regarded as post-primary school education serves as a link between primary and tertiary education institutions. The goal of secondary school education is to prepare students for useful living within the society and higher education as stated in the National Policy on Education (Federal Republic of Nigeria (FRN), 2013). Without secondary school education, the foundation for any form of future academic aspirations cannot be laid. Secondary school education also consumes the products of primary schools and produce candidate for tertiary education in the nation (Abdulrahaman, 2014).

Secondary school education in Nigeria is divided into junior secondary schools and senior secondary schools. The junior secondary school education is a form of education students attain after primary education while the senior secondary school is a three year educational system which students receive after the three years of junior secondary school before proceeding to the tertiary level of education. At both junior and senior secondary school levels, students are exposed to science education.

Science education is a gateway to the survival of a scientific and technological oriented- nation. Science education is a body of knowledge systematically arranged with scientific and technological themes and contents. It is the scholarly and practical discipline concerned with the teaching, learning and assessment of science content, science process as well as nature of science (Obialor, 2018). Science education is geared towards confronting issues that require scientific way of thinking for informed discussion, management and sharing of resources such as air, water and vegetation (Ellis, 2010). It also involves a systematic study of national phenomena and its study allows students to experience the richness and the excitement of natural world as they are engage in inquiring, critical thinking and demonstration of skills. To develop these skills,

students ought to have the ability to apply the knowledge that they have learnt in science education to face challenges of life beyond school and one of the ways to achieve this is by enhancement of scientific creativity in all aspects of human life and development.

Scientific creativity is concerned with creative science experiments, creative scientific problems finding and solving. Scientific creativity depends on scientific knowledge and skills. According to Hadzigeorgious, Forkialia and Kabouropoulou (2012) described scientific creativity as the scientific activities employed by the science teacher in order to stimulate and encourage creative thinking among the students. National development is a continuous increase in all sectors of the economy and this increase is planned and implemented so that its results will become positive to the society. However, the development of any a nation depends on the development of science education and this is intricately linked with its emphasis on scientific creativity among the individuals or members of its nation. It is in line with the theory that countries such as UK, USA, France, Sweden, Australia, South Korea, Twaiman and Singapore see the need to foster scientific creativity through education particularly Science, Technology, Engineering and Mathematics education (Shaheen, 2010; Cheng, 2010). The ability of these countries to foster creativity through education have today made them to be among the most productive nations of the world with strong and self-relevant economy that enable them to serve leading roles in global competitiveness.

Conceptual Clarifications

Science Education

Science education is the study of science and how science and technology affects the society. It is the teaching and learning of science subjects in an undifferentiated manner which stresses the fundamental unity of science (Omiko in Obialor and Osuafor, 2019). Science educati2on is a field of study concerned with producing a scientifically literate society. Omorogbe and Ewansiha (2013) added that Science education acquaints students with certain basic knowledge, skills and attitude needed for future work in science and science related fields. The authors further stated that the 21st century is characterized by advancement in science and technology and for Nigeria to realize accelerated development in the 21st century. There is need for quality science education in our schools. Madukwe (2018) maintained that the objectives of science education in Nigeria include the need to prepare students to observe and explore the environment, explain simple natural phenomena, develop scientific attitude including curiosity, critical reflection and objectivity, apply the skills and knowledge gained through science to solve everyday problems in the environment, develop self-confidence and self-reliance through problem solving activities in science.

Scientific Creativity

Scientific creativity according to Erodogen and Akkanat (2014) is said to depend on previous experiences and knowledge, sensitivity to problems and their solutions, understanding the nature

of the science and fascinating with it and development of new, extraordinary and useful scientific knowledge, experiments, theories and products. Hadzigeorgious, Forkialia and Kabouropoulou (2012) described scientific creativity as the scientific activities employed by the science teacher in order to stimulate and encourage creative thinking among the students. Scientific creativity is associated with some factors including problem solving, problem finding, formulating hypothesis, using analogy along with some personality factors such as motivation (Grosh, 2010). Scientific creativity requires sensitivity to problems because finding creative problem to solve is an important aspect of being a goal scientist. The researchers therefore see scientific creativity as acquisition of scientific skills and knowledge by an individual in order to enable him solve some creative problems and make intelligent decisions, contribute and hold educated opinions on matters that affect him.

National Development

National development, according to Egwu in Adeyera (2011) is the establishment of a viable and buoyant national economy, the establishment of a just and egalitarian society, the enthronement of equality and social justice and the building of a unified and integrated society where the different ethics, religious and geo-political identities develop a collective sense of imagination that they are one. In the same vein, national development, in the words of Emeh and Ogaboh in Okemakinde, Adewuyi and Alabi (2013) involves the total transformation of society making humanity the focus of the development drive and seeking to develop man's potentialities in a total sense. It includes reduction of poverty, wealth creation, equitable distribution of wealth, ensuring nutrition and health, housing and auxiliary services, social security and welfare. This presupposes that national development is an all embracing entity on the part of individual and societal change with such indications as quality food, gainful employment, and wealth creation, power reduction within the ambit of such framework as equality, dignity, social justice and equity (Emeh and Ogaboh in Okemakinde, Adewuyi & Alabi, 2013). Hence, a nation cannot be said to have developed when a significant percent of her population are not literate and there is decay in the country's educational system. In line with this thought, Opara, Onukwugha, Nwokeji and Mbah in Obialor (2018) opined that the need for quality human being with at least basic foundation of education which is quality and quantity, free and compulsory and its curriculum did not ignore all round development of individual or learner (Cognitive, affective and psychomotor). In addition, National Education Research Development Center (2008) asserted that the attainment of the objectives of Universal Basic Education will not be possible if functional curriculum capable of empowering the learners at the end of secondary school education is not available. This is why science education curriculum (i.e biology, chemistry, physics, mathematics, integrated science) accommodated the fundamentals of both National Economic Empowerment and Development Strategies (NEEDS) and the Millennium Development Goals (MDGS).

Importance of Science Education to National Development

Science education is very important to the development of any nation in many ways that is why nation must take it very serious in all institutions learning. Many of the developed worlds were able to achieve so much in science and technology because of science education. Launching of sputnik by the Russian government in October 4, 1957 would not have been possible if not for the position they place physics in science education.

In the area of agriculture, science and science education have taken the lead especially in the latest methods of agricultural production. Science education has provided us with the theoretical and practical knowledge of different methods of growing crops, protecting the crops and plants from insects and diseases and various ways of mechanized farming. Various agricultural institutions and research centers help both the agricultural scientists and students to research and discover new ways of improving food production and developing new varieties of food grains and fruits. Scientific education is equally striving in the area of farm animals. In this regard, keeping farm animals healthy and keeping man from the reach of some contagious animal diseases are of paramount importance of science education especially in the area of medical science which helps to keep farm animals and birds in good health.

Taking a glance at the scientific discoveries which emanated from science education and critical thinking, it is essential to note that the areas of transportation and communication are inclusive and cannot be left out. The construction, manufacturing and maintenance of ICT facilities, railway, air and sea transport, radio, television and telephone and so on are by-products of science education. Scientific education gave birth to modern medicine and hospital equipments and continues to look into the maintenance of both private and public health. Continuous study and research in advanced countries have resulted in the development of highly effective drugs and medicines that can cure most of the diseases. A country cannot protect its citizens from external aggression without military force and soldiers as we know need ammunitions. Hence, through science education modern warfare technologies and ammunitions are being produced to defend the country and its citizens and to remain prepared against foreign attacks. In fact, the whole structure of our civilization rests on the shoulders of scientific education and the benefits of science education cannot be over emphasized; take for instance, many graduates of biology education are self-employed and employers of labour, many owned schools for themselves where people work and earn their living while some are into fish business.

There are colleges of education where students of chemistry department are taught how to make dye and chalk, graduates of these departments can establish their own chalk business as soon as they graduate. If supported with fund many schools do not need to buy chalk outside anymore and they can equally produce for other schools.

Strategies of Enhancing Scientific Creativity Development through Science Education in Nigeria.

1. **Adoption of Effective Teaching Strategies**

Teaching strategies are essential to the success of the teaching and learning process. Teaching strategies influence acquisition of scientific skills, knowledge and concept during the learning process. Teaching strategies means a process of selecting, directing controlling and evaluating the experiences of the learners to achieve desirable outcome (Akinboye in Ekanem, 2006). Ekanem (2006) added that heuristic creativity and indirect teaching strategies can help the students to be creative, inventive, imaginative and original in their potential. Teaching strategies such as discovering teaching strategy is very vital in science learning. Akpan in Bash, Kabing, Dawal and Josiah (2019) opined that discovering activity is a lesson designed in such a way that the learners performs certain mental processes such as observing, classifying, measuring, predicting, describing and inferring. Discovery method creates an avenue in which science process skill could be put into consideration during science instruction. Laboratory teaching strategy provides the learners with the opportunity to practice cognitive skills such as ability to observe classify measure and interpreted date. However, activity- based strategies as discussed abov2e should be embraced by science teachers. This would drastically ensure scientific creativity in science learning.

2. **Provision of Teaching Resources**

Science teachers require different kinds of teaching resources such as textbooks, apparatus, chemicals, charts, models, motion pictures as well as facilities such as laboratories to enhance the effectiveness of their instructions (Maundu, Muthwil and Sambili, 2005). A resource is any source of information, expertise, supply or support (Otieno, 2012). Resource materials play an important role in enhancing the teaching / learning process by modifying the teaching and learning situation, it helps in conveying the intended purpose. In line with this view, Bhagwan (2005) stated that a growing body of resources in the cognitive science suggest that students learn and better retain what they learned. Twoli (2006) maintained that in many countries including Nigeria, the school science curriculum is more of laboratory based and a large proportion of learning is spent on practical or hands-on-experience. The author further added that the practical sessions afford the students an opportunity to manipulate concrete objects, specimens, equipment and chemical under the guidance of the teacher. Moreso, Nderitu (2009) opined that most schools have rule that students are responsible for apparatus under their use and should any of the apparatus break during practical work, the student pay for the broken apparatus. In science, it is a known fact that most of the apparatus used in science subjects such as chemistry and physics are glass wares and most of which are expensive. Therefore, many students shy away from experiments due to this rule. The author therefore recommends a reversal of this rule for meaningful learning. Therefore, for scientific creativity to be embraced such rule should be avoided in science learning, since these apparatus are important tools in science teaching.

Conclusion

Science education is a novelty idea that is used to improve scientific creativity and national development in developing worlds. Such improvement brings about development that makes nation to be at par with the rest of the world. For this to be achievable in nation like Nigeria, the quality of teaching rendered to the learners by science teachers is very paramount. Thus, if teachers can make a paradigm shift in their pedagogy by making science teaching as much as possible practical oriented and not theoretical based. It is only then that the learners will acquire skills and knowledge needed for scientific creativity and development in Nigeria.

Recommendations

Based on the discussions, the following recommendations were made:

1. Science teachers should adopt activity- oriented teaching strategies in teaching of secondary school science subjects in order to inculcate in the students the necessary skills and knowledge needed for scientific creativity and national development.
2. Science teachers should advocate scientific creativity among the students by posing creative problem-solving activities to them.
3. Emphasis should be laid on science education as a fundamental educational tool that can enhance scientific creativity ability among the students and national development in Nigeria.
4. Government and stakeholders should provide enough funds so that schools may obtain enough teaching resources and equipment for effective teaching and learning of science subjects in Nigeria.

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BIOLOGY TEACHERS' PERCEPTIONS ON THE INFLUENCE OF THEIR SELF-EFFICACY ON THEIR CLASSROOM PRACTICES IN AWKA SOUTH LOCAL GOVERNMENT AREA

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Abstract

The researcher, over time, has observed that poor classroom management, poor students' engagement as well as poor instructional delivery are huge sources of worry among stakeholders in the secondary education system. Although, there are many variables that may interplay with classroom practices in secondary schools, the researcher is interested in investigating the Biology teachers' perceptions of the influence of their self-efficacy on their classroom practices in Awka South LGA. Three research questions were raised to guide the study. Survey research design was utilized for the study. The population of the study was made up of 58 Biology teachers in the public secondary schools in Awka South LGA. No sampling was done as the population was of manageable size. Questionnaire titled 'Perceived Impact of Self-Efficacy on Biology Teachers' Classroom Practices (PISEBTCP)' was used for data collection. PISEBTCP was validated by three experts in Nnamdi Azikiwe University, Awka. The reliability of PISEBTCP which was established using Cronbach alpha statistics yielded alpha coefficient value of 0.83.Data analysis was done using mean. The findings of the study indicated that Biology teachers' self-efficacy positively influenced their use of instructional strategies, classroom management and student engagement. It was recommended in view of the findings that government should organize seminars and workshops for Biology teachers on the need to exude self-efficacy for efficient use of instructional strategies, classroom management and students' engagement.

Keywords: Self-efficacy, instructional strategies, classroom management and students' engagement

Introduction

Secondary education in Nigeria has witnessed active participation by non-governmental agencies, communities, and individuals as well as government interventions. It is therefore desirable for the nation to spell out in no uncertain terms the philosophy and aims that underlie its investment in secondary education. As stated in the National Policy on Education (FGN, 2013), the primary aim of secondary school education inNigeria is to prepare the individual child for useful living in the society and for higher education. Instructively, in the course of secondary education in Nigeria, some compulsory subjects are taught the students among which is Biology.

Biology as a science subject deals with the study of living things.Biology is defined as the study of living organisms, their origins, anatomy, morphology, physiology, behavior and distribution (National Eligibility Entrance Test, 2022). The teaching of biology is very important because the knowledge of biology helps in improving the quality of life. It further helps to solve many societal problems relating to health, poverty, food shortage, crop production and environmental conservation (Ogunleye, 2012).The teaching of Biology will not only serve as a pre-requisite for further science study but a means of developing a manipulative skill development. The teaching of biology in secondary schools could be effective if teachers' classroom practice is prioritized.

Teacher classroom practices refer to such practices that are implemented by teachers in the classroom that influence students' outcomes (Muijs et al., 2014). They are teaching approaches deployed by the teacher in the classroom to bring about effective learning as well as improved academic achievement of students. According to Sadeghi, Khezrlou and Modirkhameneh (2017), some of the classroom practices employed by the teacher include: the advancement of thinking skills, the development of creative problem solving approaches, use of suitable approaches and materials, ease of autonomous research, and knowledge of affective needs. In the context of the current study, classroom practices embody activities or instructional strategies employed by biology teachers in the classroom to drive home their lesson. However, teacher classroom practices can be divided into three domains: keeping an adequate classroom management to facilitate both socio-emotional and academic student's progress (Vandenbroucke,Spilt, Verschueren, Piccinin & Baeyens, 2018); provision of high quality instruction that encourage students' critical thinking and analysis (Kraft,Blazar & Hogan, 2018; Stockard,Wood, Coughlin & Khoury, 2018); and establishing supportive

teacher-students relationships (Korpershoek et al., 2016).Within the context of the current study, teacher classroom practices that can be adopted by biology teachers include instructional strategies, classroom management and student engagement.

Instructional strategies refer to the techniques employed by a teacher to facilitate effective learning. The instructional strategies adopted by science teachers that pertain to how the curriculum can be modified and how science content can be presented to the students are largely influenced by their pedagogical content knowledge (Sofianidis&Kallery, 2021). This knowledge could further help the teacher in matters of classroom management.

Classroom management is the art of creating and maintaining a classroom environment that grants students the opportunity to engage in meaningful learning. Similarly, lower self-efficacy in classroom management can culminate in disruptive student behaviors; a reflection of poor classroom management (Varghese, Garwood, Bratsch-Hines,& Vernon-Feagans, 2016). On the contrary, a teacher with a high sense of self-efficacy is bound to be efficient in classroom management.

Student engagement refers the teaching of students the relevance of working together towards the accomplishment of an instructional goal (Fredricks, 2014). The author further noted that high-quality teacher–student relationships are a key factor in determining student engagement. Uden, Ritzen, and Pieters (2013) found that teacher support, positive teacher-student relationships, structure, support, and challenging tasks have been associated with student eng2agement. Teacher self-efficacy beliefs influenced student engagement as well as a conceptual framework for effective teaching (Cason, 2018).

Teachers' self-efficacy focuses on their judgments of capacity to successfully organize and execute actions required to perform instructional tasks and by extension, exert a positive impact on students' learning (Perera,Calkins,& Part, 2019). Contextually, it can further be defined as teachers' confidence in their ability to use various teaching approaches to implement the contents of the biology curriculum in classroom situation. In the observation of Al-Alwan and Mahasneh (2014), teachers with a high sense of efficacy exhibit high levels of planning, management, organization are open to novel ideas and are more willing to experiment with new methods to better meet the needs of their students. Similarly, Katz and Stupel (2016) found that teachers with high self-efficacy invests much time in planning; collaborating with peers are open to implementing innovative ideas; perceive students' mistakes as learning and growth opportunities as well as are committed to eliciting and

maintaining students' classroom engagement. Deductively, teachers' self-efficacy could influence their classroom practices.

In secondary schools in Awka South Local Government Area of Anambra State, the researcher observed that unsatisfactory state of classroom management, students' engagement as well as instructional delivery exist. This is evidenced by the fact that some Biology teachers do not employ the requisite teaching activities and learning experiences to drive home their lesson. Although, there are many variables that may interplay with classroom practices in secondary schools, the researcher is interested in investigating the Biology teachers' perceptions of the influence of their self-efficacy on their classroom practices in Awka South Local Government area, Anambra State.

Purpose of the Study

The main purpose of this study was to determine the biology teachers' perceptions of the influence of their self-efficacy on their classroom practices in Awka South Local Government Area, Anambra State**.** Specifically, the study sought to determine:

1. Biology teachers' perceptions of the influence of their self-efficacy on instructional strategies in Awka South LGA.
2. Biology teachers' perceptions of the influence of their self-efficacy on classroom management in Awka South LGA.
3. Biology teachers' perceptions of the influence of their self-efficacy on student engagement in Awka South LGA.

Research Questions

The following research questions guided the study:

1. What is the Biology teachers' mean perception on the influence of their self-efficacy on 2instructional strategies in Awka South LGA?
2. What is the Biology teachers' mean perception on the influence of their self-efficacy on classroom management in Awka South LGA?
3. What is the Biology teachers' mean perception on the influence of their self-efficacy on student engagement in Awka South LGA?

Methods

The study adopted survey research design. According to Nworgu (2015), survey research design seeks to collect and analyze data from a group of items or people which are studied from only a few people or items deemed to be representative of the entire group. The population of the study was made up of 58 Biology teachers in public secondary schools in Awka South LGA of Anambra State. No sampling was done as the population was of manageable size. Questionnaire titled 'Biology Teachers' Perceptions on the Influence of their Self-Efficacy on their Classroom Practices (BTPISECP)' was used to collect data. BTPISECP is divided into three clusters – one, two and three. Cluster one sought information on Biology teachers' perceptions of the influence of their self-efficacy on instructional strategies and contains eight items. Cluster two sought information on Biology teachers' perceptions of the influence of their self-efficacy on classroom management and contains eight items while Cluster three sought information on Biology teachers' perceptions of the influence of their self-efficacy on student engagement and contains eight items. BTPISECP was structured in such a manner that the respondents responded in a four-point scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with numerical indexes of 4, 3, 2 and 1 respectively. BTPISECP was validated by three experts in NnamdiAzikiwe University, Awka. The reliability of BTPISECP was established by administering it to 15 Biology teachers in Awka North LGA which is outside the study area. The internal consistency of the items in the BTPISECP was determined using Cronbach alpha statistics which yielded alpha coefficient value of 0.83. This value was considered adequate and the BTPISECP reliable. Data collected were analyzed using mean.

RESULTS

Table 1: Biology Teachers' Perceptions of the Influence of their Self-Efficacy on Instructional Strategies.

S/N	I perceive that:	Mean	Remark
1.	I have confidence in my ability to make students understand biology concepts through questioning.	2.75	Agree
2.	I'm confident in my ability to use rewards and reinforcements at appropriate times.	2.70	Agree
3.	I have confidence in my ability to remodel Biology lessons based on students' needs.	3.15	Agree
4.	I lack confidence in my capability to summarize lessons for better students' retention.	1.96	Disagree

5.	I have confidence in my ability to use the laboratory to concretize practical lessons.	2.77	Agree
6.	I lack confidence in my capacity to vary my teaching strategies to facilitate learning.	2.42	Disagree
7.	I have confidence in my ability to assess existing knowledge to guide lesson planning	2.60	Agree
8.	I lack confidence in my ability to improvise unavailable instructional materials to drive home my lesson8s.	2.05	Disagree
	Cluster Mean	**2.60**	**Agree**

Data in Table 1 show that item 3 has the highest mean score of 3.15. This shows that agoodnumber of the respondents are in agreement that they have confidence in their ability to remodel Biology lessons based on students' needs. This is followed by item 5 with a mean score of 2.77; indicating that also a good number of respondents agree that they have confidence in their ability to use the laboratory to concretize practical lessons. Items 4, 6 and 8have mean scores less than the cut-off mean of 2.50 which indicates that the respondents are in disagreement with those listed items. The cluster mean of 2.60 shows that the respondents perceive that self-efficacy positively influence their instructional strategies.

Table 2: Biology Teachers' Perceptions of the Influence of their Self-Efficacy on Classroom Management.

S/N	**I perceive that**:	**Mean**	**Remark**
9.	I'm confident in my capacity to make my expectations clear to students.	2.64	Agree
10.	I'm not confident in my ability to device techniques to redirect a student in my class that is becoming disruptive and noisy.	2.07	Disagree
11.	I have confidence in my ability to increase the retention of students in the next class who could not remember information I gave in the previous class.	3.10	Agree
12.	I'm confident in my ability to adjust to the level of a student that is having troubles with assignment.	3.36	Agree
13.	I am not confident in my ability to communicate to students about my seriousness about a particular behaviour.	2.18	Disagree
14.	I have confidence in my capability to keep a few problematic students from ruining my class.	3.00	Agree
15.	I have no confidence in my ability to keep track of several activities in the class.	2.43	Disagree
16.	I have confidence in my ability of getting back students who stop working in class.	2.72	Agree

	Cluster Mean	**2.69**	**Agree**

Data in Table 2 show that item 12 has the highest mean score of 3.36. This shows that a good number of the respondents are in agreement that they have confidence in their ability to adjust to the level of a student that is having troubles with assignment. This is followed by item 11 with a mean score of 3.10; indicating that also a good number of respondents agree that they have confidence in their ability to increase the retention of students in the next class who could not remember information I gave in the previous class. Items 10, 13 and 15have mean scores less than the cut-off mean of 2.50 which indicates that the respondents are in disagreement with those listed items. The cluster means of 2.69 shows that the respondents perceive that self-efficacy positively influence their classroom management.

Table 3: Biology Teachers' Perceptions of the Influence of their Self-Efficacy on Student Engagement.

S/N	I perceive that:	**Mean**	**Remark**
17.	I'm confident in my capacity to make my students make a list of important items in Biology and memorize them.	2.75	Agree
18.	I'm confident in my ability to get my students involved in critical thinking.	2.50	Agree
19.	I have no confidence in my ability to help students analyze basic elements of an idea, experience, or theory.	2.36	Disagree
20.	I'm confident in my ability to make my students apply theories or concepts to practical problems or in new situations.	2.61	Agree
21.	I am confident in my ability to make my students keep up with the weekly classwork and assignments for Biology subject.	2.57	Agree
22.	I have confidence in my capability to make my students practice what they have been taught in Biology lesson by saying the material to themselves over and over.	2.82	Agree
23.	I have no confidence in my ability to help my students in making judgments about the value of information, arguments, or methods.	2.40	Disagree
24.	I have no confidence in my ability of getting my students to apply ideas from readings in other class activities such as lecture and discussion.	2.35	Disagree
	Cluster Mean	**2.55**	**Agree**

Data in Table 3 show that item 22 has the highest mean score of 2.82. This shows that the good numbers of the respondents are in agreement that they have confidence in their ability to make their students practice what they have been taught in Biology lesson by saying the

material to themselves over and over. This is followed by item 17 with a mean score of 2.75; indicating that many of respondents also agree that they have confidence in their ability to make their students make a list of important items in Biology and memorize them. Items 19, 23 and 24have mean scores less than the cut-off mean of 2.50 which indicates that the respondents are in disagreement with those listed items. The cluster means of 2.55 shows that the respondents perceive that self-efficacy positively influence their student engagement.

Discussion

The findings of the study indicated that Biology teachers perceived that self-efficacy positively influenced their use of instructional strategies. This is attributed to the fact that Biology teachers are expected to be persuasive in the use of their instructional strategies in order to drive home their lesson. More so, for a science subject like Biology, students are bound to show favourable disposition towards a teacher that is self-efficacious in the use of instructional strategies for effective learning. The revelation of the finding of the current study is in tandem with the position of Perera, Calkins and Part(2019) that teachers' self-efficacy focuses on their judgments of capacity to successfully organize and execute actions required to perform instructional tasks and by extension, exert a positive impact on students' learning. Thus, teacher self-efficacy is integral to effective teaching and learning in secondary schools.

The revelation of the findings of the study is that Biology teachers perceived that self-efficacy positively influenced their use of classroom management. This implies that teachers' self-efficacy is a pre-condition for class control. Put differently, the exertion of teacher self-efficacy in the classroom is capable of managing disruptive behaviours among students in a Biology class. The indication of the finding of the current study corroborates with the finding of Varghese, et al. (2016) that lower self-efficacy in classroom management can culminate in disruptive student behaviors8; a reflection of poor classroom management. In contrast, a teacher with a high sense of self-efficacy is bound to be efficient in classroom management.

The indication of the findings of the study is that Biology teachers perceived that self-efficacy positively influenced student engagement. In other words, the extent to which a student feels engaged in the classroom is dependent on teachers' self-efficacy. Student engagement is enabled by teacher-student relationship which is sustained by teachers' self-efficacy. Lending credence to this assertion, Fredricks(2014) noted that high-quality teacher–student relationships are a key factor in determining student engagement. In similar vein,

Uden, Ritzen, and Pieters (2013) found that teacher support, positive teacher-student relationships, structure, support, and challenging tasks have been associated with student engagement. The finding of the current study is in consonance with that of Cason (2018) who found that teacher self-efficacy beliefs influenced student engagement as well as a conceptual framework for effective teaching.

Conclusions

In line with the findings of the study, it was concluded that Biology teachers perceive that their self-efficacy positively influenced their classroom practices. This implies that Biology teachers' self-efficacy had a positive influence on their use of instructional strategies, classroom management and student engagement in secondary schools.

Recommendations

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

1. Government should organize seminars and workshops for Biology teachers on the need to exude self-efficacy for efficient use of instructional strategies.
2. Biology teachers should make conscious efforts towards sustaining their self-efficacy for efficient classroom management.
3. Biology teachers should continuously exude self-efficacy with a view to engendering an efficient student classroom engagement.

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TEACHING CHEMISTRY THROUGH IDENTIFICATION OF SCIENCE PROCESS SKILL INVOLVED IN THE PRODUCTION OF PERFUME USING PINEAPPLE RIND

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Abstract

The study was carried out to determine the science process skills involved in the production of perfume using pineapple rind. The study was an experimental design which employed a sample of8 one hundred (100) SS2 chemistry students randomly drawn from four co-education schools in Onitsha Education Zone. Two research questions and one hypothesis guided the study. Process skills observation guide was used to collect the data. The instrument was validated. Mean and standard deviation were used for data analysis and z test was used to test the hypothesis at the significance level of 0.05. From the findings, it was observed that almost all the science process skills listed were involved in the production of perfume using pineapple rind. Gender was not a significant factor in the level of acquisition of the science process skills by students during the production. The findings also showed that perfume as an improvised resource material enhances and increases the students' science process skills and this makes the understanding of chemistry concepts more concrete rather than abstract. Recommendations were however made.

Keywords: Chemistry, Science process skills, Production, perfume, Pineapple rind,

Introduction

The word science comes from a Latin word "scientia" meaning "knowledge" and in broadest sense is a systematic knowledge-base or prescriptive practice being capable of resulting in prediction. It is the knowledge attained through experimentation especially as obtained and tested through scientific method concerned with the physical world. Science is the origin of subjective observations on which early man based empirical rules for the practical utilization of knowledge (Chikobi, 2016). Chikobi maintained that science is a means of providing explanations for certain events, occurrences and phenomena in nature using acceptable laws, theories, principles and concepts.

Science is an accumulated and systematized learning of knowledge of natural phenomena. The origin of science has been traced to the crude and often subjective observations on which early man based empirical rules for the practical utilization of knowledge (Uzogulu, 2018). The progress of science is marked out not only by an accumulation of scientific knowledge but by the e8mergence of the scientific method and of the scientific attitude (Okebukola, 2015). Science has proved itself indispensable in the improvement, development and civilization of mankind, as well as in the skilled manpower where it is the bedrock of productive activity.

Science is dynamic in nature and new methods and strategies are continually being evolved to facilitate its teaching, hence, teachers need to improve their knowledge by attending training programmes. These updates will enable them live up to expectation by exhibiting mastery of subject matter as well as distinguish themselves as experts in pedagogy. Njelita (2017) added that science enriches the young with facts, principles and skills as tool for building the natural world. Okeke (2019) observed that science is a dynamic human activity concerned with understanding and helps man to know more about the universe. Without the application of science it would have been impossible for man to explore the other planets of the universe. Also, the awareness of the existence of other planets would not have been realized. Science can be studied in collaboration with education in institutions of higher learning as science education. Science education exposes students to the development in science skills. This will enable them face challenges, make decisions, develop survival strategies and learn to live effectively within the global community (Federal Ministry of Education, 2017). As a discipline, science education is considered as the most valuable tool for human development that is why it was included in the curriculum so as to meet up certain goals of the nation's development.

One of the most fundamental subjects of natural science is chemistry. Chemistry involves experimentation and the learner is required to observe, record, calculate and make intelligent references (Nnoli, 2021). Chemistry deals with the composition, properties and uses of matter. She maintained that chemistry is the catalyst for sustainable national development. Chemistry is also a subject that is very essential for human survival. It is an aspect that deals with nature of matter and how matter can be transformed into useful products. It is the technology we enjoy today.

Science process skills are commonly used to describe a set of broadly transferable abilities that are reflective of what scientists do. Science educators have argued that teaching students science facts is not as important as developing their science process skills so that they can learn this knowledge on their own (Nkwoma, 2018). Science process skills involve display of expertise in ordered actions designed to enhance science, which is attained through practice. Science process skills expose the learners to operate like scientists and these process skills when acquired could be applied in non-scientific situations (Njelita, 2017). The significance of science process skills highlighted above could be meaningful when the students exhibit competence in them particularly at the informative stage in science learning in schools. These skills when acquired will be carried over to higher education and will as well be utilized in solving everyday 8problems. Low acquisition of science process skills by the students has also been mentioned as the major factors militating against achievement in chemistry. Science achievement particularly chemistry cannot be realized without the acquisition of science process skills. Teachers also need to be patient especially with students that have difficulties in acquiring process skills. When we teach students to use process skills, we are also teaching them skills in every area of their lives. Science process skills are integrated together when scientists design and carryout experiments.
Active engagement with science will likely make students to become more interested and have more positive attitude towards science. It is in realization of this, that the Federal Government of Nigeria emphatically incorporated student's acquisition of the process skills as an objective of the National Policy on Education (NPE, 2017).

Gender refers to the social attributes and opportunities associated with being male or female and relationship among women and men, boys and girls as well as the relationship among women and among men. Gender equality is an issue that affects the lives and future of women as much as it does men. Chemistry teachers are therefore expected to expose learners to activities that will aid them in the acquisition of science process skills, such as the identification of the science process skills involved in the production of perfume using pineapple rind.

Pineapple (ananas comosus) is in the family of Bromeliaceae and from the specie of sorosis (A2dey, 2018). It is a multiple or composite fruit which develops from a number of flowers juxtaposed together. Historians believed that pineapple originated in Brazil in South America. Thailand, Philippines, Brazil and China are the main pineapple producers in the world supplying 50% of the total output. The Spanish introduced it to the Philippine and Hawaii in the early 19^{th} century, the first Commercial of its plantation was in 1886 in Zimbabwe and Guam. According to Chair (2019), many people said that the fruit was first introduced in Hawaii when a Spanish ship brought it in 1500. The fruit was cultivated successfully in Europe and pineapple pits began in 1720. But nowadays, together with India, Nigeria, Indonesia, Mexico, Costa Rica and Kenya form the remaining 50% of pineapple producers. The rind of pineapple is the tough outer skin on tasty tropical fruit. You can recognize the rind as the parts of pineapple that you do not usually eat.

Perfume is a mixture of fragrant essential oils or aroma compounds, fixative and solvents, used to give the human body, animal, food, objects and living spaces a pleasant scent (Chair, 2019). Perfumery or the art of making perfume began in ancient Mesopotamia and Egypt and was further refined by the Romans and Persians. According to Chair, perfumes have been known to exist in some of the earliest human civilizations either through ancient text or from archeological digs. Modern perfumery began in the late 19^{th} century with the commercial synthesis of aroma compounds such as vanillin or coumanin, which allowed for the composition of perfumes with smells previously unattainable solely from natural aromatic alone (Beychok, (2017). Production is the process of making or growing something in large amounts, hence, the researcher intends to find out the science process skills in the production of perfume (vanillin) using pineapple rind.

Statement of the Problem

Nigeria is a country endowed with huge natural resources to produced finished products for - her basic needs, but fact still remains that the skills needed for such productions is not inculcated to the young school leavers. This is partly due to the emphasis on theory teaching and little attention to practical theory which could have equipped the students with the necessary process skills that would help them engage in production of goods and also serve as a means of employment to them after school. Chemistry is taught by the combination of teaching-learning using discussion or simple demonstration methods, which have not helped in improving student's achievement in chemistry. Activity-based teaching should be encouraged in teaching chemistry in other to help students acquire more process skills. Hence, this study determines to investigate the process skills involve among chemistry students through the production of perfume from pineapple rind.

Purpose of the study

The purpose of this study was to examine the teaching of chemistry through identification of science process skill involved in the production of perfume using pineapple rind. Specifically, the study identified;

1. the science process skills involved in the production of perfume from pineapple rind.
2. the influence of gender on acquisition of science process skills.

Research Questions

The following research questions were formulated to guide the study:

3. What are the science process skills involved in the production of perfume from pineapple rind?
4. To what extent do gender influence acquisition of science process skills during the production of perfume using pineapple rind?

Hypothesis

The null hypothesis was tested at 0.05 level of significance.

1. There is no significant difference between male and female students in the acquisition of science process skills during the production of perfume using pineapple rind.

Methods

The research design adopted for this study was pure experimental. The study was carried out in senior secondary school in Onitsha North Local Government Area of Anambra State. The 8population of this study comprised the entire Senior Secondary School three (SS2) chemistry students in the 32 (Thirty two) public secondary schools in Onitsha Education Zone of Anambra State. The sample for the study comprised 100 (One hundred) SS2 chemistry students. To obtain this sample, all the government owned secondary schools in Onitsha Education Zone were first stratified into boys, girls and co-educational schools. Four schools were selected by stratified random sampling from the 14 co- educational schools in the zone. Two schools were selected from Onitsha north Local Government Area with seven (7) co-educational schools; one school was selected from Onitsha South Local Government Area with two (2) co-educational schools and one school was selected from Ogbaru Local Government Area with five (5) co-education schools. The instrument used for data collection was process skills observation Guide (POG) which was subjected to face validity. The POG was developed based on experiences of an expert in educational psychology and three experienced chemistry teachers including the researcher. The guide was to identify the process skills that are involved in the production of perfum2e using pineapple rind. The instrument consists of 15 items rated on 4 point scale. Process skills with mean value of 2.50 and above indicated mostly involved, while those with mean value below 2.50 were regarded as not involved.

Method of extraction of perfume from pineapple fruit was maceration/solvent extraction method and the solvent used was ethanol. Simple apparatus used includes grater, knives, pot, kerosene stove. The air dried fresh rind (peels) of pineapple fruit was placed on a chemical balance to determine the mass. The rind was crushed and grinded into particles by means of grinding machine. The materials were soaked with 10ml of ethanol. The soaked crushed rind was allowed to stand for 2days to allow the solid particles to be extracted by the solvent. The concentrate or the filtrate was collected by decantation and sieving separation techniques. The resultant solution was boiled for 2-3 hours to evaporate the ethanol, leaving the liquid fragrant. The alkalinity or acidity of the liquid fragrant (perfume) was tested using litmus paper.

The data were collected and analyzed using mean and standard deviation. Z-test was used to test the null hypothesis at the significance level of 0.05. The process skill that has a mean value of 2.50 and above indicates positive response while the process skills that has mean value of 2.49 and below indicates negative response. The criteria mean is 2.50.

Results

Research Question One: What are the science Process skills involved in the production of pineapple rind?

Table 1: Mean rating scores and Standard Deviation of chemistry students on science process skills involved in the production of perfume using pineapple rind.

S/N	Process Skills	Means	Standard Deviation
1.	Observing	2.85	1.15
2.	Classifying	2.20	1.03
3.	Communicating	1.80	0.98
4.	Measuring	2.85	1.19
5.	Counting and using numbers	3.20	0.82
6.	Inferring	2.70	1.14
7.	Predicting	2.55	1.24
8.	Experimenting	2.95	1.02
9.	Questioning	2.80	1.35
10.	Manipulating	2.70	1,61
11.	Formulating hypothesis	2.30	1.23
12.	Controlling variable	2.65	1.24
13.	Formulating models	2.75	1.09
14.	Interpreting data	2.72	1.03
15.	Making operational definitions	2.58	0.94
Total:		**39.60**	**17.06**

Table 1 shows the mean scores and standard deviation of process skills achieved in the production of perfume using pineapple rind. The mean scores revealed that 12 process skills out of 15 were acquired. Only classifying, communicating and formulating hypothesis were not acquired. It also shows that the acquisition of science process skills increased in the production of perfume.

Research Question Two: To what extent do gender influence acquisition of science process skills during the production of perfume using pineapple rind.

Table 2: Mean scores on gender influence on acquisition of science process skills during the production of perfume using pineapple rind.

Table 2: Mean ratings scores of male and female students on the acquisition of science process skills.

Gender	Number of students	Means	SD
Males	40	2.58	0.67
Females	60	2.68	0.87

Table 2 shows that the mean scores of females are higher than those of males in observing, communicating, measuring, counting and using numbers, inferring, experimenting, formulating, hypothesis, controlling variables, interpreting data and making operational definitions. The males obtained higher mean scores than the females in classifying, predicting, questioning, manipulating, and formulating models. Males exhibited low acquisition in measuring, counting and using numbers, inferring and experimenting. Females exhibited low acquisition in classifying, questioning and manipulating, predicting, formulating models.

Hypothesis:

There is no significant difference between male and female students in the acquisition of science process skills during the production of perfume using pineapple rind.

Table 3: Z-test of the mean ratings of male and female students on the acquisition of science process skills

Gender	Number of students	Means	SD diff		Z - cal	Z – crit
Males	40	2.58	0.67			
				98	0.13	1.960
Females	60	2.68	0.87			

From table 3, the calculated z-value is 0.13 and z-critical value is 1.960. Since the Z-calculated is less than the critical z value. The null hypothesis is therefore accepted. Hence, there is no significant difference between male and female students in the acquisition of science process skills during the production of perfume using pineapple rind.

Discussion

In the discussion of the identification of the science process skills involve in the production of perfume using pineapple rind, it was observed that12 process skills out of 15 was identified to be acquired by students. The mean scores of female are higher than those of male in observing, communicating, measuring, counting and using numbers, inferring, experimenting, formulating hypothesis, controlling variables, of interpretation data and making operational definitions. Both exhibited low acquisition in inferring and experimenting. There is no significant difference between male and female students in the acquisition of science process skills during the production of perfume using pineapple rind. It was also observed that the production of perfume enhances and increases the students' science process skills and this makes the understanding of chemistry concepts more concrete rather than abstract.

Recommendations

1. The findings of this study revealed that students exhibited low acquisition in classifying, communicating and formulating hypothesis. Teachers are therefore, expected to emphasize the inculcation of theses process skills in students by the use of appropriate methods and teaching aids in their teaching.
2. Chemistry teachers should attend workshops, seminars and conferences to acquaint themselves with modern methods of teaching especially those that are learner-centered and ways of inculcating science process skills.
3. The curriculum planners will help to determine the extent to which the stated objectives in chemistry are achieved. This will guide the teacher in helping students to identify the process skills exhibited in a particular production and those not exhibited.
4. The stated objectives by curriculum planners will also enable teachers to prepare resources, materials and equipment for inculcation of these science process skills for better performance of students. It will also provide them with empirical evidence which is necessary for important decisions in science curriculum.
5. The teacher should ensure that students have more interest in learning that involves their full participation; hand-on and minds on.
6. The government being aware of lack of teaching aids and equipment for science teaching in our schools should try to provide schools with these materials and equipments like science laboratories for effective teaching of science which will enhance the acquisition of these process skills.
7. The curriculum theory and curriculum should not start from students as learners but from students' entitlement or access to knowledge. This will guarantee youths future and create peaceful and prosperous society.

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RE–ENGINEERING CHEMISTRY EDUCATION FOR NATIONAL DEVELOPMENT THROUGH DEVELOPMENT OF CREATIVITY SKILLS IN SECONDARY SCHOOL STUDENTS IN ANAMBRA STATE

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Abstract

The purpose of this study was to find out how chemistry education can be re-engineered for national development through development of creativity skills in secondary school students. Four research questions guided the study. A survey research design was used for the study. The population was all the chemistry teachers in public secondary schools in the six education zones of Anambra State. The sample used for the study was ninety four (94) chemistry teachers selected from the fifty four (54) secondary schools used for the study. A structured questionnaire was used as an instrument to collect data for the study. The instrument was validated by experts and it has a reliability coefficient of 0.83 using Cronbach Alpha technique. The data collected was analyzed using arithmetic mean. The findings of the study among others indicated that the chemistry teachers used for the study were aware of most of the creativity skills that can be used to re-engineer chemistry education for national development but t2hey only teach to develop those skills in their students to a moderate or low extent. Only few of the teachers teach to develop those skills to a high extent. It was recommended among others that practical activities should be introduced and enforced in the teaching and learning of chemistry to develop skills in students.

Key words: Re-engineering, National development, Creativity skills, Chemistry education

Introduction

National Development is a process of reconstruction and development in various dimensions of a nation and development of individuals. It includes full growth and expansion of our industries, agriculture, and education, social, religious and cultural institution. National development includes all aspects of life of an individual and the nation (Bawa, 2022). It is the ability of a country to improve the social welfare of its citizens that is the capacity of a country to raise the standard of living of its residents. Dimensions of national development include educational, health, cultural, social and technological. We can improve national development by promoting education in general and science education in particular.

Science education is a veritable instrument for national development. Chemistry is an important science subject due to its nature and there is no controversy in understanding that chemistry due to its nature is of paramount importance for national development. Chemistry affects the people of our planets, protect and preserve our health, ecology, culture and wealth. Its principles, theories, technique and effective applications are the pedals for many industrial processes (Nleonu and Ezeibe, 2020) .Chemistry addresses the needs of majority through its relevance and functionality in content , practice and application (Egolum and Njelita,2015).

Chemistry education has been indentified to be one of the major bedrock for the transformation of our national economy (Udofia and Ekong, 2017). It is considered as a key agent of development either as a way of developing human capacity, increasing the skilled workforce or modernization or as a matter of personal freedom, developing capability and empowerment (Ayodele, 2018). Chemistry teaching should therefore enable young people have access to new knowledge and to expect change. For the change to be scientifically reasonable and meaningful, chemistry teachers must try to re-engineer chemistry education so as to impact creativity skills in their students and thus make them creative. When one is creative, it means that person has productive learning and can find new solutions to problems.

Creativity is all about originality, imagination, inspiration, ingenuity, inventiveness, resourcefulness and vision (Ibiri, 2014). Creativity is a mental activity performed where there is no prior correct solution or answer (Egolum, Igboegwu & Okonkwo, 2015). Creativity is the act of training new and imaginative ideas into reality (Naiman, 2010). It is involves two processes thinking and then producing. It is an experience of thinking characterized by a high d2egree of innovation, originality, divergent thinking and risk- taking. It requires passion and commitment. Creativity involves different kinds of intelligent working together. It is a universal concept and can be developed through training and practices (Ugwuda and Odo, 2014). According to Rees (2020), if we wish to encourage more students to do chemistry, we need to do more to emphasize the creativity that lies at the heart of scientific endeavor. According to Otuka (2004), creativity is something everyone e possesses in varying degree; everyone is born with some creative potentials. Creativity occurs at almost all ages and in all fields of human endeavor

Creativity is inherent in every person, but most people lose it as a result of influence of various factors (Maslow, 1999). The development of student's creativity should be one of the main goals of the activities of secondary school teachers. The nature and degree of development of student's creativity depends on their skill, personal competence as well as the application of innovative methods in teaching (Egolum, Igboegwu & Okonkwo, 2015) and forms of conducing classes. Creativity requires a safe environment in which to play, exercise autonomy and take risks. Creativity is a cluster of skills that are needed to produce ideas that are both original and valuable (Sternberg in Pugliese, 2020). Skills are expertness, practical

ability, dexterity and facility for doing something such as observing, cutting, manipulating, assembling, classifying, repairing, generalization and so on. Creativity skills is learned abilities related to bring forward more novel and useful outcomes and products which can be developed deliberately and enhances through practice, feedback and diverse applications. When students creativity skills are developed when teaching chemistry, they will graduate and be self reliant instead of looking only for white collar jobs which are non-existence.

One of the goals of education is to foster and encourage creativity and critical thinking (Ugwu, 2008). But in Nigeria, more emphasis is placed on measuring student's performance and knowledge acquisition with total neglect to skill acquisition and creativity, also in almost all the developed countries in the world, one time or the other involved re-engineering science education with different methods for different purposes (Ibraheem, 2012). Nigeria as one of the developing countries in the world will not be an exception in the area of re-engineering its science education generally and chemistry in particulars.

To re-engineer chemistry education is to meet the emerging needs of population and the nation as a whole so that our nation will be lifted to higher realm economically, socially and technologically. To re-engineering chemistry education for creativity, the curriculum should be carefully designed to encourage inculcation of skills and adaptations in the use of innovative 82teaching approaches. Teachers need to have a clear understanding of what creativities skills are so that they can recognize them and develop them. Therefore the researchers want to find out if chemistry teachers are aware of creativity skills and if they use them and also how chemistry education can be re-engineered for national development through development of creativity skills in secondary school chemistry students

Purpose of the Study

The purpose of this study is to find out how chemistry educa2tion can be re-engineered for national development through development of creativity skills in secondary school students.

Specifically, the study sought to;

1. Find out the creativity skills needed to be developed in secondary school chemistry students to re-engineer chemistry education for national development
2. Determine the extent secondary school chemistry teachers teach to develop creativity skills needed for re-engineering chemistry education.
3. Ascertain the factors that hinder chemistry teachers in secondary schools from developing in their students creativity skills needed for re-engineering chemistry education.
4. Suggest strategies that can be used by secondary school chemistry teachers to re-engineer chemistry education through development of creativity skills in their students.

Research Questions

The following research questions guided the study;

1. What are the creativity skills needed to be developed in secondary school chemistry students to re-engineer chemistry education for national development?

2. To that extent do secondary school chemistry teachers teach to develop creativity skills needed for re-engineering chemistry education for national development?

3. What are the factors that hinder chemistry teachers in secondary schools from developing creativity skills needed for re-engineering chemistry education in their students?

4. What are the strategies that can be used by secondary school chemistry teachers to re-engineer chemistry education through development of creativity skills in their students?

Methods

The study adopted a survey research design because it is the best technique for obtaining the necessary data from a group and involves the use of questionnaire to determine the options, preferences, attitudes or perceptions of people about a particular situation. The study was conducted in the six (6) education zones of Anambra state of Nigeria. The population of the study was all the chemistry teachers in public secondary schools in the 6 zones. Purposive sampling technique was used to select nine schools from each of the 6 zones making it a total of fifty four (54) schools. The schools selected were those that have more than one or at least one chemistry teachers. All the chemistry teachers in the fifty four schools selected were used for the study so the sample size was ninety four (94) chemistry teachers.

The instrument used to collect data relevant for answering the research questions was a structured questionnaire termed chemistry teachers response on the creativity skills needed to re-engineer chemistry education for national development. The questionnaire had two sections (A and B). A contained the respondents biodata. Section B consisted of fifty one (51) items and was made up of four sections (i, ii, iii and iv). Items on sections (B) (I, iii and iv) was built on a four point rating scales of Likert type of Strongly Agree (SA) – 4 points, Agree (A)-3 points, Disagree (D)-2 points and Strongly Disagree (SD) – I point. Items on B11 was built on a four point rating scale of Likert type of Very High Extent (VHE) – 4 points, High Extent (HE)-3points, Moderate Extent (ME) -2 points and Low Extent (LE) – 1 point. The face and content validity of the instrument was determined by giving the questionnaire to 3 experts, two from science education department and one from the department of measurement and evaluation all from Nnamdi Azikiwe University Awka. The reliability of the instrument was done using Cronbach Alpha technique and the reliability coefficient was 0.83. Thus the instrument was considered reliable for the study. The instrument was administered to the respondents by the help of research attendants and a total of ninety four (94) questionnaires were returned. The data collected was analyzed using arithmetic mean with decision point 2.50. Items with means of 2.50 and above were accepted while items with means less than 2.50 were rejected.

Results

Research Question One: What are the creativity skills needed to be developed in secondary school chemistry students to re-engineer chemistry education for national development?

Table 1: Mean responses of chemistry teachers on the creativity skills needed to re-engineer chemistry education for national development

S/N	ITEMS	SD	A	D	SD	X	DECISION
1	Making observation	32	54	2	6	3.52	A
2	Imagination	18	33	24	19	2.53	A
3	Curiosity	27	30	28	9	2.80	A
4	Asking questions	40	42	4	8	3.21	A
5	Collaboration	31	26	20	17	2.76	A
6	Effective communication skills	50	25	11	8	3.21	A
7	Self motivation	42	32	19	2	3.23	A
8	Problem solving	42	40	9	5	32.31	A
9	Experiment	31	53	6	4	3.18	A
10	Developing own project	30	27	22	15	2.77	A
181	Effective data analysis	26	31	29	8	2.80	A
12	Net working	16	19	42	17	2.36	A
13	Open mindedness	26	39	24	5	2.91	A
8	**GRAND MEAN**					**2.97**	

Results on table 1 showed that all the items except networking were regarded as the creativity skills needed to re-engineer chemistry education for national development. They all had mean score above 2.50 except item 12 hence their grand mean was 2.9.

Research Question Two: To what extent do secondary school chemistry teachers teach to develop creativity skills needed for re- engineering chemistry education?

Table 2: Mean responses of chemistry teachers on the extent they teach to develop creativity skills in their students.

S/N	ITEMS	VHE	HE	ME	LE	X	DECISION
1	Marking observation	20	18	8	48	2.10	ME
2	Imagination	9	11	30	44	1.84	LE
3	Curiosity	7	19	50	18	2.16	ME
4	Asking questions	21	48	16	9	2.86	HE
5	Collaboration	15	20	41	18	2.34	ME
6	Effective communication skills	13	22	40	19	2.318	ME
7	Self motivation	15	9	46	24	2.16	ME
8	Problem solving	21	18	12	43	2.18	ME

9	Experiment	25	32	22	15	2.71	HE
10	Developing own project	11	43	17	25	2.47	ME
11	Effective data analysis	6	15	53	20	2.07	ME
12	Net working	6	20	23	45	1.86	LE
13	Open mindedness	8	22	20	44	1.94	LE
	GRAND MEAN					**2.23**	

Table 2 revealed that chemistry teachers used for the study use only items 4 and 9 to a high extent, items 3, 5, 6, 7, 8, 10 and 11 were used to a moderate extent while other items were used to a low extent. The grand mean of 2.23 indicated that the chemistry teachers used for the study teach to develop those creativity skills to a moderate extent.

Research Question Three: What are the factors that hinder chemistry teachers in secondary schools from developing creativity skills in their students?

Table 3: Means responses of chemistry teachers on the factors that hinder their development of creativity skills in secondary school chemistry students.

S/N	ITEMS	SA	A	D	SD	X	DECISION
1	Teaching method and techniques	41	39	5	9	3.19	A
2	Teachers insufficient practical skills	54	31	6	3	3.45	A
3	Learning environment the teacher teaches	19	50	17	8	2.85	A
4	Fear of taking risks	29	41	22	2	3.03	A
5	Educational qualification and experience possessed by the teachers	45	22	16	11	3.07	A
6	Teachers inability to instill problems solving skills in their student	33	48	10	3	3.80	A
7	Lack of collaboration between teachers	8	27	50	14	2.26	D
8	Insufficient application areas	27	41	23	3	2.98	A
9	Insufficient instructional facilities	43	36	11	4	3.26	A
10	Intensive curriculum	30	42	18	4	3.04	A

11	Expectation of the child's community	8	15	45	26	2.39	D
12	Lack of teachers self confidence	10	42	15	2.7	2.37	D
13	Methods for evaluating pupils progress	45	30		181	3.27	A
	GRAND MEAN					**3.00**	

Table 3 revealed that chemistry teachers used for the study agreed that all the items in the table except items 7, 11 and 12 were among the factors that hinder chemistry teachers from developing creativity skills in their students.

Research Question Four: What are the strategies that can be used by secondary school chemistry teachers to re-engineer chemistry education through development of creativity skills in their students?

Table 4: Mean responses of chemistry teachers on the strategies they can use to re-engineer chemistry through development of creativity skills in secondary school chemistry students

S/N	ITEMS	SA	A	D	SD	X	DECISION
1	Build basic problem solving skills	33	53	4	4	3.22	A
2	Provide opportunity for discovery	39	28	17	10	3.02	A
3	Stimulate curiosity & explanation	29	28	21	16	2.74	A
4	Build intrinsic motivation	18	39	20	17	2.62	A
5	Encourage confidence & willingness to take risks	16	27	42	9	2.53	A
6	Teach chemistry using creative approach	51	26	10	7	3.29	A
7	Experiment with activities where students can practice creative thinking	30	45	18	1	3.11	A
8	Explore different creative theories	31	40	21	2	3.06	A
9	Teach techniques and strategies for facilitating creative performance	35	40	14	5	3.12	A
10	Be present with students ideas	29	43	17	5	3.02	A

11	Create enabling environment	40	34	20	0	3.21	A
Grand mean					**2.99**		

Table 4 revealed that all the items on the table were among the strategies that can be used to re-engineer chemistry education through development of creativity skills as indicated by the chemistry teachers.

Discussion

The findings of the study on the creativity skills needed to re-engineer chemistry education for national development revealed that except networking, making observations, problem solving, experimenting, open mindedness, effective data analysis, curiosity among others were the creativity skills needed to re-engineer chemistry education for national development. This study is in agreement with the work of Abubakar (2012) who in his work opined that for students to engage in laboratory work, identity problem, develop hypothesis, plan experiments, conductor experiment, gather data and do effective data analysis, it needs creativity thinking and skills.

Findings in table 2 revealed that teachers used for the study teach to develop skills of asking questions and performing experiments to a high extent when teaching chemistry. They also agreed they teach to develop skills of curiosity, observation, self collaboration, effective communication, self motivation, problem solving, making students develop their own projects and effective data analysis to a moderate extents but teach to develop the skills of imagination, networking and open – mindedness to a low extent.

Responses of teachers used for the study showed in table 3 that teaching methods and techniques, intensive curriculum, expectations of the child's community, fear of taking risk, and insufficient instructional materials among others are factors that hinder chemistry teachers from development of creativity skills in their students. This is in agreement with the work of Akkanat and Murat (2015) who found out that chemistry teachers do not have enough knowledge about teaching methods and techniques that were efficient in developing creativity ability of their students. They also found out that the allowed weekly lesson hours and curriculum was not effective for developing creativity. This is because chemistry education programme is too intense and weekly lesson hours for chemistry classes do not allow implementing any activities to develop creativity. But the study disagrees with the study of Akkanat and Murat (2015) in the area of risk taking is one of the factors that prevent them from developing skills in their students.

Table 4 revealed that creating enabling environment, teaching chemistry using creative approach, building basic problem - solving skills in students, developing motivation and willingness to take risks among others were among the strategies that can be used to re-engineer chemistry education through development if creativity skills in students.

Conclusion

Creativity is a trait that fuels the future. It serves to inspire students and should be integrated into every part of learning when planning and designing learning. When designing learning experiences, teachers can plan and frame curriculum and provide instructional recourses that give student options, voice and choice in order to enable them to be creative. Chemistry education can be re-engineered for national development when students are allowed to explore their creativity in relevant interesting and worthwhile ways. Also all possible techniques of teaching chemistry in our schools should be applied so as to produce creative citizens that will be self- dependent and self – productive for national development.

Recommendations

To re-engineer chemistry education for creativity

1. Improvised and use of locally available materials for practical experiments should be encouraged in our educational system to equip our students for self reliance
2. Practical activities should be introduced and enforced in the teaching of most chemistry topics to remove the abstract nature of chemistry concepts and replaced them with concrete experiences for creativity.
3. Chemistry curriculum should be re-structured to enable students relate chemistry to nature and society to equip them in the adequate practical skills for industrial technicians or chemical artisans
4. Seminars, Conference and workshops on ICT and practical activities should be encouraged among chemistry teachers to help them have confidence and develop creativity skills they will impact in their students.
5. Undergraduate education should be made to foster creativities by making changes in the university teaching and academic human resource policies using research and connecting resources that have sustainable benefits.

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EFFECT OF MOTHER TONGUE TEACHING STRATEGY ON ACADEMIC ACHIEVEMENT OF JUNIOR SECONDARY SCHOOL STUDENTS IN MATHEMATICS IN IJEBU ODE, OGUN STATE

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Abstract

The study examined the effect of mother tongue teaching strategy on academic achievement of junior secondary school students' in mathematics. The purpose was to examine the effect of mother tongue teaching strategy on academic achievement of junior secondary school students' in mathematics, to examine the effect of gender on academic achievement of junior secondary school students' in mathematics and to examine the interaction effects between mother tongue teaching strategy and gender on academic achievement of junior secondary school students' in mathematics. The study adopted a pre−test, post−test and control group quasi experimental design. 150 students drawn from junior secondary schools in Ogun State were sampled and used for the study using purposive sampling techniques. A unified scheme of work for the students was utilized for the study. Mathematics Achievement Test (MAT) was used to collect data on students' achievement, which was validated by the school mathematics teachers, its reliability was ascertained by using split half method and the coefficient obtained was 0.77. The data obtained from the respondents were collated and analyzed using ANCOVA (Analysis2 of Co-variance). Findings revealed that there is a significant main and interaction effect of mother tongue teaching strategy, mother tongue and gender on the academic achievement of the students' in mathematics. Based on the findings it is recommended among other things that mother tongue should be employed in the teaching and learning process at junior secondary school level in order to internalize the love for mathematics and make the students mathematics friendly at their age.

Keywords: *Gender, Mother tongue, Mathematics, Academic Achievement and students.*

Introduction

Mathematics is branch of science which deals with numbers and their operations, that involves calculation, computation and solving of problems. Dictionary put Mathematics as the science of numbers and space or the science of measurement, quantity and magnitude. Asanre, Abiodun & Odupe (2019) reported that Mathematics has been recognized as one of the subjects which is vital in people's life, it may be in science, technology, business or in other walks of life. The main objective of teaching mathematics at secondary school level is to produce persons who will be orderly, logical, accurate and precise in thought. It is also the foundation of science and technology which are multifaceted and multifarious in nature Okereke (2006).

In Nigeria, one of the ways through which any school, be it at the primary, secondary or tertiary level is assessed, is on how serious mathematics education is handled (Igbojinwaekwu, 2013). That is, mathematics occupies an important position in the Nigerian Educational system and in the developmental processes of any nation. David (2006) opined that language is undoubtedly one of the most important areas of the curriculum. They are both means to an end and end themselves. That is, they provide a learner with the tools to communicate and at the same time an integral part of the creative process that result from this communication when the language arts thought with awareness, as well as enjoyment, students gain competence of their language and confidence of their language and confidence in them. They learn to integrate the components of language into all aspects of their lives.

Dorgu & Igbojinwaekwu (2016) opined that effective instructional use of a language requires weaving together three essential strands of teachers, that is knowledge of the subject matter, the language of medium of instruction and pedagogical knowledge. Aguiyi (2012) states that, language is the surest way through which people can retain, safeguard knowledge, wisdom and authentic c2ultural inherited from their ancestor, as well as, generation after them. Anna (2016) reported that, research has demonstrated that the quantity and quality of the language of instruction has some influence on the learning abilities students.

Dorgu & Igbojinwaekwu (2016) stated that the selection of a suitable language as medium of instruction is very important, because, it is generally accepted fact that, a child's learning is seriously distorted if he/she does not understand the language of instruction use in the school and more importantly, when the language of instruction use in the school creates a gap between the language of instruction/ interaction use at home. This is the exact problem, presently, experienced by Nigerian students/pupils in primary, secondary and tertiary institutions, where English Language is used as medium of instruction and Mother tongue used as language of interaction at home. The term "mother tongue" harks back to the notions that linguistic skills of a child are honed by the mother and therefore the language spoken by mother would be the primary language that the child 8would learns. Mother tongues is the language or are the language a person has learned from birth and

understands very well or within the c2ritical periods or that a person speak the best and so is often the basis for sociolinguistic identity.

In some countries, the term native language or mother tongue refers to the language of someone's ethnic group rather than one's first language. According toIvan (2006) stated that the term "mother tongue" was first used by Catholic Monks to designate a particular language they used. Similarly, the skills of being able to plan but a piece of writing or solving of mathematics problems can be applied in their second language once they have been learned and taught in their native language or mother tongue. It makes the teacher and the students express themselves freely when teaching and learning of mathematics using their mother tongue which helps in the performance of the students. Kolawole (2005) found out that students learn faster when taught in Mother Tongue. Mathematics taught in a child's mother tongue has a lot of advantage and effects such as overcoming limited knowledge of foreign mathematical vocabulary. Teaching in mother tongue also bring closer to students mathematics examples and concepts, it helps the students to develop a mathematical vocabulary in the Mother Tongue. It equally helps students who are literate in English to understand and appreciate mathematics.

The universe cannot be read until we have learnt the language and become familiar with the characters in which it is written. It is written in mathematical language, and the letters are triangles, circles and other geometrical figures, without which means it is humanly impossible to comprehend a single word (Anne, 2019). Also, Okeworo (2014) stated that, it is through mother tongue that the child acquires local knowledge of mathematics such as counting, addition, sub2traction, multiplication, division, measurements, telling the time as well as buying and selling activities. Later on when he goes to school, he transfers all these knowledge he has acquired in the local form to the learning of formal mathematics. Using Mother Tongue in teaching and learning of Mathematics could be of a great impact in the achievement of the students and can makes the students feel good about the school and subject taught.

Statement of the Problem

It is observed that Nigeria Indigenous Languages (Mother Tongue) have been rendered unimportant in the teaching and learning of mathematics and eventually led many students to low turnout in their performance. Also students who are not fluent in speaking English are not willing to express themselves in their mothers' tongues because of the fear of the other students, meanwhile there is barely few or no formal school setting as far as Nigeria is concerned that permits students to be taught mathematics in their mothers' tongues. This act as led to some of the students not being able to interpret the concepts of mathematics correctly thereby causing increase in poor performance in mathematics. This is a gap that needs attention hence the study looks at the effect of mother tongue on junior secondary school students' performance in Mathematics.

Purpose of the Study

The specific purposes of the study were to;

1. Examine the effect of mother tongue on students' performance in mathematics.
2. Examine the effect of gender on students' performance in mathematics.
3. Examine the interaction effect of gender and mother tongue on students' performance in mathematics.

Hypotheses

1. There is no significant effect of medium of instruction on students' performance in mathematics
2. There is no significant effect of gender on students' performance in mathematics
3. There is no significant interaction effect of gender and medium of instruction on students' performance in mathematics

Methods

The research design adopted a Pre – test, Post – test and Control group quasi experimental design for this study. This design and method is considered appropriate because it will carefully mark and record students' scores in different stages of the study. The population of the study comprised of 150 junior secondary school students in ijebu ode local government area of Ogun2 State, Nigeria, selected from two junior secondary schools by purposive sampling. From each school intact class of 75 students' was made use of. One of the schools served as the experimental group while the other serve as the control group. The data for the study were collected through the use of Mathematics Achievement Test (MAT) designed by the researcher. First section consists of the student's bio–data, while the second part consists of the test items. The instrument was validated by the senior colleague and as well as mathematics teachers in secondary schools for face and content validity. The reliability of the instrument was ascertained by using split half method and the reliability co–efficient of 0.77 were obtained. Data obtained were analyzed using Analysis of Covariance (ANCOVA).

Results

Table 1: One way analysis of Covariate (ANCOVA) of students' academic achievement in mathematics scores on treatment, gender and interaction.

Source	Type III sum of squares	Df	Mean Square	F.cal	Sig.
Corrected Model	224.899^{a}	2	011.245	8.612	.000
Intercept	4457.784	1	4457.784	3414.124	.000
SEX	.467	1	. 467	.357	.551
Medium of instruction	174.724	10	17.472	13.382	.000
SEX^{*}Medium of instruction	29.597	9	3.289	2.5192	.011
Error	168.434	129	1.306		

Total	6666.000	150
Corrected Total	393.333	149

Hypothesis 1: There is no si8gnificant effect of medium of instruction on students' performance in mathematics. From the table 1 above, it shows that the result is significant therefore the null hypothesis is rejected. Hence there is significant effect of medium of instruction on students' performance in mathematics.

Hypothesis 2: There is no significant effect of gender on student's performance in mathematics. From the table 1 above, it also shows that the null hypothesis is accepted. Hence there is no significant effect of gender on students' performance in mathematics.

Hypothesis 3: There is no significant interaction between gender and medium of instruction on students' performance in mathematics. From the analysis carried out above. The null hypothesis is rejected. Hence it shows that there is significant main interaction between medium of instruction and gender on students' performance in mathematics.

Conclusion

Teaching of Mathematics strictly in English alone should be de-emphasis to enable the mathematics teachers explain in the mother tongue to the students and make them understand whenever they are teach8ing. The use of the national language in our junior secondary schools should be encouraged; this will help to preserve our national culture and heritage. Textbooks writers, publishers and curriculum planners should work together with experts in mathematics so as to produce standard texts in mathematics for the students' mother tongues to gain its pride of place in schools for better understanding of the subject. Society and groups should be educated on the need to support mother tongue initiatives in the teaching and learning of mathematics should be extended to tertiary institution so as to increase the numbers of mathematics learners in schools.

Recommendations

The following recommendations were made based on the findings from the study:

1. Indigenous languages must not be only use but be taught and use properly at all level of educational most especially junior secondary schools and by ensuring adequate and suitable training for the teachers concerned.
2. The National Mathematics Centre (NMC) Abuja should address the mode of instruction to depend solely on the mother tongue.
3. Specialist in mother tongue in this lexical committee should be involved.
4. The use of mother tongue in the teaching of mathematics in secondary schools should be prioritized so as to improve the nation's technological basis.

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COMPARATIVE STUDY OF IDENTIFYING BIOLOGY ESSAY ERROR TYPES COMMITTED BY SCINECE AND NON SCIENCE STUDENTS IN SENIOR SECONDARY SCHOOL IN DEKIN

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Abstract

This study compared error types committed by science and non-science biology students in Senior Secondary School. The study was conducted in Anyigba, Dekina Local Government Area of Kogi State, Nigeria. Two research questions and one null hypothesis were used for the study. The study population comprise 764 ss2 biology students in public government secondary school in Anyigba while the sample used for the study consist of 240 samples, selected using stratified random sampling from 8 schools. The instrument used for data collection was Biology Test for identification of students essay Error Types developed by the researcher including the marking scheme used for data collection, which have b2een validated and found reliable at 0.87 using Pearson's Product Moment Correction Co-efficient. The researcher used descriptive survey design. The questions comprised of short answer questions from two topics in the biology syllabus. Data obtained from the science and non-science groups, error types and their frequencies were recorded. The hypothesis was tested using t-test for independent group at 0.05 level of significance. The result showed that there is significant mean difference in the frequency of error types among the science and non-science students in biology essay. Among the findings of the survey result showed that science and non-science senior secondary school ii biology student committed error, the least error includ2ed little knowledge of the topic. The most error types included poor approach to answering essay questions, poor expressions of English language, poor understanding of some basic concept in biology, inability to relate biological concepts to given situation, student depending on root memory rather than understanding biological concept to reason out solutions and student demonstrated lapses in spellings. Based on the findings of this study among others, revealed that secondary school students generally commit a number of errors and there was a significant difference in error types committed by student which also affect their performance in2 essay examination and hence the students as a whole. It is therefore recommended that biology teachers should teach the possible error type to the students as students awareness of these errors will help them to guide against committing them.

Keywords: Biology, Science, Non- Science

Introduction

Science and Technology have been identified and recognized as important instruments that could be used to effect socio-economic changes in the history of mankind. This is why science and technology education assumed a prominent place in Senior Secondary School Curricular and Biology is enlisted as one of the science subjects to be taught and learnt at that level of education. The educational curriculum of a nation is usually tailored to meet the needs and aspirations of the society. Federal Ministry of Education (FME, 2016) described Curriculum to represent the total experiences to which all learners must be exposed. It is obvious and susceptible to committing errors were real learning have not taking place since what was learned or experienced and skills acquired during learning could be retrieved from the memory and utilized in solving some related or similar problems. However, experimental psychologist believed that errors are committed as a conseq2uence of forgetting. Ertherton in 40 years ago "mentioned that forgetting is an act which is displaced in order to measure the quality of learning that occurred" from the foregoing related ability of forgetting but failure to learn is one of the reasons why student are unable to recall answers to examination questions accurately an commit all sort of errors which is otherwise avoidable.

Kerski (2012) in his view lamented that errors affect results and inhibit students in responding or solving problems correctly, an error in this study refers to misconception or incorrect presentation of facts or wrong answers specified2 in the procedure of a given problem in biology essay. Against this background, some of the examining educational bodies such as the West African Examination Council (WAEC) and the National Examination Council (NECO) are institutions put in place by government in order to help monitor through evaluating the quality and extent of the attainment of the objectives of the content of the Senior Secondary School Curriculum. This evaluation is further certificated by these bodies. The statistics of grades obtained by science candidate in WAEC examination in recent years have fallen below 45 percent (45%) for 2000-2010 under review (WAEC, 2015).

The poor performance in Biology have been attributed to the use of ineffective teaching and learning strategies and lack of appropriate learning environment under which biology teaching takes place (Okebukola, 2008). Similarly, Federal Ministry of Education (FME, 2014) observed inadequate number of competent teachers and absolute infrastructure as some of the variables hampering teaching/learning of science. These factors could negatively affects the teaching/learning processes among the science students. Hence errors could be committed and replicated. Bello (2016) opined that a writing examination gives the teacher not a fair idea of the progress of the students, but also indicate which parts of the course were not well understood. Infact, a properly kept record of all types of errors will be of value when a teacher prepares his future lessons. In the same vain Akonobi 2014 mentioned that the learners written examinations reveals the learners error types, in support of this, the chief examiners report for the west Africa senior school certificate examination for May/June 2020 mentioned that most students weaknesses or errors include poor approach to answering questions, poor expression of English language and poor understanding of some basic

concepts in biology such as inability to relate applications of biological concepts to given situations and little knowledge of the topic taught among others.

Etherton (2018) observed that the classification of errors varies from individual to individual. Lederman (2016) investigated types of errors in biology practicals among high school students. In his findings, discovered that errors were committed by student and these errors differ. For example, the errors committed include rote 8memory rather than understanding biological concepts to reason out solutions am2ong others. Evidence also abound in the work of (Abdulkarim, 2012 Omosewo & Akanbi, 2013 & Falalu, 2015) that science and non-science student are committing errors and these errors differ from one another. Their studies therefore revealed that the more the errors committed by a student, the less is the mean scores and the overall achievement of the learner in the subject, leading to poor performance.

The Biology examination written by Senior Secondary School candidates is designed and composed of two main papers namely Practical Biology and Essay paper. The practical promotes scientific skill, self-confidence; group work and social interaction are encouraged. While the essay paper tests the general biology knowledge acquired by the students. The quality of their expressions in the essay part could contribute to the quality of the pass mark obtained. Few research works have been carried out on error analysis at the senior secondary and tertiary school level in science subjects (Biology inclusive); Abu (2017) carried out a research on identification and Remediation of Practical Biology Errors Committed by college of Education students in North-West Nigeria, among the findings of the survey result; showed that Nigerian Certificate in Education (NCE) two Biology students least errors committed were 4 while highest number of errors committed were 9. Others argued that science students perform better than non-science students Shangowawa, (2011). The study therefore revealed that students are committing error in biology essay even with differ differences among the group. From this view point, a study of using Biology error types to identify the common error types in biology essay is most paramount. Unless such a study is made to identify these common error types, the science and non-science student are committing in biology essay cannot be defended. Therefore the problem of this study posed as a question is what are the common error type's science and non-science students are committing in biology essay.

Research Questions

Two research questions were formulated to guide the study:

1. What are the common biology essay error types committed by students in Biology?
2. What are the frequencies of the different biology essay error types committed by non-science and science students in Biology?

Hypothesis

This hypothesis was tested at 0.05 level of significance:

HO_l: There is no significant mean difference between the frequencies of the biology error-types committed by both the science and non-science students.

Methods

The research design adopted for the study was2 descriptive survey design were biology essay error types identification test was used to identify the error type's senior secondary II biology science and non-science student commit in biology essay. The study was conducted in Anyigba, Dekina Local Government of Kogi State, Nigeria. The sample for the study was 240 students drawn from all the students offering biology in government public senior secondary schools in Anyigba, Dekina LGA of Kogi State, Nigeria. Stratified random samplings were employed for the selection of the samples of the 8 schools used this study. 120 are science and non-science consists of 120 respectfully. The instrument used for the data collection was Biology essay Test for identification of students Error Types. The instrument was developed by the researcher including questions and the marking scheme, but adopted from West African Examination Council (WAEC 2020) biology essay error typ2es. The error types are: (i). poor approach to answering essay questions (ii). Poor expression of English language (iii) understanding of some basic concept in biology (iv) inability to relate applications of biological concept to given situation (v) student depends on rote memory rather than understanding biological concept to reason out. (vi) Had little knowledge of the topic (vii) demonstrated lapses in spelling and (viii) failure to adhere to instructions. The eight (8) government public senior secondary schools are more or less homogenous with similar conditions in terms of student enrollment, teaching staff, coeducational in nature, used the same curriculum. In other to test this biology essay error types committed by the science and non-science students, the biology essay error type's identification test were used. These questions were drawn from the topics reproductive behaviours and biology of hereditary. These topics were use in determining the essay error types of biology students (science and non-science). The data collected form the test was used for research questions and the hypothesis tested in the survey study. The content validation of the biology essay error identification test item was subjected to validity and reliability before being put to use. The instrument was pilot-tested to establish its reliability. The reliability coefficient when computed gave 0.87 using Pearson's Product Moment Coloration Co-efficient. The instrument was thus adjudged to be reliable and would test what it was out to test.

The researcher organized a training workshop for the regular biology teachers of the sampled schools that taught the topics (reproductive behaviour and biology of heredity) by organizing a seminar by the researcher on how to teach these topics and also to administer the test items to the biology student in the sampled schools for the study. The test item was administered to each study subjects directly by their teachers shortly before the commencement of the SSCE. The test item was administered to all the students of science and non-science during the normal school hours in the regular classroom situation. The test was administered at the same time and day only one day by their teacher in each school respectfully. At the end of the test, the answer scripts were collected and marked by the researcher. An examiner who is also a biology teacher marking WAEC/NECO assi2sted in checking the scripts to ensure that mistakes were not made during the marking, scoring and collation of the scores. The data collected were scored. The data collected were scored. The biology essay error types committed by science and non-science SSII biology students were shown in table 1. This was used to answer the research question one while frequency counts of biology essay error types

committed by both science and non-science SSII biology students were used in answering research question 2. (Table 2) and for testing the research null hypothesis, the two study groups (Science and Non-science) irrespective of schools were pooled together to find the error types committed in the two groups using t-Test for table 3. The result of the research question one, two and null hypothesis one are shown in table 1 and 2. While the null hypothesis in table 3.

Results2

Two research questions were answered hypotheses tested as follows

Research Question One: what are the common Biology Essay Error Types Committed by Science and non-Science Students?

Table 1: Survey Biology Essay Error Types Committed by SSII Science and non Science Biology Students

S/N	Error Types Committed
1.	Poor Approach to answering essay questions
2.	Poor Expressions of English Language
3.	Poor Understanding of some basic concept in Biology
4.	Inability to relate applications of Biological concepts to given situation
5.	Students depend on Rote memory rather than understanding biological
concept to	reason out solutions.
6.	Had little knowledge of the topic
7.	Demonstrated lapses in spellings
8.	Failure to adhere to instructions

The result in table shows the common error types committed in biology essay by SS II Science and Non Science Biology students. 8 errors were identified from the student's script. The findings showed clearly that science and non-science biology student are committing errors in biology essay.

Research Question Two: what are the frequencies of the different biology essay error types committed by science and non- science students in biology?

Table 2 Frequency of Biology Error Types Committed by Science and Non-Science Students in Biology Essay Survey2

S/N	Error Types Committed	Frequency	
		Science	Non-Science
81.	Poor Approach to answering essay questions	200	110
2.	Poor Expressions of English Language	195	197
3.	Poor Understanding of some basic concept in Biology	160	140
4.	Inability to relate applications of Biological concepts to give situation	131	110
5.	Students depend on Rote memory rather than Understanding biological concept to reason out Solutions	199	189
6.	Had little knowledge of the topic	10	10
7.	Demonstrated lapses in spellings	240	200
8.	Failure to adhere to instructions	132	100

The Result in Table Two Shows the frequency of the common Biology Essay Error types committed in Biology Essay by SSII Science and Non-Science Students. 8 errors were identified from the student scripts. The most prominent common error types committed demonstrate lapses in spellings with 240 frequencies for science and 200 frequencies for Non-Science Biology Students, while the least committed errors is, had little knowledge of the topic with frequency of 10 for both science and non-science student respectfully. To test whether the difference is significant or not null hypothesis was tested using t-Test comparison of biology essay means score error types of science and non-science biology students.

Table 3 Summary of the t-Test Comparison of Biology Essay Mean Scores Error Types Performance of Science and Non-Science Biology Students.

Variable	Group	N	Mean	St.Dev.	Df	t-cal	p.	Remarks
Error Types Performance								
8	Science	120	67.40	4.10	98	4.81	0.001	Sig *
	Non-Science	2120	82.97	6.37				

Significant at P ≤0.05

The Result Presented in Table 3 revealed that the p-value is 0.001 which is lower than the level of significance at a=0.05 with df=98. This means that there is a significant difference between science and non-science biology essay error types mean scores of 67.40 of science and 82.97 for non-science performance in biology essay. This implies that the performance level of the mean score of the non-science is higher with 15.57 than their science counterpart, which showed that science biology student committed more errors therefore the null hypothesis one is rejected.

Discussion of Findings

The study investigates the comparative study of identifying biology Essay Error types committed by Science and Non-Science Students in Senior Secondary School in Dekina LGA. Kogi State, Nigeria. The result of the statistical analysis relating to research question one and two shoes that science and non-science biology students committed 8 errors in table 1 this findings is in line with the findings of Akonobi (2014). The group frequencies of error types committed differs from each other which is in agreement with Etherton (2018). This proves that the error types committed by science and non-science biology students are very significant. The frequencies of error types in table two shows that demonstrated lapses in spelling has being the highest score of frequency for both science and non-science biology students among others, and had little knowledge of the topic having the least. The finding is in agreement with the findings of WAEC (2020) chief examiners report.

The observed significant differences in the between the science and the non-science subjects could be explained in terms of the higher means and standard deviations. In each of these error types, the mean as well as the standard deviation of the non-science students is greater to that of the science students. The mean of the non-science students is higher in all the error types with reference to where there are significant differences in error types between the science and the non-science students. This indicates that the non-science students did better than the science students. The findings agreed with the finding of Abudulkarim (2012), Omossewo and Akanbi (2013), Falalu (2015) and Abu (2017) who mentioned that science students displayed lower mean scores due to more error types committed and were poorer in their achievement. This could be explained that the non-science students did better than the science students because they devoted time to study biology. Unlike the science students that would want show that they have already understood biology well as such no need to study While non-science students were more inclined to study it and hence their superiors performance.

The findings also agree with the findings of WAEC (2020) that showed the statistics of grade obtained by science candidates in re2cent years falling below 45% for the whole years in review 2000-2012. The finding is in disagreement with the finding of Shangowawa (2011) that science students perform better than non-science students. Therefore the findings of the study reveals that the more the error types committed by a student the less is the overall achievement of the learner in the subject. This is in line with the findings made by Falalu (2015) and Lederman (2016) that science and non-science Students are committing errors and these errors differ from one another.

Conclusion

Within the limitation of the findings of the present study, the following conclusions could be made:

1. The Students of this Study Committed all the 8 error types with a high degree which lead them to perform poorly in the test as a whole.
2. The order in which each of the error types was committed differs between science and non-science senior secondary II biology students.
3. The Frequency with which the errors were committed by science and non-science SSII varies because poor approach to answering essay questions was among the highest frequency among the science biology students as well as student depending on rote memory rather than understanding biological concepts to reason out solutions while the non-science SSII biology student had a low frequency in those aspect.

Recommendations

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

1. Biology teachers should teach the possible error types to the students as students awareness of these errors will help them guide against committing them.
2. The teachers are encouraged to find out the error types students are committing in what they teach so that they can be corrected.
3. Teachers already in the teaching should be encouraged to attend in-service training workshops, seminars and conferences in other to make them more competent and reliable in other to curb the commission of error types by students

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ENHANCING STUDENTS' ACADEMIC ACHIEVEMENT IN BASIC SCIENCE THROUGH THE USE OF REFLECTIVE INSTRUCTIONAL STRATEGY

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Abstract

The effect of reflective instructional strategy was investigated on upper basic VIII students' achievement in Basic Science in Onitsha Education Zone of Anambra State. Anon-equivalent groups' quasi-experimental research design was used for the study with a sample size of 89 s8tudents. Two research questions and three hypotheses guided the study. Students' achievement was measured using Basic Science Achievement Test (BSAT).The reliability coefficient of the instrument was established through a pilot study using Kuder-Richardson 20(KR-20) formula, and the instrument was found to be reliable with a coefficient value of 0.83. To answer the research questions, the data were analyzed using mean, standard deviation, and ANCOVA for testing of hypotheses at 0.05 level of significance. The study also recorded no significant difference between male and female students' achievement. Based on the findings, the study recommended that Basic Science teachers/science educators should adopt reflective instructional strategy as a medium of classroom instruction for teaching science, and basic science in particular.

Key words: Basic Science, Reflective Instructional Strategy, Achievement, Gender.

Introduction

Basic science also known as integrated science is an interdisciplinary subject that attempts to remove the various single subjects' boundaries by presenting science as one entity through a unified approach. Basic science as the name implies, forms the basis of every core science subject offered by students at the senior secondary level or classes (Mbonu-Adigwe, Eya, Umate and Attah, 2021). According to Agbidye (2015), it serves as the bedrock that provides the required training in science skills acquisition to meet the growing needs of the society. To this end, there is need to offer the best experience in teaching and learning of basic science in order to facilitate the students' interest early enough in science. Basic science prepares students at the junior secondary schools for the study of core science subjects (Biology, Chemistry and Physics) at the senior secondary (SS) level (Oludipe (2012); and Joseph and Ikechi, 2018). In Nigerian educational system, every student is expected to undertake the subject, Basic Science.

In Nigeria, poor academic achievement of students has continued to be a major cause of concern for all especially basic science teachers, researchers and other stake holders in the system (Obomanu and Adaramola, (2011), Omiko (2017) and Mbonu and Okoli (2019). Evidence from the achievement reports recorded by the Examination Development Center (EDC) Awka, Anambra State (2014-2019) showed that students' achievement in basic science is still inconsistent and far below average. The body (within the range of academic year above), reported that more credit and failure in students' performance in BECE examination were recorded compared to percentage of distinction made. This report of poor and inconsistent achievement of students in basic science is one that deserves urgent attention. The present study is an attempt to fill this gap.

Interestingly, several reports have revealed that this poor achievement in Basic Science 8among other factors, is as a result of poor teaching method such as the use of conventional method (Obomanu and Adaramola, 2011; Ochu and Haruna, 2015; Agbidye 2015; Okeke 2015; Akama 2015; Enebechi 2016). Many researchers such as Omiko (2017); Mbonu and Okoli (2019) reported that despite the efforts by the government, Science Teachers Association of Nigeria (STAN) and other stakeholders in an attempt to solve or overcome the problem of students' poor achievement, achievement in basic science is still below average in both internal and external examinations. The persistent poor achievement in basic science

which is as a result of poor method of teaching portrays that the current educational paradigm is weak (Mbonu-Adigwe et al, 2021). Conventional method is the method of teaching that is characterized by the following: it is teacher-centred. It inhibits active participation of students in the classroom; it reduces students to mere note-taking and passive listeners and learners, perception and assimilation of the subject matter is slow. It is examination oriented (Agbidye, Achor and Ogbeba, 2019). To tackle this problem, a new approach to teaching and learning of science subjects in general and basic science in particular has to be considered and adopted. It is on this note, that the present study investigated the effect of reflective instructional strategy (RIS) on students' achievement in basic science.

Reflective instructional strategy (RIS) is a broad-based approach that engages the learners to discuss, collaborate and think back on their learning experiences together on a particular subject matter (Timitimi, 2010). Reflective instructional strategy can also be seen as a tool for self-assessment in the classroom (Fines, 2014; Gupta, et al, 2019). Specifically, RIS presents8 students with problems and allows them to utilize collaborative learning, self-assessment, and peer evaluation tools to solve the problems (Agbasi and Okeke, 2020. According to Gupta et al (2019), reflective instructional strategy also includes peer observation, self-evaluation, peer critique and feedback mechanism. Several studies have emphasized the effectiveness of RIS (Ogbuanya and Owodunni (2013); Odewale (2018; Agbasi and Okeke 2019; Gupta, et al (2019). Since poor teaching method has been identified as reported the major contributing factor in students' poor achievement especially in basic science, this study therefore sets to determine the effect of RIS on students' academic achievement in basic science.

Academic achievement in basic science is the quality of knowledge acquired by students as a result of exposure to classroom experiences. It is the outcome to which a student, teacher or institution has achieved their educational goals (Tomas, 2011). Odagboyi (2015) highlighted the indicators of achievement as knowledge gained, skills acquired and retained, through their studies within and outside the classroom experience. The students' academic achievement on the other hand can also be used by the teacher as an indicator in assessing his teaching and methodological approach (Samba and Ogah, 2020; Adonu, et al, 2021). Perhaps, reflective instructional strategy may affect students' academic achievement positively irrespective of their gender.

Gender refers to the roles and relationships between men and women in a given context (Akper, Gire and Orshi, 2014). It is a socio-cultural construct that assigns roles, attitudes and values considered appropriate for each sex (Godpower-Echie and Owo, 2019). Several contrasting findings have been reported as regards to students' achievement with respect to gender. For instance, Khairulanuar, Nazre, Sairabanu and Norasikin (2010) found gender differences in favour of male students. Oludipe (2012) and Anaehobi and Okigbo (2019) in their different studies found out that there is no significant difference on the academic achievement of male and female students. Amidst these contrasting reports, the study also sought to determine gender influence on the academic achievement of students in basic science.

Statement of the Problem

Basic science as a necessary subject for national development must be taught effectively and purposefully for meaningful learning to take place. The necessity of the subject has prompted many stakeholders such as Government, STAN and others to proffer solutions to the abysmal performance of students in basic science reported by EDC (2014-2019), in order to improve their academic achievement. Several studies reviewed, have pointed out reasons for the poor achievement of student in basic science. One major factor as highlighted by these researchers is the use of conventional approach. On this note, there is need to consider a different approach that could prepare and equip the students with problem solving skills, decision making, and most importantly improved academic achievement. Thus, the choice for a student-centered approach like reflective instructional strategy. The approach was employed to find out if it will enhance the academic achievement of students in basic science which is main the rationale of the study.

Purpose of the Study

The purpose of the study was to determine effect of reflective instructional strategy on students' achievement in basic science. Specifically, the study intended to determine;

1. Difference between the mean achievement scores of students taught using RIS and that of those taught using conventional method
2. Difference between the mean achievement scores of male and female students taught Basic science using RIS

3. Interaction effect of teaching method and gender on students' achievement in Basic science

Research Questions

The following research questions guided the study

1. What is the difference between the mean achievement scores of students taught Basic Science using RIS and that of those taught using conventional method?
2. What is the difference between the mean achievement scores of male and female students taught Basic Science using RIS?

Hypotheses

1. There is no significant difference between the mean achievement scores of students taught Basic Science using RIS and those taught basic science using conventional method.
2. There is no significant difference between the mean achievement scores of male and female students taught basic science using RIS
3. There is no interaction effect of teaching methods and gender on students' achievement in Basic Science.

Method

A non-equivalent groups quasi-experimental research design was used in the study. The design was adopted because the study adopted intact classes of which the subjects in the sampled schools were not randomized. The research was conductedin Onitsha Education Zone of Anambra State. All two thousand, eight hundred and forty-five (2,845) Secondary School Two (JSS 2) basic science students in nineteen (19) public Secondary Schools in Onitsha Education zone made up the study's population. The sample size comprised of eighty-nine (89) students. For sampling, multistage sampling procedure was used: purposive and simple random sampling (Balloting without replacement). The instrument for data collection was Basic Science Achievement Test (BSAT).The instrument drawn from Basic education Certificate Examination (BECE) past questions, consisted 25 multiple choice questions of two sections -A and B. Section A contained the demographic information of the

students while section B was actual question items. Using Kudder-Richardson 20 (K-R 20) formula, the internal consistency reliability coefficient of BSAT was calculated to be 0.83.

Data collected were analyses using mean, standard deviation and Analysis of Covariance (ANCOVA). 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

The results of this study were presented in line with the research questions and hypotheses that guided the study

Research Question One: What is the difference between the mean achievement scores of UPPER BASIC VIII students taught Basic Science using RIS and that of those taught using conventional method?

Table 1: Pre-test and Post-test Mean Achievement scores of students taught basic science using RIS and (CLM)

		Pre-test		Post-test		
Groups	**N**	**Mean**	**SD**	**Mean**	**SD**	**Gained Mean**
Experimental	45	44.09	10.50	81.33	7.77	37.24
Control	44	43.91	8.90	73.09	8.81	29.18
Mean Difference		0.18		8.24		8.06

Results in table 1 reveals that the students taught Basic Science using RIS had pre-test mean achievement score of *(M=44.09, SD=10.50)* and post-test mean achievement score of *(M=81.33, SD=7.77)*with gained mean achievement score of 37.24, while those in the control group taught with conventionalmethod has pre-test mean achievement score of *(M=43.91, SD=8.90)* and post-test mean score of *(M=73.09, SD=8.81)* with gained mean 29.18. Students taughtconventional method Basic Science using RIS had a less spread of scores in the post-test (7.77) than those in the conventional group (8.81) indicating that students taught using RIS had a more homogeneous score in their post-test. The difference between the mean gained achievement scores of the students in both groups is 8.06 in favour of RIS.

Research Question Two: What is the difference between the mean achievement scores of male and female students taught Basic Science using RIS?

Table 2: Pre-test and Post-test Mean Achievement Scores of Male and Female Students taught Basic Science using RIS

Gender	N	Pre-test Mean	SD	Post-test Mean	SD	Gained Mean
Male	26	43.85	10.09	79.54	7.27	35.69
Female	19	44.42	11.31	83.79	7.94	39.37
Mean Difference		0.57		4.25		3.68

Table 2 reveals that the male students taught Basic Science using RIS had pre-test mean achievement score of *(43.85, SD=10.09)*and post-test mean achievement score of *(M=79.54, SD=7.27)*with a gain in mean scores of 35.69, while the female students have pre-test mean achievement score of *(M=44.42, SD=11.31)* and post-test mean achievement score of *(M=83.79, SD=7.94)* with a gain in mean scores of 39.37.There was a higher spread of scores among the female students in the post-test (7.94) than among the males (7.27) indicating that the male students had a more homogeneous score in the post-test. The difference between the mean gain achievement score of the male and female students is 3.68 in favour of the females.

Test of Hypotheses

H_{o1}: There is no significant difference between the mean achievement scores of students taught Basic Science using RIS and those taught basic science using conventional method.

Table 3: ANCOVA Test of Significance of Difference between the Mean Achievement Scores of Students taught Basic Science using RIS and (CM)

Source	SS	Df	Mean Square	F	Sig.	Decision
Corrected Model	1722.240[a]	4	430.560	6.252	.000	
Intercept	23134.409	1	23134.409	335.930	.000	
Pre-test	6.541	1	6.541	.095	.759	
Gender	137.716	1	137.716	2.000	.161	Not Sig.
Method	1473.510	1	1473.510	21.397	.000	Sig.
Gender * Method	54.837	1	54.837	.796	.375	Not Sig.
Error	5784.816	84	68.867			
Total	538736.000	89				
Corrected Total	7507.056	88				

Results in table 3 shows that there is a significant mean effect of the treatment on students' achievement in Basic Science *F(4, 84) =21.397, P =0.000 < 0.05*. Therefore, the

null hypothesis is rejected meaning that there is a significant difference between the mean achievement scores of students taught Basic Science using RIS and those taught using conventional method in favour of RIS.

H_{o2}: There is no significant difference between the mean achievement scores of male and female students.

Table 3 also shows that there is no significant mean influence of gender on students' achievement in Basic science *F(4, 84) =2.000, P =0.161> 0.05*. Therefore, the null hypothesis is not rejected meaning that there is no significant difference between the mean achievement scores of male and female students.

H_{o3}: There is no interaction effect of teaching methods and gender on students' achievement in Basic Science.

Table 3 further shows that there is no significant interaction of teaching methods and gender on students' achievement in Basic Science *F(4, 84) =0.796, P =0.375> 0.05*. Therefore, the null hypothesis is not rejected meaning that there is no significant interaction effect of teaching methods and gender on students' achievement in Basic science.

Discussion

The findings of the study revealed that there is a significant difference in the mean achievement scores of students taught basic science using RIS than those taught using the conventional method. The result revealed that the students taught Basic Science using RIS had pre-test mean achievement score of *(M=44.09, SD=10.50)*and post-test mean achievement score of *(M=81.33, SD=7.77)*with gained mean achievement score of 37.24, while those in the control group taught with conventional method has pre-test mean achievement score of *(M=43.91, SD=8.90)*and post-test mean score of *(M=73.09, SD=8.81)*with gained mean 29.18. The result is supported by the hypotheses in table 3 that there is a significant mean effect of the treatment on students' achievement in Basic Science *F(4, 84) =21.397, P =0.000 < 0.05*. Therefore, the null hypothesis is rejected. This means that the effect of RIS differs significantly when compared with that of conventional method. The use of RIS enhanced basic science students' achievement as seen from their gained mean score. This is because RIS is innovative and activity-oriented, and acts as stimulant for the learners to be actively engaged in the classroom. The method also sustained students' attention in the classroom throughout the lesson. The outcome of the findings supports that of

Ogbuanya and Owodunni (2013); Odewale 2018; Agbasi and Okeke 2019; Gupta, Shree and Mishra (2019).

The findings also revealed that gender is a significant factor in students' achievement in basic science. The result revealed that the male students taught Basic Science using RIS had pre-test mean achievement score of *(43.85, SD=10.09)*and post-test mean achievement score of *(M=79.54, SD=7.27)*with a gain in mean scores of 35.69 while the female students have pre-test mean interest score of *(M=44.42, SD=11.31)*and post-test mean achievement score of *(M=83.79, SD=7.94)*with a gain in mean scores of 39.37. The null hypotheses also shows that there is no significant mean influence of gender on students' achievement in Basic science $F\ (4, 84) = 2.000$, $P = 0.161 > 0.05$. Therefore, the null hypothesis is not rejected meaning that there is no significant difference between the mean achievement scores of male and female students. This finding of the study is because the reflective instructional strategy of instruction uniformly affected the whole students. Since every student irrespective of gender partook in the activities, their achievement and retention were equally affected, although the female students with a gained mean score of (39.37) performed better than the male students with a gained mean score of (35.69), but this was not significant. Therefore, the influence of RIS on female secondary school students' achievement in basic science does not differ significantly when compared with that of the male students. Therefore, the strategy is not gender biased. This is in support of Oludipe (2012) and Anaehobi (2019) who in their different studies discovered that there is no significant difference on the academic achievement of male and female students.

The result of the study also showed no significant interaction between teaching methods and gender on students' academic achievement in basic science. This shows that effect of the instructional approaches did not change when gender was put into consideration. Thus, the method is not gender biased with respect to achievement.

Conclusion

The aim of the study was to see how effective reflective instructional strategy approach is at improving students' achievement in basic science. The study revealed that reflective instructional strategy enhanced student' achievement in basic science more than the

conventional method. Students who were taught basic science using reflective instructional strategy performed better than those who were taught using conventional method.

Recommendations

Based on the findings, the following recommendations were made:

1) Teachers should use reflective instructional strategy to teach basic science in order to enhance students' achievement.

2) Teacher education programmes should restructure their special methodology courses to include reflective instructional strategy. This will enable teachers in basic science to receive sufficient training in the use and implementation of reflective instructional strategy in basic science classrooms.

3) Reflective instructional strategy should be included by the curriculum planners among the appropriate instructional approaches to teach basic science in Nigerian senior secondary schools by curriculum planners.

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