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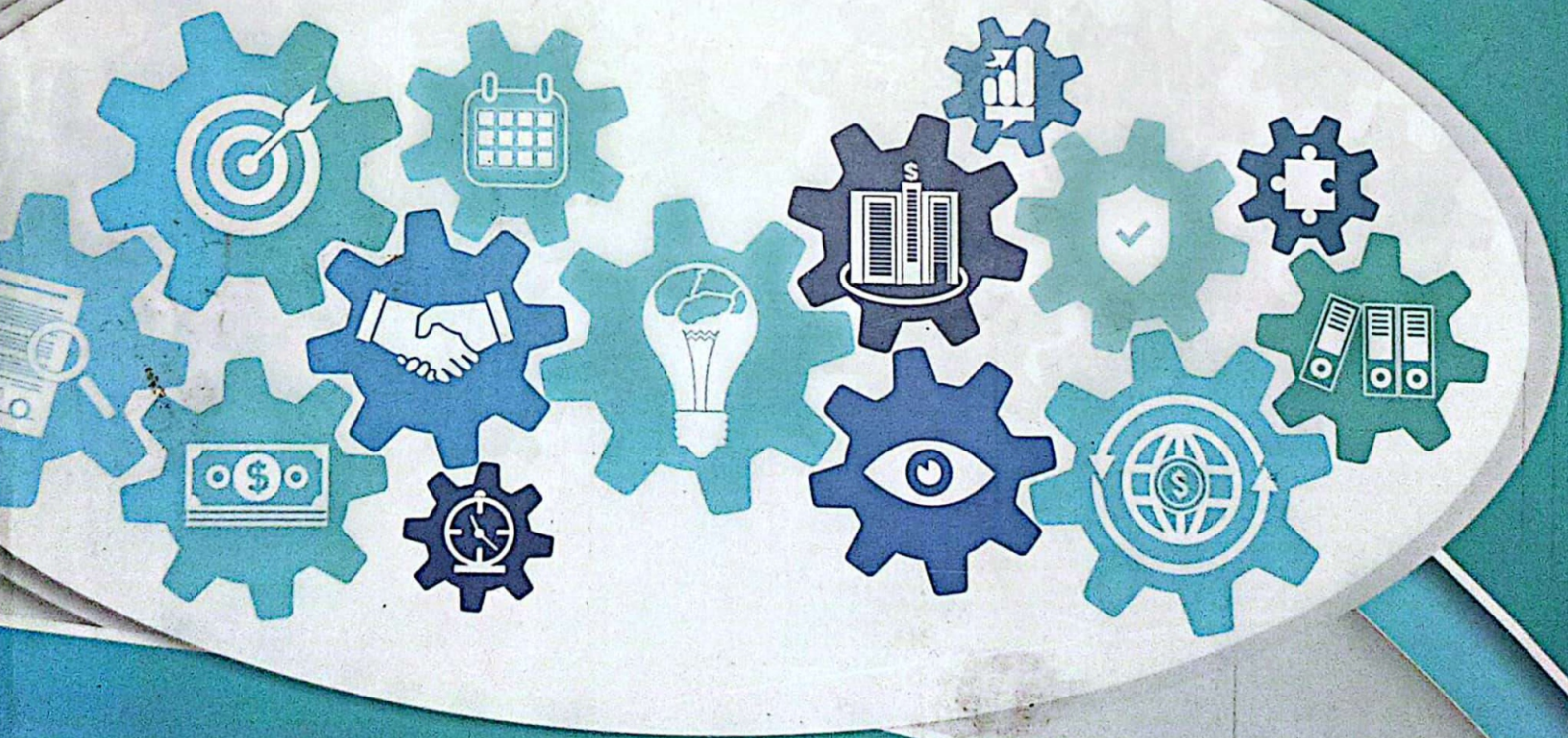

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TOWARDS OPTIMAL ENHANCEMENT OF PRACTICAL WORK AND ACTIVITIES IN SCHOOL SCIENCE

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Abstract

Science and science education occupy core positions in the technological development of any nation. The duo is capable of producing skilled human resources needed for transformation into national prosperity only when there is quality. Qualitative science education requires that the mode of delivery is action-packed and learner-centered through valuable practical work and activities, and must be applied at all levels of education. The discussion paper explored ways of enhancing practical work and activities in school science regardless of the level of education; primary, secondary or tertiary. The paper navigates the pathways for achieving quality practical work with focus on the concepts of science and science education, meaning and purpose of practical work and activities, the place of the laboratory in science teaching, obstacles to good quality practical work and activities, ensuring standards in the quality of practical work and activities in school science and basics for achieving quality practical assessment.

Key words: Optimal, Enhancement, Practical work, Practical activities, School science

Introduction

Science can in simple terms be described as the intellectual, systematic and strategic attempt to explain and control the natural world. It entails dynamic and determined interaction with the universe through search and verification. Science education is unique because search and verification combine with transfer whereby scientific knowledge, skills and principles are acquired, tested and transmitted. Science education is the engine that drives science and technology. While the interplay of the trio guarantees sustainable development and global survival, the modes of science delivery play predominant roles. Science is activity and must be presented as such at all levels. It is taught through task- based and learner-centered methods giving cognizance to valuable practical work and activities. Meanwhile, only certain important practices guarantee optimal enhancement of practical work and activities in school science.

Science and Science Education Concepts

Science is the act of doing and it is more concerned with intellectual and investigative processes and activities. Science relates to developing, acquiring and controlling knowledge, skills and attitude about the natural environment, while science education involves the strategic and professional processes involved in acquiring, transferring and demonstrating science knowledge, skills and attitudes. Science education involves the in-depth study of science.

In simple perspective, science education deals with sharing science content and process with individuals, learners (children, youths and adults) or the general public and it makes one relevant in the scientific community. The field of science education mainly involves work in science content and process (the scientific method), analysis of science product, and science pedagogy. Science education leads the path and opens the gate to sustainable development (economic, society and environmental development). Through science and science education, individuals are

empowered to be scientifically literate, and because the utility values are overwhelming, the trend worldwide is to produce scientifically literate citizens through science education. The foregoing thus imposes and impresses it upon Nigeria to give consideration to productive science education, and the foremost way of achieving this is by placing science teaching procedures in right perspectives.

Qualitative science education assures human and national survival and self-sufficiency. The Nigerian National Policy of Education recognizes the significance of science and places premium on effective science teaching and learning at all levels of education (FRN, 2013). The move to transform a nation into a self-sustaining economy can be achieved through science and technological growth, but a number of issues concerning functional and qualitative science education should be addressed. Evidences abound that many problems militate against the development of science education in developing countries including Nigeria. (Omotayo, 2005; Alebiosu & Ifamuyiwa, 2008; Omoregbe & Ewansiha, 2013; Okoli, Obiajulu & Ella, 2013; Jacob, 2013). However, It is not enough to dwell on problems and challenges, the concern is that science education must be taken to higher stride and due attention given to practical work. Doing quality and effective practical work is a significant index of a worthwhile science education programme and it is very critical for teachers to adopt laboratory and action-packed or activity-laden dynamic and valuable teaching methods.

Meaning and Purpose of Practical Work and Activities in School Science

Practical work is a distinctive feature of science education and it plays a key role in the teaching of evidence, provided the type of practical work is selected carefully with a clear purpose in mind. It is an attempt to describe the working of the real world around us and it helps to facilitate and improve the learning of science. It gives students the appreciation of the spirit and methods of science. Practical work serves two major functions. Firstly, it consolidates theoretical understanding and converts apparently dry and uninteresting science facts and theories into real experiences. Secondly, it develops and promotes skills and competencies of doing science.

Specifically, according to Alebiosu (2003), practical work serves the following purposes:

- Promotes long term memory in students
- Enhances pupils development of the ethical dimension of science
- Instills the spirit of collaboration and active participation in learners
- Exposes learners to scientific experiences that could ultimately help them in developing scientific attitude, skills and values e.g longing to know, questioning all things
- Trains the mind in the understanding of the world.
- Enhances the acquisition of scientific attitude, skills abilities and competencies for the effective learning of science
- Equips students with the need to face future challenges in the modern age of science and technology
- Inculcates in the student the spirit of inquiry and scientific mode of thinking.
- Consolidates teacher's thinking and learner's understanding.
- Stimulates students' interest and understanding.
- Leads to perfection of skills of doing
- Enables the evaluation of student's learning.

Aside from these broad functions, there are specific functions and objectives of practical activities in the different school subjects. Some of these according to Alebiosu (2000) are;

In Physics, it develops experimental and problem solving techniques in ability to take records and observations, measurements and estimates with due regard to precision, accuracy and units.
In Chemistry, it familiarizes students with skills and principles in preparation, dilution and standard solutions, filtration and so forth. In Biology, it enables students obey instructions make accurate observations and drawings.

The report and proposal for strategic frame work for enhancement of practical work in school science in the UK presented by the body representing the UK's foremost science education organisations: Science Community Representing Education (SCORE) (2008), classified practical activities into three viz; core activities, directly related activities and complementary activities.

The report explained these activities with the following break- down;

Core activities include investigations, laboratory procedures and techniques and fieldwork. Directly related activities entail designing and planning investigations, data analysis using ICT, analyzing results, teacher demonstrations, and experiencing phenomena, while complementary activities are associated with science related visits, surveys, presentations and role play, simulations including use of ICT, models and modeling, group discussion and group based text-based activities. (SCORE, 2008).

The Place of Laboratory in Science Teaching

The laboratory is a major resource for science teaching. It is an integral part of any school where science is studied as a subject (Alebiosu, 2003). The laboratory is a place of experimentation, and is simply any place where scientific investigation takes place. A make shift or temporary place set up to meet certain needs and requirements of science teaching at particular time can serve as laboratory. E.g students may be taken for field trip and in the process engage in serious and complex investigations. Such an environment at that particular time is regarded as laboratory. Laboratory activities have been used in science teaching to support theoretical science instruction over the years.

Certain facilities are most essential if the school science laboratory is to be functional, relevant and productive. Apart from the adequacy of the laboratory human and material resources, there are required specifications for the design of each of the physics, chemistry, biology or any other science subject's laboratory. According to Alebiosu (2003), factors to be considered for ease of and efficiency in laboratory practical work include; the class, size and age group of the student, the nature of the students' interests, mood, readiness etc, the nature of experiences, the time slated for the practical activity and, the form in which the practical work is done. Teachers and students must be protected from internal and external hazards, accidents or crises in the laboratory hence rules and regulations must strictly be adhered to while improvisation should be taken seriously. The specific roles and expectations of the teacher among others entail that he/she;

- Plans practical work with specific learning objectives in mind.
- Specifies outcomes
- Practices and masters the activities ahead of the class (behind the scene).
- Provides outlines and needed materials for the exercise
- Guides students through the activities

Well planned and effectively implemented practical work is very potent at stimulating and engaging students' learning at varying levels of inquiry; challenging them mentally and physically. It is expedient that the teacher gives cognizance to the following specific activities for optimal enhancement of practical work and activities in school science.

- Actively participating in the class such as; moving round the class, ensuring students ask questions to be sure they understand what is being done, encouraging and helping students and so forth.
- Ensuring the class recognizes the purpose of the experiment being performed.
- Giving full guidance on the procedure of the experiment such as handling of apparatus, observation, description, measuring, taking readings, graphs, calculations etc.
- Conducting experiments in such a way as to make students think and talk.
- Instilling the spirit of accuracy in students while experiment is being conducted
- Making sure conclusions are drawn only from the evidence obtained from the experiment.
- Controlling the appropriate use of simple and complex apparatus as required.
- Developing resourcefulness in learners such that they can design their own experiments.
- Encouraging and guiding students to apply the purpose of the experiment and experiences derived to everyday life situations, problems and challenges.
- Demonstrating serious Commitment and confidence

Obstacles to Good Quality Practical Work and Activities

Effective science teaching involves a creative interplay of experiments, observations and theoretical inference, hence practical activities cannot be marginalized in schools. There is outcry on impediments to the ability to achieve good quality practical work and activities in school science. Related literature particularly emphasized issues relating to unavailable necessary infrastructure and weak assessment procedures (Alebiosu & Bamiro, 2007; Okoli, Obiajulu, & Ella, 2013; Omoregbe & Ewansiha, 2013, Cossa & Uamusse, 2015) and that weak assessment procedures particularly confront quality practical work in developed countries (Shiksha, n.d; SCORE, 2008; Abraham & Saglam, 2010; Cambridge News-Department of Education, 2013).

Main actors in the barriers to effective practical work are as presented in figure 1.

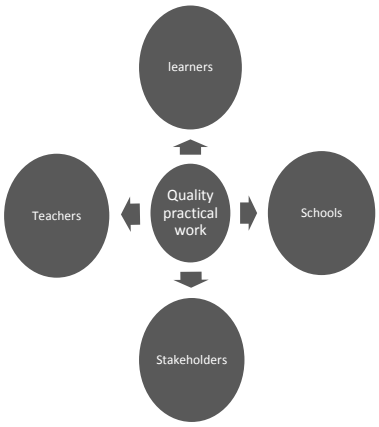

Figure 1: *Barriers to Effective practical work Issues emanating from these main actors can be teased out as presented in table 1.*

Table 1: Classification of Barriers to Quality Practical Work in Science

Stakeholders	**Teachers**
Inadequacy of resources and facilities	Teachers' incompetence
Inadequacy of text materials	Lack of professional expertise
Insufficient funding	Teachers' non diligence
Lack of home support	Lack of motivation for science teachers
Parent's non- challant attitude	Job dissatisfaction
Parent's level of education	Inadequate in-service training
SCHOOL	LEARNERS
Lack of school support & short school time	Insufficient student cooperation
Large class size	Shallow student's understanding of procedures
Limited amount of time slated for science lessons	Lack of student's interest
Wrong scheduling of time in the school time table	Student's fear of touching materials
One shot practical examination syndrome	Student's carelessness in handling resources
Unclassified assessment procedures	Peer influence
One-time assessment procedure practices	

Ensuring Standards in the Quality of Practical Work and Activities in School Science

Science is a practical-oriented discourse, which driving force is science education. Practical work and activities allow students to share their scientific understandings and explanations with one another. It is imperative for science education to give significant consideration to providing opportunities that are rich in practical activities. The importance of practical work is widely accepted and it is acknowledged that quality practical work promotes the engagement and interest of students as well as developing a range of skills, science knowledge and conceptual understanding. (SCORE, 2008).

The value of practical work and activities lies in its being used to accomplish variety of cognitive, affective and psychomotor objectives. Cognitive objectives refer to learning of scientific concepts, developing problem solving skills and increasing the understanding of scientific methods while psychomotor objectives refer to developing skills and performing science investigations, analyzing data, communicating and skills in working with others. Affective objectives refer to enhancing motivation towards science and positive perceptions of ability to understand the environment. (Alebiosu, 2003).

In Nigeria, the Universal Basic Education Commission (UBEC) has integrated some positive measures into existing practices at the Basic education level. Teaching texts and workbooks are loaded with practical activities that can easily be carried out in the class (FGN/UBEC, 2014). This has significantly revolutionized the study of Junior secondary school science. For example; to teach the topic "sense organs", the teaching text specified the following stepwise activities;

"Make a small dot on a piece of white paper, place the paper on the table, stand back two meters away from the paper, use a meter rule to point to the dot with your two eyes open. Repeat the activity with one eye open. Explain what you notice in the two cases"

(FGN/UBEC, 2014. pg 57).

The new joint schemes of work for senior secondary schools in Oyo State is very comprehensive, detailed and explicit in weekly teaching exercises, content and practical activities. The document categorically stated the practical activities for all the learning materials in a tabular form. (Oyo State Government, n.d). It is almost certain that similar documents are used in other States. Nevertheless, it is pertinent, logical and obvious that certain conditions are important and salient initiatives have to be put in place in order to entrench standards in practical work and activities in school science. Some of these include;

1. Enforcing improvisation
2. Strong commitment to high quality practical work among teachers, technicians and stakeholders
3. Teachers and students should be able to refer to common materials supporting practicals.
4. Using ICT driven strategies and technology -enabled pedagogy.
5. Giving students chances to evaluate their individual actions
6. Mentoring of inexperienced teachers
7. Good knowledge and practice of health and safety measures.
8. Supportive leadership and management
9. Adequate supply of technical support
10. Attaching importance to professional expertise in practical work
11. Giving high priority to resource allocation and supply.
12. Provision of adequate teaching time frame.
13. Ensuring stakeholders remain informed through research and evidence
14. Employing appropriate assessment practices

Basics for Achieving Quality Practical Assessment

There is no doubt that assessment practices in science practical work calls for transformation because current assessment practices both damage and restrict practical science. Assessment of practical work and activities and the assessment of skills in practical work and activities are not the same. Prevailing assessment procedures align with the assessment of practical work which tends to concentrate on a written product of an inquiry produced by an individual. The processes of constructing arguments, planning, observing and formulating conclusions are neglected. There is the need to align the aims and objectives of doing practical work with the actual practical activities and assessment practices and procedures. Quality assessment would facilitate quality teaching in that assessment outcomes afford the teacher the opportunity to appraise how well the students have learned specific learning material in the context of the objective of doing the work as well as how effectively he/she (the teacher) performed.

The need to overhaul assessment procedure of practical science has received the attention of science educators and researchers globally. Many assessment procedures in Nigeria have been reported to be faulty because the measure of skills are side tracked (Alebiosu, 2000; Omotayo, 2005; Afemikhe, Imobekhai, & Ogbanya, 2015). Tan & Towndrow (n.d) expressed displeasure with assessment procedure in Singapore schools and recommended peer digital video evaluation mode. The study advocated "giving students a voice in practical science assessments". Abrahams & Saglam (2010) studied teachers' views on practical work in secondary schools in England and Wales and recorded teacher's notable support for Science Investigation (Sc1) format assessment criteria that cover a wide range of assessments.

It is in the light of global moves to reform modes of practical assessment in schools that Abrahams, Reiss & Sharpe (2013) reviewed Direct Assessment of Practical Skills (DAPS) and Indirect

Assessment of Practical Skills (IAPS) and recommended the former. The Council for Science and Technology U.K commented on the loss of laboratory experiments in school science while advocating for reforms in practical work assessment as follows:

> "The current methods of assessing practical work in science based on continuous assessment and internal marking do not work. They fail in both of their main objectives: to provide a fair assessment and to encourage and promote good quality practical work in schools. They are time consuming, prescriptive and repetitive, and they undermine both the relationship between teachers and pupils and the professional integrity of teachers. They encourage 'teaching to the test'."

(Cambridge news, 2013. Retrieved from http:// www. cambridge-news.co.uk/)

In Nigeria, the most common assessment mode is the paper and pencil test or the alternative to practical mode. Even the certificate examinations that claim to do real test of practical is the 'one-shot' practical examination that only uses 'one-time' practical assessment. It is the 'teaching to the test' type. An example of a practical question is shown;

Question:
A student used magnesium oxide to prepare magnesium nitrate. The magnesium nitrate was then heated to re-form magnesium oxide. The object of the experiment was to determine whether the mass of the magnesium oxide produced was the same as the amount used initially.

Some magnesium oxide was put into a weighed evaporating dish. The dish was re-weighed.

Mass of dish + magnesium oxide = 14.70g

Mass of dish = 8.90g

a). Calculate the mass of magnesium oxide used

Answer: *The mass of magnesium oxide = 5.8g*
b). An acid was slowly added until all the magnesium oxide had dissolved. Magnesium nitrate was produced. What acid was produced?

Answer: *Tetraoxonitrate V acid.*
c). The solution was evaporated to dryness and the resulting solid was heated in a fume cupboard. The following reaction took place.

$2Mg(NO_3)_2(s) \rightarrow 2MgO(s) + 4NO_2(g) + O_2(g)$

After cooling, the dish was weighed. It was then heated again, cooled and re-weighed. The final mass of the dish contents was 14.40g.

i). Why was the heating done in a fume cupboard?

Answer: *Nitrogen IV oxide (NO_2) is a poisonous gas.*

ii). Why was the dish reweighed?

Answer: *To ensure decomposition was complete.*
iii). Calculate the mass of magnesium oxide obtained.

Answer: *14.40 - 8.90 = 5.5g.*
d). Using your answers to (a) and (c) (iii), calculate the percentage yield of magnesium oxide.

Answer: *5.55/5.8 X 100% = 98.8%.*
c). Suggest one reason why the experiment did not produce the same amount of magnesium oxide as was at the beginning of the experiment.

Answer: *Some of the magnesium oxide could have been lost during heating*

(Culled from: Ugenyi, 2011).

The illustrated example shows that knowledge-based questions are translated into practical activity questions and students regurgitate the experiences gained from the teaching phenomenon. There is no provision for interaction and practice with real materials and with one another. In addition, there is no room for demonstration and measure of practical skills. Another example is shown in Figure 2. Diagram illustrating the experiment is given and questions are asked.

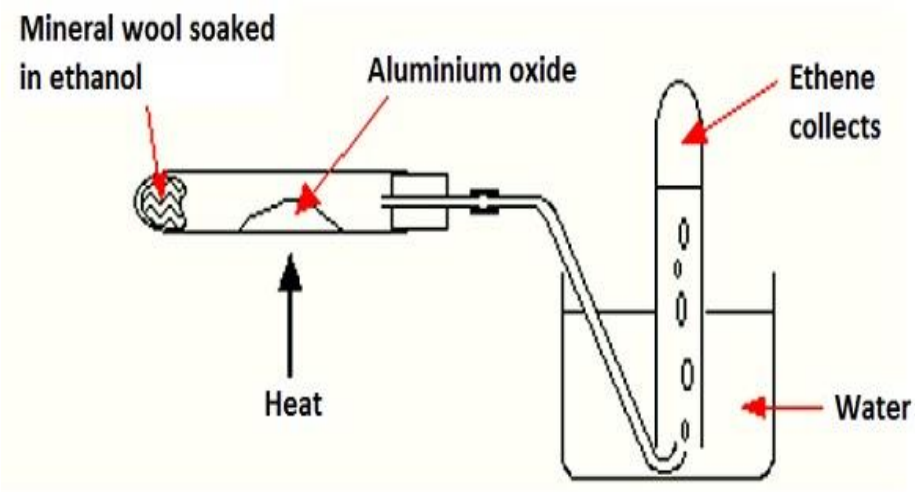

Figure 2: *Dehydration of ethanol to form ethene*

Question:
Ethanol vapour is dehydrated over a heated catalyst (aluminium oxide) to produce ethene

a). What is the purpose of the mineral wool?

Ans: *For lagging the test tube to prevent it from cracking*

b). What is the type of chemical reaction called?

Ans: *Catalytic cracking*

c). Give a test for ethene

Ans: *Add a few drops of bromine dissolved in tetrachloromethane (CCl_4); the bromine solution is decolourized*

d). What precaution should be taken in the experiment when the heat is removed?

ANS: Ethene should be collected quickly so that petroleum products of lower boiling points do not contaminate it. Hence the delivery tube must be removed before the heat is turned off.

(Adapted from: Ugenyi, 2011).

Alebiosu (2003) classified assessment forms as follows;

i). Direct observation and reporting using assessment schemes in which various tasks, skills and skill areas are identified and highlighted to be observed and graded during practical work. E.g open –ended schedule, intermediate schedule and the check-list schedule

ii). Written reports in which students write reports on completion of the investigation and submit for teachers to assess.

iii). Paper and pencil test in which questions are asked without recourse to the demonstration of particular skills and attitudes, but the focus is the skills in the cognitive domain.

It was garnered from literature (Reiss, Abrahams and Sharpe, 2012), that a merger of direct observation and reporting using assessment schemes and written reports constitute two new categories; Direct Assessment of Practical Skills (DAPS) and Indirect Assessment of Practical Skills (IAPS). The two examples earlier illustrated in the paper align with IAPS form and is the more dominant assessment mode.

According to Reiss, Abrahams and Sharpe (2012), DAPS, refers to any form of assessment that requires students, through the manipulation of real objects, to directly demonstrate a specific or generic skill in a manner that can be used to determine their level of competence in that skill, while IAPS relates to any form of assessment in which a student's level of competency, again in terms of a specific or generic skill, is inferred from their data and/or reports of the practical work that they undertook. The researchers' comparison of the two modes is presented in table 2;

Table 2: Comparison of DAPS and IAPS

	DAPS	IAPS
What is the principle of the assessment?	A student's competency at the manipulation of real objects is directly determined as they manifest a particular skill.	A student's competency at the manipulation of real objects is inferred from their data and/or reports of the practical work they undertook
How is the assessment undertaken?	Observations of students as they undertake a piece of practical work	Marking of student reports written immediately after they undertook a piece of practical work or marking of a written examination paper subsequently taken by students
Advantages	High validity, encourages teachers to ensure that students gain expertise at the practical skills that will be assessed.	More straightforward for those who are undertaking the assessment.
Disadvantages	More costly, requires teachers or others to be trained to undertake the assessment, has greater moderation requirements	Lower validity, less likely to raise students' level of practical skills

Source: Reiss, Abrahams and Sharpe (2012)

To ease the use of the direct assessment of practical skills (DAPS), the use of a scheme is more convenient and appropriate and hereby suggested. Such is the scheme developed by Alebiosu (2000), presented in Table 3.

Table 3: Skill Area and specific tasks

Skill Area	Specific Tasks
Planning and Designing	Ability to plan instructions and select techniques. Planning and designing procedures in the experiment clearly, concisely and correctly
Manipulative skills	Ability to work methodically, manual dexterity, confidence, obedience and orderliness in carrying out activities within stipulated time.
Observing and Recording	Ability to promote, describe, report and record observations and measurements, draw, analyse and present results precisely, correctly, neatly and clearly within stipulated time
Interpretation of data and Formulation of generalizations	Ability to transform results precisely and correctly. Accuracy in experimental data, units, decimal places, formulae, equations of reactions and calculations. Neatness and accuracy of graphs, lines, scales, diagrams, drawings and labels. Ability to draw valid conclusions from observations made.
Application	Ability to predict, evaluate and infer from results obtained as well as the ability to state and explain necessary precautions and possible improvements for the experiment.
General attitude to work, orderliness and tidiness	Students self-confidence, interest, enthusiasm and orderliness to work within stipulated time and do it well.

Source: *Alebiosu (2000)*

Questions are drawn to cover these practical skill areas and the teacher assesses them by observing students and awarding scores on their actions and performances.

The following should be considered in the planning of quality practical work assessment in school science:

- There should be access to rich resources (human and physical).
- Give attention to the cognitive, affective and psychomotor domains.
- Incorporate feedback. Science learning and retention are encouraged and enhanced when students receive feedback about their learning progress.
- It is strictly objective and content directed.
- Focus strictly on specific and precise skills and activities.
- It is not examination driven.
- It has sufficient time frame. The time given for assessment is adequate
- Single out every aspect of the activity.
- Consider learner individual differences and learning difficulties
- Embrace a measure of student's individual and collaborative work
- Do not discriminate against gender

Conclusion

Students learn better when they experience science for themselves, not as abstract material for 'rote learning' but as real experiments to be designed, executed and evaluated. Science is doing. The old adage 'Tell me and I shall forget, show me and I shall remember, involve me and I shall understand' holds true. It is in view of this that practical work is considered an essential component of school science at every level of education.

Schools should be sensitive to the efficacy of practical work and activities, procedures of doing them and assessment forms. Practical work and activities in science should be embedded in the professional life of the science teacher and should be conducted appropriately. The teacher, at any level whatsoever has no justification for not arranging practical experiences for students or denying them of rich and proper practical experiences. The survival of any nation truly depends to a large extent on development in science and technology, but it is a function of the strength of science education.

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INFLUENCE OF TEACHERS' DEMONSTRATION OF SCIENCE PROCESS SKILLS ON STUDENTS' ACHIEVEMENT IN BIOLOGY IN SECONDARY SCHOOL IN SOUTHWEST, NIGERIA.

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Abstract

The study examined the influence of teachers' demonstration of science process skills on students' achievement in Biology. The study specifically outlined various science process skills used in Biology teaching. It employed a descriptive research design of correlation type. The population for the study comprised all Senior Secondary School two (SSS2) students and Biology teachers in both public and private schools in South West, Nigeria. The sample consisted 1,500 Biology students and 90 Biology teachers selected from 36 schools in 3 participating states (Ondo, Osun, Ekiti) using multistage sampling procedure. The instruments used for the study were: Biology Achievement Test (BAT) and Teachers' Demonstration of Science Process Skills (TDSPS). The instruments were subjected to face, content and construct validity and their reliability co-efficient were ascertained using test-retest method. The reliability co-efficient of 0.79 was obtained for TDSPS while BAT was adapted from West Africa Examination Council and National Examination Council past questions being a standardized test. Two research questions were raised and one null hypothesis was formulated and tested at 0.05 level of significance. The research questions were answered using descriptive statistics of frequency count, percentage and standard deviation while the null hypothesis formulated was tested using inferential statistics. The findings of the study revealed a significant correlation between teachers' demonstration of science process skills and students' achievement. Based on the findings, it was recommended that Biology teachers should engage students in scientific skills that could promote meaningful learning in Biology classroom.

Key Note: Process- skills, content- knowledge, Achievement, Teachers' demonstration.

Introduction

Science process skills are the scientific skills to be inculcated in science students in terms of abilities, potentials and technical know-how which can be developed through experience and used in carrying out mental operations and physical actions (Nwosu 2004). The American Association of Advancement of Science (AAAS) classified the science process skills into fifteen. These are: observing, classifying, measuring, communicating, inferring, predicting, using space/time relationship, using numbers, questioning, controlling variables, formulating hypothesis, defining operationally, formulating models, designing experiments, and interpreting data. These science process skills according to Collette and Chiappeta (2004) were later grouped into basic and integrated.

According to Rambuda and Fraser (2004), the basic science process skills apply specifically to foundational cognitive functioning especially in elementary classes. They represented the foundation of scientific reasoning that learners are required to master before acquiring and mastering the advance integrated science process skills (Brotheton and Preece, 1995). Rambuda and Fraser (2004), maintained that basic science process skills are interdependent, implying that scientists may display and apply more than one of the skills in any single activity. For instance, to measure the area of a habitat, Biology students

may start by observing the habitat, then measure the dimensions and communicate the same using symbol; thereafter the students may calculate the area. In this scenario, the students have involved in the skill of observing, measuring and calculating. The basic science process skills include: observing, communicating, classifying, measuring, inferring and predicting (Padilla, 1990). From this, it appears that the basic science process skills provide an intellectual groundwork in problem solving.

On the other hand, the integrated science process skills are the immediate skills used in problem solving or doing science experiments. As the term integrated implies, learners are called upon to combine basic science process skills for greater expertise and flexibility to design the tools they apply when they study or investigate phenomena. The integrated science process skills include controlling variables, defining operationally, formulating hypothesis, interpreting data, experimenting and formulating models.

Ozgelen (2012), enthused that science process skills are thinking skills that scientists use to construct knowledge in order to solve problems and formulate results. Implicit in these definitions of science process skills is that these skills are integral and natural to a scientist: they are instruments for the study and generation of scientific knowledge, science learning and development of science process skills are integrated activities.

Therefore, teachers should impart these skills into Biology students during teaching and learning process. Basic science process skills form the back bone of the more advanced problem solving skills and capacities (Padilla, 1990). These include observing, communicating, measuring, inferring, classifying, and predicting. It appears that basic science process skills provide the intellectual ground work in solving scientific problems. Integrated science process skills combine two or more basic process skills and are therefore more advanced than basic science process skills. They are the immediate skills that are used in sciences, they include such skills as identifying variables, formulating hypotheses, describing relationship between variables, designing investigations, experimenting, acquiring data, formulating model, defining variable operationally, understanding cause and effect relationships.

The researcher observed that science process skills are cognitive and psychomotor skills employed in problem solving. They are the skills which scientists use in problem identification, objective inquiry, data gathering, transformation, interpretation and communication. Science process skills can be acquired and developed through training such as are involved in science practical activities. They are the aspects of science learning which are retained after cognitive knowledge has been forgotten. Using science process skills is an important indication of transfer of knowledge which is necessary for problem-solving and functional living.

In addition, science process skills are seen as problem solving skills in which a problem is represented and a systematic process is carried out in order to arrive at solving the problem. Science process skills are important for teaching ways of reaching knowledge. The students need the process skills both when doing scientific investigations and during their learning process (Harlen, 2000; Taconis, Ferguson-Hessier and Broekkamp, 2000). Science process skills are also believed to be able to ensure that students have meaningful learning experience because they help students to develop higher order thinking (Lee, Hairston, Thames, Lawrence & Herron, 2002).

The science process skills must be understood by the teachers so that they can impart on their students a lasting and valuable science comprehension. Science process skills are vital for students and teachers should inculcate them in their students very early in life. It is essential that teachers do not only have an understanding of the science process skills, but must be functional literate in the skills in order to effectively and appropriate teach them to the students during Biology lessons.

Statement of the Problem

Biology teachers are faced with the challenge of improving Biology teaching so that learners can achieve high in their academic career. Since Biology learning leads to higher scientific development of any nation, it is necessary that Biology teachers should demonstrate appropriate science process skills in their classrooms to

enhance effective learning and better academic achievement in Biology. The researcher observed poor demonstration of science process skills as a major deficiency in Biology teaching which could be attributed to the fact that most Biology teachers fail to demonstrate these skills in the classrooms.

The achievement of students have been of great concern to many educators, parents, guardians, curriculum planners, researcher and government. It is of great concern that students are not achieving as expected in Biology, this may be due to poor demonstration of science process skills.

Significance of the Study

The study was designed to determine the relationship between teachers' demonstration of science process skills and students' achievement in Biology.

Research Questions

In order to find solution to the problem of this study, the following research questions were raised:

1. What is the pattern of student's achievement in Biology?
2. Is there any relationship between teachers' demonstration of science process skills and students' achievement in Biology?

Research Hypothesis

One null hypothesis was formulated for the study:

There was no significance relationship between teachers' demonstration of science process skills and students' achievement in Biology.

Research Method

The study employed a descriptive research design of correlational type.

The population for the study comprised all Senior Secondary School two (SSS2) students and Biology teachers in all public and private schools in South West, Nigeria. The sample for this study consisted of 1,500 Biology students and 90 Biology teachers selected from 36 Senior Secondary Schools in three Senatorial Districts of Ondo, Osun and Ekiti states. Both students and teachers for this study were selected through multistage sampling procedure using stratified and purposive sampling technique across the public and private urban and rural senior secondary schools of the participating states in order to enable all participants have equal chance of being selected for the study. Two research instruments were used to collect relevant data for the study. These were: Biology Achievement Test (BAT), and Teachers' Demonstration of Science Process Skills Questionnaire (TDSPSQ).

The instruments were subjected to face, content and construct validity, this was ensured by given the instruments to experience Biology teachers, experts in tests, measurement and evaluation for their suggestions, correction and to ascertain its suitability. Biology Achievement Test was adapted from West Africa Examination Council (WAEC) and National Examination Council (NECO) past questions hence, a standardized test. The reliability of the Questionnaire on Teachers' Demonstration of Science Process Skills was ensured through test-retest method. The results obtained showed the reliability co-efficient of 0.79 which suggested that the instrument was reliable enough for use.

Results

Question 1

What is the pattern of students' achievement in Biology?

In answering question 1, scores on Biology Achievement Test (BAT) was obtained and expressed in percentages of the total score (25 marks). Students' scores were categorized into 'Fail', 'Pass', 'Credit' and 'Distinction'. Students who scored below 40% were categorized as 'Fail' while those who scores above 40%-49%, 50-69%, 70% and more were grouped into 'Pass', 'Credit' and 'Distinction' respectively. The result is presented in Table 1 and Figure I

Table 1: Pattern of students' achievement in Biology

Academic performance	*Frequency*	*Percent*	*Cumulative Percent*
Fail (0-40)	802	53.5	53.5
Pass (40-49)	371	24.7	78.2
Credit (50-69)	275	18.3	96.5
Distinction (70 and above)	52	3.5	100.0
Total	1500	100.0	

Table 1 revealed that 802 students representing 53.5% of the total sample failed, 371(24.7%) passed, 275(18.3%) had credit while 52(3.5%) had distinction in Biology. Cursory look at the result further that about 78.2% of the sample had below credit pass in Biology while 21.8% passed at credit level. This implies that the level of students' achievement in Biology is low. The level of students' achievement in Biology is further presented in Figure I

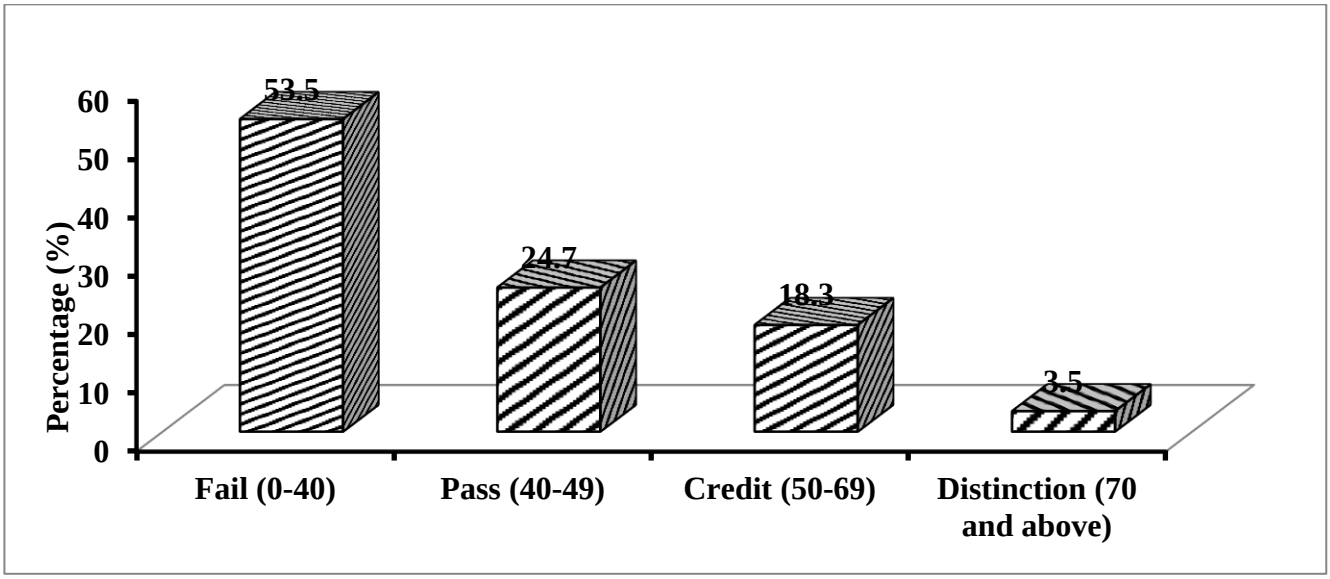

Figure I: *Pattern of students' achievement in Biology*

The chart indicated that 53.5% students failed Biology examination, 24.7% scored average marks between 40-49; 18.3% Biology students scored between 50-69 marks while only 3.5% Biology students scored 70 and above. Hence, the achievement of Biology students is low.

Hypothesis

There is no significant relationship between teachers' demonstration of science process skills and students' achievement in Biology.

Table 2: Pearson's Correlation of teacher's demonstration of science process skills and students' achievement in Biology

Variable	N	Mean	SD	r_{cal}	r_{table}
Teacher's demonstration of science process skills	90	23.53	6.90	0.228*	0.195
Students' achievement in Biology	1500	9.81	2.43		

*$p<0.05$

Table 2 revealed that r_{cal}(0.228) is greater than r_{table}(0.195) at 0.05 level of significance. The null hypothesis is rejected. This implies that there is significant relationship between teachers' demonstration of science process skills and students' achievement in Biology. The correlation between teacher's demonstration of science process skills and students' achievement is low, positive but statistically significant at 0.05 level. Hence, teacher's demonstration of science process skills could promote students' achievement in Biology

Discussion

The result of the findings revealed a significant correlation between teachers' demonstration of science process skills and students' achievement. This implies that teachers' demonstration of science process skills could engage students in scientific skills, promote meaningful learning and develop adequate understanding in Biology students. The finding is consistent with Sevilay (2011), who revealed that the mastery of science process skills enable students to conceptualize at a much deeper level, the content they do know and equips them for acquiring content knowledge

in the future. Content knowledge is acquired more efficiently and understood at a deeper level when obtained through inquiry using science process skills. The science curriculum that emphasizes science process skills will be able to help students to improve the skills in decision making, critical, and creative thinking. These skills can be transferred to other disciplines (Meador, 2003; Halim and Meerah, 2012). It was also revealed that science process skills are terminal skills for carrying out any experiment in Biology. This was in agreement with Opaleye (2012) who enthused that science process skills are helpful on the development of favourable scientific attitudes and a disposition in the learners. These include being curious and imaginative, enthusiasm about inquisitiveness.

Conclusion and Recommendations

It was concluded that science process skills are essential in promoting scientific skills during Biology lessons. Science process skills are very important for science achievement and for other science related subjects. Demonstration of science process skills in the classroom by teachers help students to move from one cognitive development level to the next, enhance operational ability and problem-solving skills in Biology classroom.

It was therefore recommended that Biology teachers should inculcate science process skills in their students to provide them with active skills, foster a natural sense of curiosity which is for scientific creativity. Biology teachers should present the subject to the students in a way that students would comprehend and acquire scientific skills as this would enhance their interest in the subject. Biology students should be engaged in scientific skills that could promote meaningful learning in Biology classroom.

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AVAILABILITY AND UTILIZATION OF ICT AND E-LEARNING RESOURCES FOR SCIENCE TEACHING IN OSUN STATE SECONDARY SCHOOLS

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Abstract

The study assessed the availability of ICT/e-learning resources for teaching the science subjects in public schools in Osun State; It also investigated the extent of teachers' use of ICT/e-learning resources in the science classrooms and examined the challenges faced by science teachers in using ICT/e-learning resources for teaching in Osun State public schools. The study adopted descriptive survey research. The population for the study comprised of science teachers (Biology, Chemistry and Physics) in Osun State public high schools. The study sample consisted of 108 Science teachers selected using multistage sampling technique. The instrument used to collect data for the study is a questionnaire titled "Teachers Utilization of ICT Resources (TUICT)". Data collected were analysed using frequency counts and percentages. The results showed that ICT/e-learning resources were not available for teaching in the public schools in Osun state. Only 16.67 % of schools have ICT resources while 74.07% do not have ICT resources. Result also showed that many of the secondary school science teachers (86.85%) do not make use of ICT resources for science teaching. Result indicated that only android tablet is the ICT resource that is available for teaching. Result further showed that the challenges of non-availability of ICT resources (66.67%) ; non availability of fund to purchase and maintain ICT resources (86.11%); non- availability of power supply (74.07%) and inadequate availability of ICT resource (69.44%) are the challenges faced by science teachers in using ICT/e-learning resources in the classrooms. The study recommends that science teachers should try to upgrade their knowledge and get new ideas that can make them to be able to use ICT resources to teach in science classrooms; Government should endeavour to make available ICT resources in public schools in Osun State and employers of labour should always organise training programmes like seminars, workshop, Conferences and in-service training for science teachers.

Key words: Information and Communication Technology (ICT), E-learning, Availability and Resources.

Introduction

Information and Communication Technology (ICT) is a diverse set of Technological tool and resource [es used to communicate and create, disseminate, store and manage information. ICT is an information handling tool that is used to produce, store, process, distribute and exchange information. It encompasses a range of applications, communications and technologies which aid information retrieval, research communication and administration. ICT is an electronic based system of information transmission, reception, processing and retrieval which has drastically changed the way we think, the way we live and the environment in which we live. (Ogunsola, 2005)

ICT has become a global phenomenon of great importance and concern in all aspects of human endeavour, spanning across education, governance, labour, business, marketplace, agriculture, commerce among others. It has an impact on nearly every aspect of our live from working to socialising, learning to playing. The digital age has transformed the way young people communicate, network, see help, access information and learn. Many countries of the world now regard the mastering of the basic skills and concepts of ICT as an inevitable part of the

core of Education as it has become one of the fundamental building blocks of modern society. To this end various new models of education are evolving in response to the new opportunities that are becoming available by integrating ICT and in particular Web-based technologies into the teaching and learning environment (Ogunsola, 2005). Abimbade (2006) described Information and Communication Technologies as essential tools in any educational system. They have the potentials of being used to meet the learning needs of individual student, promote equality of educational opportunities; offer high quality learning materials; increase self-efficacy and independence of learning among students, and improve teachers' professional development.

ICT is widely recognised that learners are motivated and purposefully engaged in the learning process when concepts and skills are underpinned with technology and sound pedagogy. Mar-ikemenjima (2005) said that ICT enhances administrative functions of teaching and learning, which in turn has a direct impact on pedagogy.

The role of E-Learning in teaching and learning is rapidly becoming one of the most important and widely discussed issues in contemporary educational policy. ICT in education can be understood as the application of digital equipment to all aspects of teaching and learning. It is being used in almost all schools in advance countries of the world. Several research studies have indicated that when properly used, ICT holds a great promise to improve teaching and learning. (Kwasha, 2007, Kubiatko and Halakova, 2009). Students taught with ICT/E-learning gain deeper understanding of complex topics and concepts and are more likely to recall information and use it to solve problems outside the classroom. In addition, through ICT, students extend and deepen their knowledge, investigation and inquiry according to their needs and interest when access to information is available on multiple levels. (Ajadi, Salawu and Adeoye, 2008).

According to Okanlawon & Ayoade (2014), the use of ICT in teaching is a relevant and functional way of providing education to learners that will assist in imbibing in them the required capacity for the world of work. ICT offer some reprieve from the confines and constraints of conventional classrooms. They afford teachers a wide variety of opportunities to re-think and re-engineer the nature of our teaching and learning practices. For example, various technology software serve different purposes in the classroom; word processing and e-mail can promote communication skills; database and spreadsheet programme can promote organization skills and modelling software can promote the understanding of science and Mathematics concepts. Word processing allows materials to be shared easily among teachers. e.g. teachers can make corrections to word processing documents more quickly than they could on typewriter or by hand. With word processing, students can also share ideas and product among themselves.

Spreadsheets package can be used by teachers in preparing students results so as to compete almost on the same footing with their counterparts in other parts of the world. Spreadsheets are normally used by teachers to manage students' grades and results.

Teachers can explore the internet to obtain information which will broaden their knowledge and assist their teaching. They can make use of flash drive to store information and use them later. Teachers can also make use of the internet when preparing lesson so that they will be able to be in touch with what their counterparts all over the world are doing and also be able to have first-hand information on current trends and best practices in their profession. Teachers can also download experiments on-line and use them to teach their students to improve their understanding of scientific concepts. Teachers can record their teachings and demonstrations of experiments on video for the students either before the normal class teaching to serve as advance organizers or even after the class teaching to serve as effective tool for remembering concepts taught in the classroom.

According to Ololube, Ubogu and Ossai (2007), the introduction of ICT usage, integration and diffusion has initiated a new age in educational methodologies, thus it has radically changed the traditional method of information delivery and usage patterns in the domain as well as offering contemporary learning experience for both teachers and students. However, the effective

integration of ICTs into the classroom depends to a large extent on teachers' ability and familiarity with the IT learning environment. According to Aladejana (2007) there have been very little efforts in the integration of ICT into Nigerian secondary school classroom. Has the situation changed now? Despite the enormous importance of ICT resources in education, it is not likely that science teachers in Osun State are making use of these resources in teaching. This study therefore intends to investigate the extent of the use of ICT resources by science teachers in the science classrooms in Osun State.

Purpose of the Study

The aim of this study is to investigate the availability and the extent of Utilization of ICT resources in teaching and learning of science subjects (Biology, Chemistry, and Physics) in public schools in Osun State. The specific objectives of the study are to:

(i) assess the availability of ICT/e-learning resources for teaching the science subjects in public schools in Osun State;
(ii) investigate the extent of teachers' use of ICT/e-learning resources in the science classrooms; and
(iii) examine the challenges faced by science teachers in using ICT/e-learning resources for teaching in Osun State public schools.

Research Questions

The study provided answers to the following questions

(a) How available are ICT/E-learning materials for teaching science subjects in the public secondary schools in Osun state?

(b) What is the extent of teachers' utilization of ICT/E-learning resources in the science classroom in Osun state?

(c) What are the challenges faced by science teachers in using ICT/e-learning resources for teaching in Osun state secondary schools?

Methodology

The study employed the descriptive survey research design. The population for the study consisted of all the science teachers (Biology, Chemistry and Physics) in the public secondary schools in Osun state. The sample consisted of 108 science teacher's selected using multistage sampling technique. There are three senatorial districts in the state, three Local Government each were selected from the senatorial districts using simple random technique. From each local government area, four secondary schools were selected using simple random sampling technique and from each school, the science teachers (Biology, Chemistry and Physics) were purposefully selected making a total of 108 science teachers.

The instrument used to collect data for the study was a questionnaire titled "Teachers utilization of ICT" (TUICT) for teaching science subjects. The questionnaire consists of four sections. The first section dealt with demographic variables of the respondents which include sex, qualification, years of teaching experience and level of computer literacy. Section B sought for availability of ICT/e-learning resources in the schools; while section C contained questions that sought for the extent of science teachers' utilizing ICT/e-learning resources in teaching Biology, Chemistry or Physics subjects and section D sought after the challenges faced by the teachers in using ICT resources for teaching and learning. The instrument was validated by an expert in Test and Measurement in Faculty of Education, Obafemi Awolowo University, Ile-Ife who examined the items in the questionnaire and the objectives of the study and make some suggestions. His suggestions were used for further revision of the instruments.

Data Collections and Analysis

The researcher and one research assistant visited the secondary schools selected for the study, and sought for the cooperation of the science teachers in responding to the items in the questionnaire. The questionnaire were administered to the respondents and collected back after ensuring that all the items have been attended to. The study lasted for six weeks. The data collected were analysed using frequency counts and percentages.

Results

Research Question one: Are ICT resources/facilities available for teaching the science subjects in Osun state public secondary schools?

Table 1: Availability of ICT Resources for science teaching in Secondary Schools

S/N	Items	Available		Not Available	
		Frequency	(%)	Frequency	(%)
1	Desktop Computers	100	92.59	08	7.41
2	Lap top computers	0	0.0	108	100.0
3	Overhead projector	05	4.63	103	95.37
4	Video player	06	5.56	102	94.44
5	Internet connections	04	3.70	104	96.30
6	Printer	65	60.18	43	39.82
7	Android Tablet	96	88.89	12	11.11
8	Television set	75	69.44	33	30.56
9	Radio set	12	11.11	96	88.89
10	Video conferencing	04	3.70	104	96,30
11	Public address system	05	4.63	103	95.37
12	Digital Multimedia	03	2.77	105	97.22
13	Scanner	20	18.52	88	81.48
14	Flash Memory	10	9.26	98	90.74
15	Stand by generator	15	13.89	93	86.11
	AVERAGE	207	16.67	1200	74.07

Table 1 showed that 16.67 % of schools have ICT facilities while 74.07% do not have ICT facilities. Desktop computers (92.59%), Tablet (88.89%) and Television set 69.44%) are the most available ICT facilities in schools.

Research Question two: What is the extent of teachers' utilization of ICT/E-learning resources in the science classroom in Osun state?

To answer this question the responses of science teachers (Biology, Chemistry and Physics) on the use of ICT resources in the science classroom were analysed using frequency counts and percentages. The result obtained is presented in table 2.

Table 2: Science Teachers use of ICT resources in the classroom

S/N	Items	Often Used		Seldom use		Never Used	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
1	Desktop Computers	06	5.56	21	19.44	81	75.0
2	Lap top computers	00	0.0	00	0.0	108	100
3	Overhead projector	00	0.0	03	2.78	105	97.22
4	Video player	00	0.0	02	1.85	106	98.15
5	Internet connections	00	0.0	00	0.0	108	100
6	Printer	20	18.5	45	41.67	43	39.82
7	Android Tablet	36	33.33	60	55.56	12	11.11
8	Television set	00	0.0	00	0.0	108	100
9	Radio set	00	0.0	00	0.0	108	100
10	Video conferencing	00	0.0	00	0.0	108	100
11	Public address system	00	0.0	00	0.0	108	100
12	Digital Multimedia	00	0.0	00	0.0	108	100
13	Scanner	00	0.0	00	0.0	108	100
14	Flash Memory	00	0.0	05	4.63	103	95.37
15	Stand by generator	00	0.0	15	13.90	103	86.11
	AVERAGE	62	3.82	151	9.32	1407	86.85

Result in table 2 above showed that many of the secondary school science teachers (86.85%) do not make use of ICT facilities for science teaching. Result indicated that only android tablet is the ICT resource that is available for teaching but not even in all the sampled schools. Most other facilities were not being used at all or more so they are not available in the schools. The findings of this study revealed that ICT facilities are not made available for teaching the science subjects in the public schools.

Research Question Three: What are the challenges faced by science teachers in using ICT/e-learning resources for teaching in Osun state secondary schools.

Table 3: Challenges faced by Science Teacher in Using ICT Resources for science Teaching

S/N	Items	Yes (%)	No (%)
1	Non availability of ICT resources	72 (66.67%)	36 (33.33%)
2	Inability of teachers to use the resources	08 (7.41%)	100 (92.6%)
3	Non availability of power supply	80 (74.07%)	28 (25.93%)
4	Large population of students	20(18.52%)	85(81.46%)
5	Non availability of fund to purchase and maintain ICT resources	93(86.11%)	15(13.89%)
6	Lack of seminar/workshop to train teachers on the use of ICT resources in teaching and learning	60 (55.56%)	48 (44.44
7	Unawareness of Science teachers on the use of ICT resources for teaching	20 (18.52%)	88 (81.46%)
8	Inadequate availability of ICT resources in the School	75 69.44%)	33 (30.56%)
9	Poor knowledge of science teachers on the use of ICT facilities for teaching	10 (9.30%)	98(90.74%)
10	No ICT laboratory in the school	100(92.60%)	08 (7.41%)

Result in table 3 revealed that schools are faced with the challenges of non-availability of ICT resources (66.67%). Other challenges observed revolved around this, like non availability of fund to purchase and maintain ICT resources (86.11%), non-availability of power supply (74.07%) and inadequate availability of ICT resource (69.44%). The respondents submitted the large population of students does not pose problem and that they can use the ICT resources if made available.

Discussion

On the first research question which states that are ICT resources/facilities available for teaching the science subjects in Osun state public secondary schools? From the result, it could be seen that ICT facilities are grossly inadequate in schools in Osun state. The result corroborates the report by Aladejana (2007) who says there have been very little efforts in the integration of ICT into Nigerian secondary school classroom. Also Olaobaju (2017) who also claimed that there were non-availability of ICT facilities for Chemistry Teaching in Osun State public high schools.

On research question two, what is the extent of teachers' utilization of ICT/E-learning resources in the science classroom in Osun state? The findings of this study revealed that ICT facilities are not made available for teaching the science subjects in the public schools. This is in line with the study of Okwudishu (2005) that ICT facilities are not made available for teaching in rural schools in Aniocha South Local Government area of Delta State. Similar result was reported by Njelita and Emendu (2015). They submitted that there were no ICT facilities in schools, that some of the desktops available were not functional, some were not installed but packed somewhere for security reasons.

With respect to research question three, the findings of this study revealed that ICT resources are not made available for teaching science in the public schools in Osun state. The science teachers are faced with various challenges which deprive the knowledgeable science teachers the use of ICT resources in public high schools. This includes lack of fund to purchase ICT facilities, unavailable ICT resources, lack of seminars/workshop and non-availability of power supply in most public schools in the state. This result is in line with the findings of Morrisa (2011) in his study on the use of ICT facilities in teaching, and found out that teachers have difficulties in the use of ICT facilities in teaching and this is associated with non-availability of ICT facilities in the school and weakness of teachers' knowledge about what technologies are available and how they can be used in Nigerian secondary schools. This study is also in line with study of Njelita & Emendu (2015), they submitted that ICT materials were not adequately supplied in schools and some of the desktops supplied were not functional while some were yet to be installed but packed somewhere for security reasons. Also, the findings of Olaobaju (2017), indicated that though teachers are knowledgeable in the use of ICT facilities, but the facilities are not available for teaching Chemistry in the High schools in Osun State. Also, Ochuku et.al. (2013) identified some constraints to effective utilization of ICT especially the e-learning technologies to include poor perception and conservative attitude of lecturers on the use of e-learning technologies for instructional delivery, shortage of qualified staff with capacity in e-learning applications, lack of training and retraining of staff and students in e-learning technologies and applications and inadequate time allocated to e-learning instruction and applications

Conclusion

The study concludes that despite the fact that science teachers have a good knowledge of ICT/e-learning resources, the resources are really not available in the public secondary schools in Osun State. Other challenges observed are non-availability of fund to purchase and maintain ICT resources, non- availability of power supply and inadequate supply of ICT resources to schools. These challenges have made it impossible for the science teachers to use ICT resources in the science classrooms.

Recommendations

Based on the result obtained from this study, the following recommendations were made:

The Government in the State should endeavour to provide ICT resources for science teaching in public secondary schools.

Government should organise regular workshops, seminars and in-service training for science teachers, head teachers/principals to enable them see the importance and how ICT resources can be used for teaching and learning.

Ministry of Education should embrace ICT integration for the development of ICT friendly curriculum in the sciences. This will provide the pathway for easy application of ICT in teaching and learning.

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COMPARATIVE STUDY OF PHYSICS STUDENTS' ACADEMIC PERFORMANCE IN EKITI STATE

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Abstract

The study examined the comparative study of physics students' academic performance in private and public schools in both internal and external examinations in Ikere Ekiti Local Government area. Recently, most parents with moderate and high economic status do register their children with private schools. Even those who could not afford private schools wish to have their children in private school at all costs, which consequentially affects enrollment in public schools. This crave for private schools and the eventual exodus of public school students to private schools to write external examination makes the researcher to carry a comparative study of physics students academic performance in private and public schools in both internal and external examination in Ikere-Ekiti local government area of Ekiti state. This study found out whether students do perform better in internal exams than external exams, whether private secondary schools students do perform better than public schools students in Ekiti states and if they do, then what factors lead to their differences? The research design used was expo facto and this work was designed to compare physics students' academic performance in internal and external examinations in private and public schools in Ekiti State. The finding of this study revealed that there is a significant difference between public and private schools in external examination and also shown that the private school students performed better than the public school students in internal examination. It is therefore recommended that government at all levels should support the running of both public and private schools. More supervision should be done on the public schools to make teachers work better on the students. Retraining of the teachers in both school types to improve their physics instructional strategies should be the concern of all education stake-holders.

Introduction

Education is the basic pro of progress towards sensible change. It extends people's capacities to change their fantasies for society into reality. All countries try quality direction for their supportable change. At any preparation level, the nature of education depends on a couple of variables, for instance, school workplaces, teachers' ability, instructors' motivation, organization and association, e.t.c. An understudy's informative outcome and educational accomplishment is inconceivably influenced by the kind of school that they go to; class factors join; school structure, school association, and school atmosphere (Barry, 2006). The key concepts in this study are the nature of schools which is conceptualized in terms of two categories; public and private schools and the performance of students. Crosnoe, Johnson, and Elder (2004) suggested that school sector (private or public) and class size are two important structural compounds of schools, private school tends to have both better funding and smaller class sizes than public schools. The relative social class of a student body also affects academic achievement. Student from low socio economic backgrounds who attend poorly funded school do not perform as well as students from higher social classes (Eamon 2005).

The Federal Government of Nigeria has even come to the conclusion that there is a fall in the standard of education in Nigeria (NTA News, 2017). The senior secondary certificate examinations (SSCE) conducted by WAEC and NECO are taken by both private and public secondary school candidates in their final year of

secondary education. The performance of students in science subjects especially physics has not been encouraging (Kanno, 2000; Ajagun, 2001).

Today, there are many kinds of private schools in Nigeria. Highly costly schools for the rich, more affordable schools for the middle class and cheap private school that might run out of someone's house or some rented rooms for the poor. However Agbatogun (2009) and Olatoye (2009a, 2009b) reported that there is a significant difference between public and private school students' achievement in science

Statement of the Problem

Nigeria like some other developing nations in Africa has tried endeavors to give auxiliary training to its kin. The acquaintance of schools was normal with enhance scholastic execution by giving equivalent open doors for all students from all socio-social foundation. The introduction was on value and access for education to all youngsters. The government that is expected to improve academic performance by establishing many schools, yet, it has achieved only equity and access but not quality performance. Recently, most parents of moderate and high economic status do register their children for external exams with private schools. Even those who could not afford private schools wish to have their children at all costs in private school, which consequentially affects enrollment in public schools. This crave for private schools coupled with exodus of public school students to private schools to write external examination makes the researcher to carry a comparative study of physics students' academic performance in private and public schools in both internal and external examination in Ikere-Ekiti local government area of Ekiti State, was to know whether students do perform better in internal exams than external exams, whether private secondary schools students do perform better than public schools student in Ekiti State and if they do, what then is the difference.

The purpose of this study is to compare the academic performance of students in both internal and external exams in physics, also private and public schools Ekiti State. Specifically it was designed to: ascertain the difference in students' academic performance in private and public schools in external exams in physics; find out the difference in students' academic performance in private and public in internal exams in physics; investigate the difference in male and female students' academic performance in internal examination; identify the difference in male and female students' academic performance in external examination; examine the difference in students' academic performance in private schools in internal and external examinations; determine the difference in students' academic performance in public schools in internal and external examinations; investigate the significant relationship between students' academic performance in internal and external examination in private schools; identify the significant relationship between students' academic performance in internal and external examination in public schools.

Methodology

The research design used for this study expo facto research design and this work was designed to compare physics students' academic performance in internal and external examinations in private and public schools in Ekiti State. The results of 238 SS3 students that sat for 2014/2015 internal and external (mock and WAEC) examination in four selected schools were used

The instrument used in collecting data for this study was primary source. The results of physics student in internal and external examinations from the four selected schools were used using random sampling technique.

The data collected, which were the students' scores of internal and external results of physics students, were analyzed using frequency counts and simple percentages. The null hypotheses were tested using the t-test statistical technique and correlation at 0.05 α-level.

Research Hypotheses

The following hypotheses were generated for this study:

H_o1: There is no significance difference in students' academic performance in private and public in external exams in physics.

H_o2: There is no significance difference in students' academic performance in private and public in internal exams in physics.

H_o3: There is no significant relationship between students' academic performance in internal and external examination in private schools.

H_o4: There is no significant relationship between students' academic performance in internal and external examination in public schools

Testing of Hypotheses

Hypothesis 1: There is no significance difference in physics students' academic performance in private and public schools in external exams.

Table 1: A t-test analysis of students' academic performance in private and public in external exams in physics.

Group	N	$\overline{X}$	S.D	df	Calculated value	Critical value	Remark
Public	42	6.5455	2.71713	107	2.21	1.96	Significant
Private	67	6.6779	2.80326				

Significant at 0.05 probability level

Table 1 shows that there is significant difference between private and public physics students' academic performance in external examinations. The private school students mean score in external examination is 6.68 as against that of public school students which is 6.55. This shows that there is significant difference as revealed in table 2, with private students performed better than the public students in external examination.

Hypothesis 2: There is no significance difference in students' academic performance in private and public in internal exams in physics."

Table 2: A t-test analysis of students' academic performance in private and public in internal exams in physics.

Group	N	$\overline{X}$	S.D	df	Calculated value	Critical value	Remark
Public	67	8.0714	3.40296	127	2.26	1.96	Not Significant
Private	62	8.92512	3.61512				

Significant at 0.05 probability level

Table 2 shows that there is a significant difference between private and public physics students' academic performance in internal examinations ($t = 2.26$, $p>0.05$). The private school students mean score in external examination is 8.93 as against that of public school students which is 8.07. This shows that there significant difference revealed in table 3 private students performed better than the public students in internal examination.

Hypothesis 3: There is no significant relationship between students' academic performance in internal and external examination in private schools.

Table 3: Correlation analysis between students' academic performance in internal and external examination in private schools

Variable	N	Df	r-cal	r- table
Internal	62	127	-0.431	0.195
External	67			

From table 3, the Pearson correlation analysis showed a calculated r-value of -0.431. This was observed to be greater than the critical r-value of 0.195 with 127 degrees of freedom at $\alpha = 0.05$ level of significance. Going by the result, the null hypothesis of no significant relationship between students' academic performance in internal and external examination in private schools was rejected.

Hypothesis 4: There is no significant relationship between students' academic performance in internal and external examination in public schools.

Table 4: Correlation between the academic performances of between students' academic performance in internal and external examination in public schools

Variable	N	Df	r-cal	r-table
Internal External	67 42	107	0.74	0.195

From table 2, the Pearson product moment Correlation analysis showed a calculated r-value of 0.74. This was observed to be greater than the critical r- value of 0.195 with 107 degrees of freedom at $\alpha = 0.05$ level of significance. Going by the result, the null hypothesis of no significant relationship between students' academic performance in internal and external examination in public schools tics was rejected.

Discussion

The findings revealed that the there is a significant difference between public and private school students in external exams. The mean score for the private school students is 6.68 while the public school students' mean physics achievement score is 6.55. This shows that the private school students are better than the public school students in external examination which in line with Agbatogun (2009), Olatoye (2009a, 2009b) who reported that there was a significant difference between public and private school students' achievement in science. Factors that could cause this include small class size, safe, neat and welcoming environment in private schools.

The findings also revealed that there is significance difference in male and female students' academic performance in external examination. It is evident that gender factor has influence on the performance of the students. It is important to note that both public and private school female students have higher mean scores. This is contrary to the popular opinion among researchers that the male students are better than the female students in science achievement.

Taking close look at the result of the findings, the students performed differently both in internal and external examinations. The failure in internal and external extermination was more pronounced in public schools. It was crystal clear from the data collected that the population of public school students sitting for internal exams was but later reduced drastically during external examination. This dropped a hint that some public school students moved to private schools when writing external examination.

Conclusion

This study has been able to establish the fact that private school students in Ikere–Ekiti Local Government Area of Ekiti state are perform better in physics than their counterparts in the public schools. These findings tend to provide justification for parents who have found private schools as an alternative to government-owned public schools. It is however important to stress that students' mean achievement scores in both public and private schools are below average.

This shows that a lot of work still needs to be done to raise students' performance in both public and private schools. The no significant difference in achievement by school type is an assurance that there is hope that private and public students have the potential of benefiting from science teaching.

Recommendations

It is therefore recommended that government at all levels should support the running of both public and private schools. More supervision should be done on the public schools to make teachers work better on the students in physics. Retraining of the teachers in both private and public schools to improve their physics instructional strategies should be the concern of all education stakeholders.

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IMPLICATIONS OF FLIPPED INSTRUCTIONAL STRATEGIES AND GENDER ON PRE-DEGREE STUDENTS' ATTITUDE TO BIOLOGY

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Abstract

The study examined the effects of flipped instructional strategies and gender on pre-degree students' attitude to Biology. Three null hypotheses were generated and tested at 0.05 level of significance. Pretest posttest control group quasi-experimental design was used; One hundred and seventy four pre-degree students *purposively selected from three universities in Nigeria were involved in the study. Biology Achievement Test (BAT) and Students Attitude to Biology Questionnaire (SABQ) were the instruments used. Data were analysed using Analysis of covariance (ANCOVA). Result indicated that treatment was significant in enhancing student's attitude to Biology. There was no interaction effect of flipped instructional strategy and gender on students' attitude to Biology. It is therefore recommended that Biology lecturers should adopt flipped instructional strategies.*

Keywords: Flipped strategy, gender, attitude, pre-degree students

Introduction

Biology is a vital Science subject in the Nigerian school system. It is generally defined as the study of life. Ukoh and Ade (2015) said that the introduction of science subjects in school curriculum (Biology inclusive) was done with a view to developing scientific attitude, scientific nature, critical thinking, active inquiry, independent work and understanding the physical world from different perspectives. Introductory courses in Biology often taken by Nigerian undergraduates in the Faculty of Science and Science Education programmes stand as gateways into science, introducing scientific inquiry, the use of evidence, and the core biological concepts that can help students make informed decisions about the complex Biology related problems in their daily lives. (Odili, 2006).

The conventional teacher-centred approach usually deployed for teaching Biology has been considered by researchers as one of the factors that have contributed to poor attitude of students to Biology. For instance Danmole, (2012) said that whenever students are not involved in hands-on activities with equipment during practical sessions, they are likely to retain very little of what is being taught and this has implication on their attitude towards the subject. The poor attitude of students to Biology has also been traced to insufficient facilities/resources available for Biology instruction, especially the practical component of the subject, in many Nigerian Universities. This poor attitude to Biology may eventually translate into poor performance in it. Jegede and Ayeni (2013) commented that the use of practical approach such as field work in the instruction of Biology improves the attitude of teachers toward the teaching of biology.

Flipped instructional strategy also known as 'flip teaching', the 'inverted classroom', or 'reverse instruction' has been found to be particularly useful for lessons that are practical based which do not always have the materials needed readily available, and also with a large number of

students to cater for (Mike, 2012). Flipped learning is also suitable for courses such as Biology, which contents are voluminous and are usually difficult to complete during regular classroom periods, as well as for concepts that have more of practical work and that involve students' hands-on experience on equipment. In flipped instructional strategy, pedagogical model which largely depend on educational technology is used to leverage the learning in a classroom, so that a teacher can spend more time interacting with students instead of lecturing (Bergmann and Sams, 2012). The typical lecture and homework elements of a course are reversed or inverted.

The influence of gender on students' attitude to science courses has been vigorously examined by researchers. Divergent reports abound from fields of research on gender issue. Efuwape and Aremu (2013) concluded that there is no disparity in the use and acceptability of technology and science based equipment on gender. Studies have shown significant difference in favour of boys (Bilesanmi-Awoderu, 2002; Aremu and John, 2005; Abiona, 2008; Ojo, 2009): sometimes in favour of girls (Olatundun, 2008) and sometimes have shown no significant difference between boys and girls in relation to their achievement in and attitude to different science subjects (Owoyemi, 2007; Okoye, 2010). The findings of Ajitoni (2005) revealed that there were significant differences between female and male students in terms of attitude in favour of the female. Aremu and John (2005) in their study have stated that the search for strategies to bridge the gap in the achievement and attitude of males and females is an ongoing one. Olagunju (2007) reported that teachers, especially female teachers possessed significant attitude to the teaching of Biology. Her suggested reasons are perhaps high potential abilities in verbal expression and the ability to use technology.

There is the need to explore more effective strategies that will be learner- centered and activity based. This might be able to influence the attitude of students positively. The effect of a technology based strategy: flipped strategy, using animation and video packages on Nigeria State Universities pre-degree students' attitude to Biology was determined in this study. The flipped classroom model may provide many benefits for instruction that are not possible with the conventional instruction. For example, after flipping his classroom, Bergmann (2011) said he could more easily query individual students, probe for misconceptions around scientific concepts, and clear up incorrect notions. By instinct, Bergmann said the most important benefit of flipped strategy is profoundly human and that he now had time to work individually with students and talk to every student in every classroom every day.

With flipped classroom approach there is now enough time for students to collaborate with peers, engage more deeply with contents, and receive immediate feedback from their instructor says Hamden, McKnight, McKnight, and Argstrom, (2013). One very important feature of the flipped class model is to increase teacher-to-student and student-to-student interaction during class time.

Statement of the Problem

Despite the emerging trend in technology-assisted learning, researchers observed that the attitude of students to Biology is gradually becoming negative. This is evident in their low subscription or enrolment to the subject at senior secondary school level. Similarly, the result of students at Senior Secondary School level in Biology has been observed to be poor when compared with science subjects such as Chemistry, Agricultural science among others. This reflects the attitude of students to the course. Few scholars and agencies have also tried to get a solution to the problem of poor attitude to Biology courses by introducing electronic contents and making it available to the students on various electronic media, but this solution according to findings, appears to be more utilized by the male students than their female counterparts. These efforts therefore revealed that the use of Information and Communication Technology-based instruction such as the flipped strategy may not favour both male and female equally, which may be responsible for poor attitude by the female to the subject.

Hypotheses

Three null hypotheses were raised to guide the study

1. There is no significant main effect of flipped instructional strategy on students' attitude to Biology

2. There is no significant main effect of gender on students' attitude to Biology
3. There is no significant interaction effect of flipped instructional strategy and gender on students' attitude to Biology

Methodology

The study adopted the pretest-posttest control group quasi-experimental design. It determined the possible effect of animation and video-based flipped instructional strategies on pre-degree students' attitude to Biology in Southwestern Nigeria.

Instrument

Two Instruments were used for the study. They are Biology Achievement Test (BAT) and Students Attitude to Biology Questionnaire (SABQ)

BAT is a thirty-five item multiple choice test items developed by the researchers. It was presented to experts in Biology Education for content and face validity. It was administered to 50 Biology pre-degree students (not part of the study sample) their scores were subjected to internal consistency using the Kuder- Richardson 20 formula. The values yielded 0.82 which shows that the instrument is reliable enough to be used for the study.

Similarly, SABQ is a twenty five item close-ended questionnaire developed by the researchers which sought the attitude of students to Biology. It was administered to 50 Biology pre-degree students (not part of the study sample) their scores were subjected to internal consistency using Cronbach alpha formula and it yielded 0.73 which shows that the instrument is reliable enough to be used for the study.

Selection of Participants

Purposive sampling technique was used to select 174 pre-degree students (69 males, 105 females) from three state universities in Nigeria offering pre-degree programme. Criteria for selecting universities are the availability of hostel accommodation for students where electricity generators are always put on at night for students to read (for the experimental groups) as well as availability of pre-degree programme in Biology. Participants were also purposely selected based on their possession of a personal computer or other smart mobile devices that was used for flipping the lessons

Participants were assigned into Animation-based Flipped Strategy group (71), Video-based Flipped Strategy group (51) and control group (52). Treatment lasted eight weeks.

Results

The results are presented according to the sequence of the hypotheses which were tested. Analysis of Covariance (ANCOVA) was computed for the variables in both the experimental and control groups. Estimated Marginal Mean (EMM) was also computed to find out how each of the groups performed, and where there is a significant difference among the groups. Scheffe Post-Hoc analysis was used to find out the source of significance among the three groups. All hypotheses were tested at $p < 0.05$ level of significance

Hypothesis One: There is no significant main effect of flipped instructional strategy on students' attitude to Biology

Table 1: Analysis of Covariance (ANCOVA) of Post-Student Attitude to Biology Questionnaire Scores by Treatment and Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1473.486[a]	18	81.860	1.244	.233	.126
Intercept	9657.435	1	9657.435	146.740	.000	.486
PreSABQ	2.962	1	2.962	.045	.832	.000
Treatment	386.154	2	193.077	2.934	.041*	.036
Gender	7.799	1	7.799	.119	.731	.001
Treatment * Gender	24.695	2	12.348	.188	.829	.002
Error	10201.043	155	65.813			
Total	771732.000	174				
Corrected Total	11674.529	173				

a. R Squared = .126 (Adjusted R Squared = .025) * Denote significant difference at 0.05 level of significance

The results on Table 1 indicate that there is significant main effect of treatment on students' attitude scores ($F_{(2,155)} = 2.934$; $P < 0.05$, partial $\eta^2 = 0.036$). The effect size is 3.6%; this implies that 3.6% of the variance observed in the attitude mean score is due to the treatment. It means that there was a significant difference in the post-attitude mean scores of students. Thus, hypothesis 1 was rejected. In order to determine the magnitude of the significant main effect across groups, the estimated marginal means of the groups was carried out and the result is presented in Table 2

Table 2: Estimated Marginal Mean Post-Attitude by Treatment and Control Groups

			95% Confidence Interval	
Treatment	**Mean**	**Std. Error**	**Lower Bound**	**Upper Bound**
Flipped Animation (FAS)	68.02[a]	1.784	64.493	71.540
Flipped Video (FVS)	66.08[a]	1.904	62.322	69.845
Conventional Strategy(CS)	61.85[a]	1.820	58.257	65.448

a=adjusted post-attitude mean score

Table 2 shows that students in the flipped animation strategy group had the highest adjusted post-attitude mean score (68.02) followed by the flipped video strategy group (66.08) while students in the conventional strategy control group had the least adjusted post-attitude mean score (61.85).

Table 3: Scheffe Post-hoc Analysis of Post-Attitude by Treatment and Control Group

Treatment	Mean	FAS	FVS	CS
FAS	68.02		*	*
FVS	66.08	*		*
CS	61.85	*	*	

* = Pairs of significantly different at $p < .05$ This order can be represented as FAS> FVS > CS.

Table 3 revealed that students exposed to flipped animation strategy are significantly different from their counterparts exposed to flipped video strategy and conventional strategy in their post-attitude scores. Furthermore, the students exposed to flipped video strategy are significantly different from those exposed to conventional strategy. This implies that both flipped animation and flipped video strategies are the main source of significant differences in treatment.

Hypothesis Two: There is no significant main effect of gender on students' attitude to Biology

The results in Table 1 shows that gender had no significant main effect on students' attitude to Biology ($F_{(1,155)} = 0.119$; $P>0.05$, partial $\eta^2 = .001$). Hence the hypothesis was not rejected.

Hypothesis Three: There is no significant interaction effect of flipped instructional strategy and gender on students' attitude to Biology

The results in Table 1 revealed that there is no significant interaction effects of treatment and gender on students' attitude to Biology ($F_{(2,155)} = .188$, $P>.05$, partial $\eta^2 = 0.002$). Therefore, the hypothesis was not rejected.

Discussions

Effect of Treatment on Students' Attitude to Biology

Findings from this study revealed that there is a significant main effect of animation and video-based flipped instructional strategies on students' attitude to Biology: students in the animation-based flipped group particularly had the highest adjusted post-attitude mean score, followed by the video-based flipped group, while students in the control group had the least adjusted post-attitude mean score. This result is in line with the findings of Adedoja *et al.* (2013), Aremu *et al*. (2013), Nsofor *et al.* (2015) and Adedoja (2016). Students are likely to have developed a positive attitude towards flipped classroom strategies because it frees them from the boredom often associated with the conventional method of teaching Biology. Observation from this study revealed that students' interest and participation in Biology have increased as a result of the flipped strategies used. Students in the treatment groups commented that they never knew that Biology lectures could be this lively and benefiting. They specifically reported that they enjoyed the collaboration segments of the study. These reports are in conformity with what Jason (2012) experienced when he reported that 75% of students in flipped classroom frequently or always help other students in class.

It appears that any strategy that is ICT based always receives more attention and acceptance from students, especially those in higher level of studies. Several scholars have established this: Adedoja *et al.* (2010), Aremu *et al.* (2010), Efuwape *et al.* (2013), Akingbemisilu (2014), Aremu *et al.* (2015), Gladys *et al.* (2015). The rate of acceptance and usability of ICT based strategy by students in higher institutions has been confirmed high. It is therefore appropriate to infer that ICT based instructional strategy (such as flipped instructional strategy) always influence the attitude of students positively to the subject it is used to facilitate. In this study, the flipped strategy using animation and video platforms was able to significantly and positively influence the attitude of students towards Biology.

Conclusion

The results of the study have shown that animation and video-based flipped instructional strategies are more effective in enhancing students' attitude to Biology than the conventional method. The flipped strategies produced more positive attitude to Biology than the conventional method. This means that the current low enrolment to Biology caused by poor attitude to Biology could be effectively tackled through the application of flipped instructional strategies.

Recommendation

1. Lecturers taking Biology courses in universities should adopt flipped instructional strategy in teaching their courses

2. Curriculum planners and developers in Biology courses for Nigeria Colleges of Education and Faculties of Education and Science should emphasize on the need to continuously use innovative strategies such as flipped strategy to enhance biology instruction.

3. Educational technology and Biology units in various higher institutions of learning should incorporate flipped strategies into their curricula.

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TEACHING PRACTICE: DISTINCT CONSTITUENT FOR PROFESSIONAL COMPETENCE

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Abstract

Teaching is a complex, multifaceted activity, often requiring the need to juggle multiple tasks and goals simultaneously and flexibly. It requires specialized education, knowledge, training and ethics. On this account, student-teachers must be exposed to a period of quality tutelage in the practice of teaching. The paper contends that teaching practice is a very distinct and prominent component of the professional training in the teacher education programme. Hence every institution saddled with the responsibility of training teachers must offer quality training that guarantees sound professional competence. The paper emphasized the centrality of teaching practice and highlighted the objectives. Focus was also on components of effective teaching practice exercise and roles of supervisors and cooperating teachers. Also, the paper explicated the expected responsibilities of the student-teacher. It is pertinent to put all these into proper perspectives for successful and meaningful teaching practice exercise. Challenges of teaching practice exercise were analysed and while suggestions for improving teaching practice exercise in Nigeria teacher education programmes were offered, the paper concluded with appropriate recommendations.

Keywords: Teaching practice, Constituent, Professional practice

Introduction

Education is defined as the acceptable processes which enable the learner to study and learn those skills, attitudes and values of the society in readiness to live a meaningful life and to contribute to the development of the society (Wosu, 2016). In simple terms, it is the major instrument for change, bringing about social and economic transformations. To Okorie (1986) education is a part of life, which is deliberately controlled, and experiences developed according to a conscious plan. Fundamentally and precisely, education is the means of universal literacy involving the acquisition of knowledge and skills and the ability to apply and transform the acquired skills into meaningful systems i.e systems embedded in political, cultural and economic contexts (Alebiosu, 2014). It is the most veritable instrument for change in any society and its quality is a function of the quality of teachers. The quality and quantity of what students learn and retain remain functions of teachers' instructional capabilities and effectiveness (Alebiosu, 2012). The teacher is the arrow head in the realization of quality education and must be professionally competent.

Quality teachers are bound to be skilled enough to produce quality teaching whereby the goals of education are realized in schools. They must receive training to perform the duties effectively and it is in this light that teaching is regarded as a profession. Teaching requires specialized education, knowledge, training and ethics, hence student-teachers must be exposed to a period of quality tutelage in the practice of teaching. It is pertinent, therefore, that every institution saddled with the responsibility of training teachers offer quality training in the practice of teaching that guarantees sound professional competence. Consequently, teaching practice is a compulsory component of teacher education curriculum. It is a situation in which concepts, theories and principles of education are demonstrated and put into practice in the classroom situation.

Teaching practice is an important component of teacher education in Nigeria through which

necessary pre-service teaching experience is acquired. It is the core of teacher education and a necessary ingredient in teacher training, and budding teachers must experience it as part of their preparation (Alao, 1998; Afemikhe, 2004; Adetayo, 2008). The National Policy of Education (FRN, 2013) giving credence to the importance of teaching practice, stated as part of teacher education goals, the provision of requisite knowledge both intellectual and professional to teachers so that they can perform their assignments i.e. teaching.

Teaching Practice is a culminating experience in teacher preparation. It provides opportunity for teachers in training to become socialized into the profession and their performances during the exercise provide some basis for predicting professional competence and their future success as a teacher (Furlong, Hirst and Pocklington, 1988). The centrality of teaching practice is an important contributing factor towards the quality of teacher education programme. During practice teaching, student- teachers feel themselves grow through experience and they begin to link to a culture of teaching. They feel engaged, excited, challenged and even empowered, but incidentally, the foregoing is not the situation. Experiences over the years revealed a continuous decline in both the quality of teachers in training sent on teaching practice from higher institutions of learning and the quality of the teaching practice exercise (Adetayo, 2008; Ekundayo, Alonge, Kolawole & Ekundayo, 2014).

Student-teachers continue to demonstrate lack of enthusiasm in the teaching practice exercise while the supervision leaves much to be desired. Quality time is not available for teaching practice component of the teacher education curriculum as it is rushed through and in most cases the feedback component of the exercise is trivialized. These and many other challenges have been put forward as confronting teaching practice component of teacher education programme in Nigeria thereby constituting obstacle to achieving professional competence among prospective teachers.

The Concepts of Teaching Practice and Professional Competence

A number of terms such as the teaching practice, student teaching, field studies, practice teaching, infield experience, school based experience or internship are used to refer to the concept of teaching practice (Taneja, 2000). The term practice teaching embraces all the learning experiences of student-teachers in schools (Ashraf, 1999). The term has three major connotations: the practicing of teaching skills and acquisition of the role of a teacher; the whole range of experiences that students go through in schools; and the practical aspects of the course as distinct from theoretical studies. According to Kolawole (2015), teaching practice gives student-teachers opportunities to practically demonstrate skills such as interpersonal/relational, counseling, supervisory, content-knowledge and pedagogical content-knowledge they have acquired in the course of their preparation under the close watch of more knowledgeable and experienced supervisors.

Teaching practice is a school-based internship programme with the main aim of introducing prospective teachers to teaching and its routine under the guidance of qualified professionals to develop skills, attitudes and competence in the profession (Ekundayo, et al, 2014). Teaching practice simply connotes the preparation of student-teachers for teaching by practical training. It is the practical use of teaching methods, teaching strategies, teaching principles, teaching techniques and practical training and practice / exercise of different activities of daily school life. The absence of teaching practice breeds non – professionals which Alebiosu (2012) refers to as teachers that are not adequately equipped with deep knowledge of learning and learning conditions that are essential for devising effective instructional tools. Teaching practice is the springboard for effective pedagogy and professional competence. Its efficacy paves way for sustainable, meaningful and productive teaching and learning phenomena.

Teaching requires specialized education, knowledge, training and ethics, and the professional teacher must serve the educational interests of students as they practice under conditions that enable them to exercise professional judgment. The processes which make teaching a profession must contribute to the holistic development of students, hence it is imperative that teachers are professionally competent. Teacher's professional competence is

a situation in which the teacher possesses and demonstrates a wide-range repertoire of different teaching and learning models, methods, approaches, strategies and techniques, different learning skills and learning styles, and knows how to create the right conditions for learning in order to obtain desired learning.

Objectives of Teaching Practice

Teaching practice enables student-teachers develop and acquire pedagogical skills in the natural setting which is the schools of practice. We know that student-teachers enter the classroom with a degree of training which, on many occasions, proves to be of little value. This is because the practical situation in the classroom is one which is full of complexity, uncertainty, instability, and one where conflicting values exist. The skills and capacities required to act in this type of situation has deviated from theoretical acquisition to its application. It is complex requiring the demonstration of initiatives and expertise. In this vein, teaching practice provides the opportunity for linking theory and practice under the guidance of more experienced teachers and supervision by college lecturers. The quality of teaching practice to a great deal depends on the extent to which educational theory and practice are joined and integrated in teaching. The aim of teaching practice is to give student-teachers the opportunity of learning at first hand the actual work of a teacher in a typical classroom situation. It provides student-teacher the opportunity to meet learners as they are and to practicalize the theories acquired (Nakpodia, 2011). According to Afolabi (1999) cited by Ekundayo, et al (2014) teaching practice exercise is to acquaint student teachers with the practical knowledge of teaching and learning process including lesson plan preparation, presentation, class management, communication skills, evaluation and the required personality of professional teachers. According to Akbar (2002) cited by Nakpodia (2011), the following are the objectives of teaching practice:

1. To provide prospective teachers with an opportunity of establishing an appropriate teacher- pupil relationship.
2. To provide an opportunity for evaluating the student potential as a teacher and suitability for the teaching profession.
3. To develop personal relationship with others: administrators, teachers, parents and students.
4. To provide the future teachers with practical experience in school to overcome the problems of indiscipline and enable him / her to develop method of control.
5. To give the teacher an opportunity to put theories into practice and to develop a deeper understanding of educational principles and their implications for learning.
6. To enable the student- teachers effectively plan and prepare lessons.
7. To develop skills in the use of fundamental procedures, techniques and methods of teaching.
8. To develop desirable professional interests, attitudes and ideas relative to teaching profession.
9. To enable student-teachers acquire desirable characteristics / traits of a teacher and to display appropriate behaviour.
10. To provide student-teachers with an opportunity to have teaching evaluated and to gain from the benefits of constructive criticism.
11. To provide an opportunity for self-evaluation and to discover own strengths and weaknesses.
12. To develop skills in future teachers related to teaching like fluent speaking, meaningful reading, using blackboard and other teaching material.
13. To provide an opportunity to liaise with school environment, its functioning and with community and its resources.
14. To provide for the exchange of ideas, materials and methods between practicing school and teacher training institution and teacher training institutions' staff and students.

Facets and Components of Effective Teaching Practice Exercise

Teaching practice exercise has many facets and these are implemented for a successful teaching practice exercise. They include;

1). Getting intimated with the school of teaching practice: This is the first step in the preparation for teaching practice. The student-teacher should visit the school for teaching practice to see and create a good rapport with the head of school, class teachers and school staff and obtain information about school and its environment from them, and establish an atmosphere of cordiality. The student-teacher must also observe and/or be equipped with information on the teaching arrangements of the school, teaching methods of cooperating class teacher, notebooks of the students and their usual routine, age of the students, strength of the class, abilities and specific problems of the students, timing of the school, scheme of work, textbooks and teaching aids.

2). Preparation of Lesson: The next facet to familiaring with the school of teaching practice is to prepare for the lesson. Effective preparation requires that the student-teacher masters the content through thorough study of relevant reading materials. In addition, the student-teacher should prepare relevant teaching aids and a well laid out lesson plan. He/she must also be able to envisage un-planned / unexpected phenomena.

3). Actual classroom teaching: This component entails the actual classroom interaction involving the teaching of content. It involves the purposeful interaction between the materials, the subject-matter, the learner and the student-teacher. Effective lesson delivery is an essential component of teaching practice. The student-teacher while teaching passes through different steps of his/her teaching (introduction, presentation, recapitul-ation) during the which, the teacher/supervisor assesses/observes the student-teacher's lesson. A good lesson according to Nakpodia (2011) has the following qualities;

i). Lesson planning should be in complete detail.

ii). Lesson should be interesting.

iii). There should be effective and timely use of teaching methods and teaching aids.

iv). Students should be ready for learning.

v). Students should be involved practically in teaching learning process.

vi). Lesson should be taught in professional and friendly environment.

vii). All students should be given same attention by keeping in view their individual differences.

4). Evaluation of teaching practice: This component entails the assessment of the performance of the student-teacher while teaching in the classroom. The teaching practice supervisor evaluates/observes the punctuality, lesson planning, teaching methods, use of audio visual aids, adequacy of audio visual aids, pitch of voice, dress, start and end of lesson, interest of the students, discipline of class, use of black/ white board, students' notebooks and objectives of the lesson, including the enthusiasm of the student-teacher.

5). Participation in other routine works of school: Teaching in the classroom is not only the objective of teaching practice, it also includes training in all activities/work which student-teachers are going to perform in future during their job. The student-teacher is expected to participate in all the activities in the school. Some of these as highlighted by Nakpodia (2011) and others include;

i). Preparation of timetable, preparation and maintenance of registers, evaluation of class work and home work, arrangement of tutorial groups.

ii). Taking part in sports/games, morning assembly, co-curricular activities, decoration of classrooms and beautification of school environment and premises.

iii). Performing duties during recess, as day master, before and after school timing, and as counsellor.

iv). Preparation and maintenance of attendance boards, news boards, information boards and other boards, as well as maintenance of workshops, home economics rooms, equipment rooms, science laboratories and library.

v). Preparation of question papers for examinations, invigilation in examinations, evaluation of answer scripts and compilation of results.

vi). Relating well with students' parents, officers of the school, school employees and guests.

The following activities and procedures are pertinent for effective teaching practice exercise:

i). The students are asked to propose a school of choice after which letters are written to principals of co-operating schools asking them to indicate the number of student- teachers they need and the subject areas of need. The principals are also reminded of their responsibility to ensure that accommodation is provided for the student- teachers (if possible).

ii). Orientation activity is organised and made mandatory for both the prospective student-teacher and college participating supervisors. Papers on various aspects of the teaching practice exercise are presented and prospective student-teachers are made to ask questions. Topics so discussed only serve to reinforce what the students have been taught in their Education and subject method lectures.

iii). The students are posted, as much as possible, according to their choices and the principals' requests and participating schools are enjoined to give maximum cooperation and support.

iv). Supervisors are adequately mobilized and empowered with facilities required for the exercise. Such as grouping, consideration of distance in posting, consideration of area of specialization, use of standard and uniform assessment format, and so forth.

v). The student-teachers are supervised at least two times and by more than one supervisor. The average scores are used for the final grading.

vi). Evaluation considers both the rating of the supervisors and the contributions / comments / observations of the participating school.

Roles of Supervisors and Cooperating Teachers in Teaching Practice

Supervisors play significant roles in teaching practice and the effective discharge of their duties to a large extent determine the success of teaching practice. The supervisor should have meeting and conversation with head teacher/principal, cooperating teachers and other teachers in the cooperating school. It is important for the supervisor to interact with the student-teacher to harvest the problems and challenges he/she faces in the school for teaching practice and help to proffer solutions. Also it is the duty of supervisors to check lesson plans, supervise lessons, other assigned activities like guidance and counseling as well as provide the student- teachers with feedback and encourage them to criticize and reform themselves.

In broad terms, the supervisor performs the following roles;

i). A resource person
ii). An adviser
iii). A general morale booster
iv). An interpreter of feedback
v). An assessor
vi). A facilitator

The cooperating teacher is the one that relates directly and closely with the student-teacher, and monitors all activities embarked upon by the student-teacher. Cooperating teachers perform the following roles;

i) Make the student- teacher feel wanted and welcome by introducing him/her to the school staff and students, special buildings and the administrative structure and procedure of the school.

ii). Give guidance and assistance to the student-teacher in the area of construction of unit/lesson plans and how to deliver the lessons.

iii). Aid the student-teacher in mastering the grading system that is consistent with the school's policy.

iv). Provide guidance and assurance in problems of indiscipline which the student-teacher is likely to be confronted with.

v). Encourage and help the student-teacher in developing an appreciation for the teaching profession and giving it a pride of place.

vi). Provide continuous evaluation of the student-teacher's functioning as a teacher and all other facets of the practice teaching assignment.

Duties and Responsibilities of the Student-teacher for Effective Teaching Practice

The essence of teaching practice is to prepare student-teachers for future teaching roles and assignments as they teach for a period of time and

it is a vital part of their training. Teaching practice period is when the student-teacher applies the methods and the philosophy of education which he was taught theoretically in the classroom. He/she is expected to demonstrate certain roles and responsibilities. Such as;

i). Good content mastery
ii). Adequate lesson plan preparation
iii). Good communication skills
iv). Effective classroom teaching involving appropriate teacher and student activities
v). Effective classroom management in terms of class organization and management as well as class control and discipline
vi). Using relevant and appropriate instructional resources
vii). Employing appropriate evaluation procedures in teaching such as periodic evaluation, evaluation at the end of the lesson, giving home assignment, checking of students' classwork and achievement of stated objectives.
viii). Acceptable teacher's personality such as self-confidence, discipline, mannerism and dressing.
ix). Engaging in routine works, projects and general development of the school

Challenges of Teaching Practice Exercise

A lot of problems confront the prospective teachers in the course of carrying out the teaching practice exercise that seem to affect the effectiveness of the student- teachers. These challenges cause the mismanagement of teaching practice which according to Kolawole, Abdurrahaman and Kolawole, (2016) is not an entirely Nigerian phenomenon. Many studies have reported inadequacies and shortcomings in the teaching practice exercise in Nigeria Universities and Colleges of Education. For instance, Ogonor and Badmus (2006) lamented improper grooming of student-teachers and weak teachers partnership in schools in which cooperating school do not provide specific aid to student-teachers to improve their teaching skills and strategies. Nakpodia (2011) remarked that the periods of teaching practice is too short as it does not provide the student teacher the ample opportunity to effectively gain the experience which the exercise is intended to encourage. Kolawole, Abdurrahaman and Kolawole, (2016) collated the following as challenges of teaching practice;

i). Inadequate supervision.
ii). Wrong timing of teaching practice.
iii). Poor financial support in terms of allowances for supervisors.
iv). Lack of discipline.
v). Use of inappropriate strategies by student-teachers.
vi). Anxiety whereby student-teachers often forgot the content matter and feel nervous when their lecturers sit at the end of the classroom and observe.
vii). Poor relationship between mentors and student teachers.
viii). Inadequate orientation of student-teachers about the school.
ix). Negative attitude of other teachers in the school.
x). Low level of student- teachers in other school activities.
xi). Negative attitude to the teaching profession.
xii). Poor and inadequate assessment due to irrelevant job status and inexperience

Problems confronting effective implementation of teaching practice can be categorized into three viz; student-teacher related problems, institutions (universities) related problems and school of teaching practice related problems (Ekundayo et al, 2014). The researchers enumerated the problems under each category as follows;

1). Student-teacher related problems:

- Student- teacher accommodation.
- Difficulty in instilling discipline in the classroom.
- Shallow knowledge of lesson note preparation.
- Non-challant attitude of student-teacher to give evaluation report.
- Non- genuine rejection by student-teacher from going to the school of posting.
- Nervousness of the student-teacher when being supervised.
- Student-teachers inability to use variety of teaching methods when teaching.

- Inability of student-teacher to make good use of quality instructional material.

2). Institution (university) related problems:

- Short period of teaching practice.
- Inadequate preparation of student-teachers for teaching practice.
- Posting of student-teachers to inappropriate schools
- Absence of microteaching that can help students gain confidence as they go for teaching practice.
- Non exposure of student-teachers to supervisor's observations and comments after completing the classroom teaching.
- Absence of opportunity for student-teachers to interact with partnership schools before the commencement of the teaching practice exercise.

3). School of teaching practice related problems:

- Rejection of student –teachers by schools where they are posted
- Non willingness of schools to distribute their schedules according to the needs of the student-teachers.
- Non availability of instructional materials in schools.
- Poor learning environment such as congestion and poor ventilation in the practicing schools.
- Non- cooperation of teachers in participating schools in serving as mentor.
- Giving student-teachers subjects outside their areas of specialization to teach.
- Uncooperative attitude of students in partnership schools towards student-teachers.

The problems constitute a major impediment to the effective implementation of teaching practice and ultimately lead to the production of poorly prepared and ill-motivated teachers who cannot teach effectively (Kolawole, Abdurrahaman and Kolawole, 2016).

Towards Improving Teaching Practice Exercise in Nigeria Teacher Education Programmes

Teaching practice is an inevitable part of the professional preparation and certification of teachers. In Colleges of Education and Nigerian universities, teaching practice is a compulsory course in the Faculties of Education forming part of the prerequisites for graduation. However, observations have shown that there is a decline in the quality of teaching practice being offered in the universities at the moment with very many inadequacies. The nature of teaching practice in many Nigerian Universities is such that it is designed to take place in two or three parts. The following suggestions are proffered for improving teaching practice exercises in Nigeria teacher education programmes.

a) In teacher training institutions teaching methods should not just be taught, the methods should also be practically demonstrated by the teacher educators.

b) The duration of teaching practice should be increased up to 12 weeks at least, so that practical training can take a quarter of the year.

c) Teaching practice should not be consisted of classroom teaching only. Other routine works and aspects should be included.

d) Microteaching should be adopted in teacher training institutions and model lessons should be given by experts as well as by video films before student- teachers.

e) Student- teachers should not be given marks for model lessons only. All the aspects of teaching practice should be included in evaluation.

f) In order to make the evaluation of teaching practice more effective, appropriateness of lesson, teaching methods, teaching aids, practical organization of lesson, interest of students and teachers and students' answers should be included in evaluation.

g) Student- teachers should be encouraged to make audio visual aids by themselves and they should be given/provided guidance after every lesson.

h) Student- teachers should be made to watch the lessons of experienced teachers for some time and write evaluation report about them, and supervisors should provide guidelines to student- teachers in the light of this evaluation report.

i) Student- teachers should be made to keep the sequence of lessons so that they can

teach all types of lessons and use different teaching methods.

j) Prior to teaching practice, student-teachers should practice with their fellows in order to build more confidence in them.

k) During teaching practice student- teachers should be given projects, which cover all the aspects of teaching practice i.e. (preparation of teaching kit, planning for decoration of classrooms, betterment of environment and provision of facilities).

l) During practice teaching prospective teachers should be made habitual of preparing daily lesson plan.

m) Teaching practice should be more realistic and suited to the actual class room situations.

n) Universities and Colleges must adequately fund the teaching practice programme and rich and separate budget must be created for it.

o). Stakeholders should explore school – based mentoring approach whereby the mentor (supervisor and cooperating teacher) and mentee (student-teacher) work harmoniously to teach and learn the appropriate tenets of teaching practice, accompanied with rich feedback.

p) Cooperating schools should be adequately informed of the required activities and support.

Conclusion and Recommendations

Teaching practice is an activity that is very vital to the preparation of teachers. It is a major ingredient of professional competence and its effectiveness is paramount for a nation's education industry. Teaching practice is a combination of personality, professional skills, knowledge and training, which is fuel for an endless journey and responsibility. It is very beneficial because it provides an opportunity for the trainee teachers to teach and increase their professional competence. It offers the opportunity for prospective teachers not only to build necessary confidence and competence in lesson preparation but to develop necessary skills and attitude. A teacher's first moral obligation is to provide excellent instruction. Teachers with a high level of competence have a deep obligation to help students learn and achieving so requires the demonstration of excellent teaching.

In addition to suggestions for improving teaching practice in Nigeria teacher education programmes, it is recommended that the government and school authorities should encourage proper orientation for trainee teachers through seminars, workshops, conferences and discussion. Faculties and Colleges of Education should organize quality teaching practice exercises in order to give the best professional practice to trainee teachers. Institutional resource centers of various institutions should be adequately equipped and expanded to enable every trainee teacher participate in micro-teaching exercise as a way of exposing them to teaching practice.

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MODIFYING CLASSROOM INSTRUCTIONAL STRATEGIES TO IMPROVE SECONDARY SCHOOL STUDENTS' LEARNING OUTCOMES IN CHEMISTRY IN OSUN STATE, NIGERIA

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Abstract

The paper examined the effects of Heuristic, Associative Creativity and Community Contact Instructional Techniques in improving students' performance and attitude in Chemistry among secondary school students. The study adopted the non-equivalent pretest-posttest control group research design. The population comprised all Senior Secondary (SS) II Chemistry students in Osun State. The sample comprised 200 SS II Chemistry students in their intact classes from four schools selected using multi-stage sampling technique. One intact class of SS II students in each school were selected using simple random sampling technique. The four schools were randomly assigned to three experimental and one control groups. The two instruments used: Students' Chemistry Achievement Test and Questionnaire on Attitude toward Chemistry had reliability coefficients of 0.82 and 0.84 respectively. Findings revealed that the three instructional strategies differentially improved students' performance ($F = 48.57$; $p < 0.05$) and attitude ($F = 15.54$; $p < 0.05$) better than the conventional teaching method with Community Contact Instructional Technique being the best.

Keywords: Heuristic, Associative Creativity, Community Contact, Instructional Techniques Performance, Attitude, and Chemistry.

Introduction

Science and Mathematics teaching and learning are very imperative for meaningful technological development in any country. The scientific and technological progress could be achieved if Chemistry is meaningfully taught at secondary school level in order to ensure continued interest of learners and promote their conceptual understanding in the subject since it could be regarded as central to all other science subjects. The knowledge of Chemistry is central to vocations in health services, pharmaceutical, petroleum and petrochemical industries, agriculture, food processing, teaching services and extractive industries. Learning Chemistry goes beyond only learning facts and concepts that describe the physical world at the atomic level, but also relating the Chemistry curriculum contents to day-to-day human activities. Chemistry promotes advancement in science and technology by enabling critical thinking and problem solving which are essential ingredients in the disciplines. Ability to achieve this target is however dependent on the cumulative performance of students in school Chemistry. In south western Nigeria, achieving this cumulative performance and attitude in Chemistry has been problematic. Students are not learning as expected and attitude towards the subject is equally not impressive.

Following Nigeria's endorsement of international protocols for Education for All (EFA) and the Millennium Development Goals; and subsequent adoption of a National Economic Empowerment and Development Strategy (NEEDS), senior secondary school Chemistry curriculum objectives are designed to cater for contemporary needs of the nation as outlined in the Nigerian Educational Research and Development Council (NERDC, 2009) to enable students to:

(i) develop interest in the subject of Chemistry;

(ii) acquire basic theoretical and practical knowledge and skills;

(iii) develop interest in science , technology and mathematics;

(iv) apply skills to meet societal needs of creating employment and wealth; and

(v) provide a course which is complete for students not proceeding to higher education while at the same time provides a reasonably adequate foundation for a post-secondary Chemistry course.

In order to achieve these objectives, factors identified from research studies as being responsible for students' unimpressive performance in Chemistry had to be addressed. The most common factors identified were the inappropriate, uninspiring, non-innovative teaching methods and strategies adopted by the teachers, inadequate exploration of the community where learners dwell to gain most of their learning experiences coupled with students' inability to relate Chemistry curriculum content to day-to-day human activities, (Bamidele, 2003; Adetunji, 2007, Olorundare and Aderogba, 2009).The researchers maintained that if novel teaching methods were employed in teaching the students, learners would perform better. According to Olorundare and Aderogba (2009) unless a teacher adopts suitable strategies, and engage students actively in the classroom, learners would continue to record unimpressive performance in Chemistry because students learn better when they are actively involved in the teaching and learning processes. Teachers must continue to organize instruction by using learner centered strategies that could facilitate learning.

In order to achieve the set goals of secondary school Chemistry curriculum objectives and facilitate meaningful learning, students are supposed to learn for their own sake through hands-on and minds-on meta-cognitive approaches. Memorization leads to regurgitation of facts, poor retention ability and non-transfer of knowledge all that served as evidence of lack of understanding thus, cannot promote thinking and problem-solving skills to meet societal needs for creating employment and wealth. Observations by the researchers have discovered that in most of our secondary schools, the usual practice of most teachers is to give specific chemical reactions in learning Chemistry without explaining the principles behind them nor link it to everyday life applications. The students are not being exposed to intensive experimentation, inquiry-based and collaborative learning which will make them to be vast in Chemistry that can help them to understanding the principle involved in the various concepts in the subjects. The omnipresent challenge in teaching Chemistry in senior secondary schools is lack of provened methods of organizing instruction that will facilitate learning for majority of students. Heuristic, associative creativity and community contact instructional techniques which have not been sufficiently used in learning Chemistry may be a solution.

Heuristic Instructional Technique (HIT) is an approach in which students are given activities to develop knowledge and understanding of specific ideals by engaging in self-discovery through the use of definite route (procedural operations) while the teacher acts as facilitator. Fajemidagba and Olawoye (2009) described Heuristic Instructional Technique (HIT) as rules for selecting search paths through problem space by exploiting the information in the task environment. In HIT, the facilitator provides procedural knowledge of the process for learners to discover the path way by themselves through their experiences. The technique is based on thinking and discovery. HIT is based on four principles which are: principles of activity or learning by doing, law of exercise, logical thinking and purposeful experience. The students get an insight into what they are doing and develop a critical attitude and the like. HIT involves the teaching process of growth of the mind rather than on the storing of knowledge.

Associative Creativity Instructional Technique (ACIT) refers to a teaching approach of creative assemblages where students contribute ideas in order to generate fluent and novel ways of tackling scientific problems and organize materials through collaborative knowledge with peers. Craft, Jeffery and Leibling (2001) explained that, Associative Creativity Instructional Technique (ACIT) is a lateral thinking process by which students are encouraged to develop ideas on

issues in order to diagnose a problem. In ACIT, the facilitator keeps the session focused on the problem with no one criticizing the ideas generated by the students.

Oloyede, Ajibade and Bamidele (2010) explained that Community Contact Instructional Technique (CCIT) is a strategy used either to bring the community to the classroom or to take the class to the community. Taking the students out of the classroom and engaging them in utilization of resources in the community relevant to Chemistry classroom experience for the purpose of learning some concepts in Chemistry is the central core of the technique and has the similar feature as field trip. The focus for the CCIT is to enable the learners to see in reality what has been taught in theory and discover things by seeing, touching, feeling, smelling or even tasting.

Statement of the Problem

Chemistry attracts many students at the secondary school yet studies have shown that performance is not as good as expected. Unimpressive performance is attributed to poor thinking ability, inadequate problem-solving skills, inappropriate teaching methods by the teachers and lack of utilization of resources in the community. Instructional designs in most Chemistry classrooms may not have met learners' needs for conceptual understanding and promotion of the right attitude to learning probably due to conventional teaching method used. Heuristic, Associative Creativity and Community Contact Instructional techniques are learner centred strategies that have been effectively used to improve learning outcomes in technological subjects. The likelihood of these techniques promoting effective Chemistry teaching has not been ascertained in Nigeria**.**

Objectives of the Study

The specific objectives of the study are to:

a. determine the effects of Heuristic Instructional Technique (HIT), Associative Creativity Instructional Technique (ACIT) and Community Contact Instructional Technique (CCIT) and Conventional Teaching Method (CTM) on performance of students in Organic Chemistry in Osun State;

b. compare the attitude of students towards learning Organic Chemistry when exposed to HIT, ACIT and CCIT and CTM.

Research Hypotheses

From the objectives mentioned above, the following hypotheses were generated.

1. There is no significant effect of each of Heuristic Instructional Technique (HIT), Associative Creativity Instructional Technique (ACIT), Community Contact Instructional Technique (CCIT) and Conventional Teaching Method (CTM) on students' performance in Organic Chemistry.
2. There is no significant difference in the attitude of students towards learning of Organic Chemistry when HIT, ACIT, CCIT and CTM are used.

Procedure

The study adopted non-equivalent pretest-posttest control group research design. The population for the study comprised all Chemistry students in Senior Secondary School two (SSS II) in Osun State. The study sample consisted of 200 Chemistry students in their intact classes in four Senior Secondary Schools from four local government areas in Osun State. The sample was selected using multi-stage sampling technique. Four local government areas (LGAs) were selected from the existing 30 LGAs in the State using simple random sampling technique. One school was then selected from each LGA and one intact class of SS II students was selected in each school using simple random sampling technique as well. The four schools were randomly assigned to three experimental groups and one control.

Research Instruments

Two instruments were used for the study.

i. Students' Chemistry Achievement Test (SCAT) consisted of 30-item multiple choice questions with four options A to D constructed to serve as pretest to ascertain equivalence of ability of subjects, posttest to determine the effect of the treatments on ability to solve problems in Organic Chemistry to ascertain if subjects retained the concepts taught. SCAT

for pretest and posttest contained the same test items.

ii Questionnaire on Attitude toward Chemistry (QAC)

This consists of two sections, A and B. Section A is students' biodata with respect to sex, age, name of school and class. Section B consisted of 25-items designed to find out the attitude of students toward the use of each instructional technique in learning Organic Chemistry. Subjects were required to respond to each item of the QAC on a five- point Likert-type scale, ranging from strongly agree to strongly disagree.

Data Collection

The experiment was carried out in six weeks. Research Assistants (Teachers) trained on the use of heuristic, associative creativity and community contact instructional techniques. Four lesson plans were prepared on weekly basis and used for the study. Each of the experimental groups and control were taught for double periods once in a week. The researcher prepared lesson plans on heuristic, associative creativity and community contact instructional techniques as well as conventional teaching method (control group).

In the HIT group, students conducted inquiry processes themselves while the teacher who served as facilitator presented specific problem and procedural operations on the topics. The aim of HIT was to encourage students to think on their own. In ACIT, students were given specific problem by the teacher and were then divided into a convenient number of small groups of five members (with at least one female) to work together. The aim of ACIT was to encourage students to make constructive suggestions rather than the teacher always spoon-feeding them with correct ideas in addition to persuading them to be inquisitive. In CCIT group, the teacher took students out of the classroom into the community to learn some concepts in Chemistry in order to see things in reality and for the process to become internalized in the minds of the students.

In CTM, the teacher asked the students questions so as to ascertain their previous knowledge before introducing the new topic, presents the lesson stage by stage making examples and illustrations verbally with reference and diagrams on a chart. He wrote on the chalk board, asked the students questions related to the topic to find out if the contents have been learned, wrote notes on the board for the students copy, summarized the key points verbally, briefly reflected the lesson, evaluated what is learned and then gave assignment to the learners.

Data Analysis

Data were analyzed using mean, t-test Analysis, One-way and Two-way Analysis of Variance (ANOVA) and One-way Analysis of Covariance (ANCOVA), and where significant difference existed the Tukey's post-hoc Multiple Comparison was used to determine the direction of the significance. In order to account for the possible difference among the groups, the pre-test and pre-attitude scores were used as covariates in ANCOVA. All the analyses were carried out at $p < 0.05$ level of significance.

Results

Hypothesis One

There is no significant effect of each of Heuristic Instructional Technique (HIT), Associative Creativity Instructional Technique (ACIT), Community Contact Instructional Technique (CCIT) and Conventional Teaching Method (CTM) on students' performance in Organic Chemistry.

In testing this hypothesis, the post-test scores of students in the experimental groups (HIT, ACIT and CCIT) and control group (CTM) were subjected to the Analysis of Covariance (ANCOVA) where pre-test scores were treated as covariates. The results of the analysis are presented in Table 1

Table 1: One way Analysis of Covariance (ANCOVA) of Post-test Scores of Organic Chemistry Students Exposed to HIT, ACIT, CCIT and CTM using Pre-test as Covariates

Source of Variance	Sum of Squares	df	Mean square	F	p
Corrected model	2733.20[a]	4	683.30	38.37	0.00*
intercept	10026.55	1	10026.55	563.09	0.00*
Covariate	132.24	1	132.24	7.43	0.01*
Treatment	2594.55	3	864.85	48.57	0.00*
Error	3472.20	195	17.81		
Corrected Total	6205.40	199			
Total	82685.00	200			

*= significant at $p < 0.05$

Table 1 shows that there was a significant effect in the performance of students taught Organic Chemistry using HIT, ACIT, CCIT and CTM (control group) ($F= 48.57$; $p < 0.05$).The hypothesis was therefore rejected. This implies that there was significant effect of treatment on the performance of students taught Organic Chemistry using HIT, ACIT, CCIT and CTM respectively.

To find the order of effectiveness of the treatments and direction of significance under investigation, the posttest scores were subjected to Post-hoc test. The result is presented in Table 2

Table 2: Post Hoc Multiple Comparison of Post Test Scores of HIT, ACIT, CCIT and CTM Groups

(I)	(J)	Means difference (I – J	Std. Error	p
HIT($\bar{X}$= 20.30)	ACIT($\bar{X}$= 20.86)	-0.56	0.81	1.00
	CCIT($\bar{X}$= 22.65)	-2.35*	0.82	0.03*
	CTM($\bar{X}$= 12.34)	7.96*	0.89	0.00*
ACIT($\bar{X}$= 20.86)	HIT($\bar{X}$= 20.30)	0.56	0.81	1.00
	CCIT($\bar{X}$= 22.65	-1.79	0.81	0.17
	CTM($\bar{X}$= 12.34)	8.51*	0.89	0.00*
CCIT($\bar{X}$= 22.65)	HIT($\bar{X}$= 20.30)	2.35*	0.82	0.03*
	ACIT($\bar{X}$= 20.86)	1.79	0.81	0.17
	CTM($\bar{X}$= 12.34)	10.31*	0.90	0.00*
CTM($\bar{X}$= 12.34)	HIT($\bar{X}$= 20.30)	-7.96*	0.89	0.00*
	ACIT($\bar{X}$= 20.86)	-8.52*	0.89	0.00*
	CCIT($\bar{X}$= 22.65)	-10.31*	0.90	0.00*

* =significant at $p < 0.05$

The result in Table 2 revealed that significant difference existed in HIT, ACIT, CCIT and CTM with mean difference as follows: CCIT & ACIT (($\bar{X}$= 1.79), CCIT & HIT($\bar{X}$= 2.35) and CCIT & CTM ($\bar{X}$= 10.31) all in favour of CCIT; ACIT & HIT($\bar{X}$= 0.56), ACIT & CTM ($\bar{X}$= 8.51) and HIT & CTM ($\bar{X}$= 7.96).The results also indicated that CCIT is the most effective technique ($\bar{X}$= 22.65), followed by ACIT ($\bar{X}$= 20.85), HIT ($\bar{X}$= 20.85) and CTM ($\bar{X}$= 12.34) in facilitating students' performance in Organic Chemistry.

Hypothesis Two

There is no significant difference in the attitude of students towards learning of Organic Chemistry when HIT, ACIT, CCIT and CTM are used.

In testing this hypothesis, the post-attitude scores of experimental groups (HIT, ACIT and CCIT) and control group (CTM) were subjected to the Analysis of Covariance (ANCOVA) where pre-attitude scores were treated as covariates. The results of the analysis are presented in Tables 3

Table 3: One way Analysis of Covariance (ANCOVA) of Post-attitude Scores of Organic Chemistry Students Exposed to HIT, ACIT, CCIT and CTM using Pre-attitude as Covariates

Source of Variation	sum of squares	df	Mean square	F	p
Corrected Model	22502.30[a]	4	5625.58	11.67	0.00*
Intercept	62317.44	1	62317.44	129.25	0.00*
Pre-attitude	15.70	1	15.70	0.033	0.86
Treatment	22476.58	3	7492.19	15.54	0.00*
Error	94018.98	195	482.15		
Corrected Total	116521.28	199			
Total	186716.00	200			

* = significant at $p < 0.05$

Table 3 showed that there was a significant difference in the attitude of students taught Organic Chemistry using HIT, ACIT, CCIT and CTM (control group) ($F = 15.54$; $P < 0.05$). The hypothesis was therefore rejected. This implies that, the three experimental and control groups (HIT, ACIT, CCIT and CTM) differ significantly in their enhancement of the attitude of Organic Chemistry students.

To find the order of effectiveness of the treatments and direction of significance under investigation, the post-attitude scores were subjected to Tukey's post-hoc test. The result is presented in table 4

Table 4: Post Hoc Multiple Comparison of Post Attitude Scores of HIT, ACIT, CCIT and CTM Groups

(I)	(J)	Means difference (I – J)	Std. Error	p
HIT($\bar{X}$= 95.09)	ACIT($\bar{X}$= -3.30)	-3.24	4.20	1.00
	CCIT($\bar{X}$= -7.18)	-7.15	4.27	0.58
	CTM($\bar{X}$= 22.75)	22.83*	4.67	0.00*
ACIT($\bar{X}$= 98.39)	HIT($\bar{X}$= 3.30)	3.24	4.20	1.00
	CCIT($\bar{X}$= -3.88)	-3.91	4.23	1.00
	CTM($\bar{X}$= 26.05)	26.07*	4.62	0.00*
CCIT($\bar{X}$= 102.27)	HIT($\bar{X}$= 7.18)	7.15	4.27	0.58
	ACIT($\bar{X}$= 3.88)	3.91	4.23	1.00
	CTM($\bar{X}$= 29.93)	29.98*	4.70	0.00*
CTM($\bar{X}$= 72.34)	HIT($\bar{X}$= -22.75)	-22.83*	0.89	0.00*
	ACIT($\bar{X}$= -26.05)	-26.07*	0.89	0.00*
	CCIT($\bar{X}$= -29.93)	-29.98*	0.90	0.00*

* =significant at $p < 0.05$

In Table 4, the result revealed that significant difference exists in HIT, ACIT, CCIT and CTM with mean difference as follows: CCIT & ACIT (($\bar{X}$= 3.88), CCIT & HIT($\bar{X}$= 7.18) and CCIT &CTM ($\bar{X}$= 29.93) all in favour of CCIT; ACIT & HIT($\bar{X}$= 3.30), ACIT & CTM ($\bar{X}$= 26.05) and HIT & CTM ($\bar{X}$= 22.75).The results also indicated that CCIT is the most effective technique ($\bar{X}$= 102.27), followed by ACIT ($\bar{X}$= 98.39), HIT ($\bar{X}$= 95.09) and CTM ($\bar{X}$= 72.34) in effecting better attitude in students towards Organic Chemistry.

Discussion

Effects of Heuristic, Associative Creativity, Community Contact and Conventional Teaching Method on Students' Performance in Organic Chemistry.

The findings of this study revealed that all the four treatment groups: HIT, ACIT and CCIT were effective in enhancing students' comprehension and performance in Organic Chemistry. This may be due to the distinctive characteristics of the instructional techniques, being grounded in sound, cognitive and constructivist learning theories of Piaget (1970) and Bruner (1971) which centres on creative thinking and problem-solving skills. The findings further revealed that significant effect existed in students' performance when exposed to HIT, ACIT, CCIT and CTM.

Tukey's post hoc result also indicated that students in CCIT performed better than those in ACIT which in turn performed better than HIT with those in CTM being the least effective. This implies that CCIT enhanced students' performance more than other treatments. This agrees with the finding of Chang (2010) who concurred that integration of field trip was an effective learning mechanism that allows students to make the connections between field observations and more abstract concepts in Chemistry. It is also in tandem with Jackson and Leahy (2005) who found out that museum presentation contributed to students' personalization of material, thus, improved their performance.

Furthermore, Ajaja (2010) also established better performance of students exposed to Biology with field trip instructional technique compared to students exposed to conventional teaching method. Michie (1998) observed that field trip enhanced learning outcomes and the support of the school community. The finding is also in tandem with the work of Yusuf (2006) who observed that Community Contact Instructional Technique like field trip promoted learning by experience. The effectiveness of community contact instructional technique may be due to high level of students' participation in learning activities coupled with resource persons who taught them in their local language. All the students in the CCIT group saw things in reality and were able to relate concepts in Organic Chemistry to everyday life. Positive interdependence, dependence and self-reliance which are critical to successful application of Chemistry to society and the responsibility of use of scientific knowledge and evidence took place. CCIT benefits both weak and bright students. Weak students benefit from interaction with brighter students as well as the resource person, they learn the materials they are explaining in more depth and remember it longer (Johnson and Johnson, 1992).Through the use of community contact instructional technique, the Chinese's adage of "tell me and show me, I remember, and involve me I understand" that was made use of probably boosted the morale of learners, thereby promoting effort in the learning process. Hence the higher performance reported.

Attitudes of Learners toward Learning Organic Chemistry with HIT, ACIT, CCIT and CTM

From the results obtained, majority of the students under different treatments and control groups, showed positive attitude to the instructional techniques. Most of the students agreed that the instructional techniques are good for learning Organic Chemistry, as they enabled them to see the relationship between their observations outside the classroom and the scientific concepts learnt due to their relatedness to everyday life applications. The students were of the opinion that CCIT, ACIT and HIT provided them with better understanding of Organic Chemistry concepts. However, a significant difference existed in the attitudes of the three experimental groups. The CCIT group showed more positive attitude toward learning Organic Chemistry compared to the ACIT and HIT groups. These findings are consistent with the study of Ajaja (2010) who found a significant relationship between students' attitude and performance in Biology. It is also in tandem with Farmer, Knapp and Benton (2007) who found positive increase in students' attitude toward Biology and natural environment. Majority of the students who responded to the questionnaire (QAC) expressed that they would like to pursue science and technology in future because they found learning Organic Chemistry very interesting.

The different experimental groups used in this study called for students' participation inherent in group activities and construction of knowledge. This made the learning to be cooperative regardless of sex and academic ability level. This finding is in line with the United States national assessment of 4th and 8th grade civic education classroom which found that students' participation in group activities and projects tended to outscore those who rarely or never participated in this kind of classroom assignment (Adetunji, 2012). The outcome of this study is typical of the Child-Friendly School System (CFSS) initiative in Asia by UNICEF. The initiative draws on many of the principles of good practice that have been documented.

The instructional techniques used in this work have the following attributes among other:

1 inclusive, gender sensitive and non–discriminating,

2 encourage learners to think and decide for themselves, ask questions and express their opinions,

3 encourage learners to work together to solve problems and to achieve what they aim to do,

4 raise the students' motivation through presenting Organic Chemistry as a subject which
is directly connected with both real life and the natural environment around them,

5 work up students' enthusiasm for activities that will ideally comprise all four spheres of the psyche: sensory and mental cognition, feelings and volition,

6 develop students' independence and self-reliance,

7 develop transferrable skills such as: observation skill, group and independent work and
work management.

Conclusion

The study concludes that students' performance and attitude in Chemistry can be effectively improved using each of heuristic, associative creativity and community contact instructional techniques. However, the community contact instructional technique produced the best effect.

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DIGITALIZING SCIENCE EDUCATION: THE PANACEA FOR APATHY OF THE PRESENT NIGERIA YOUTH

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Abstract

The paper sought to examine various digital techniques for teaching science education with a bid to making the subject more interesting, practical and research oriented with the attendant innovations. The paper also sought to explore the learning support materials necessary to implement the digital teaching of the sciences. Not only these, the paper also highlighted digitalization as a good construct to equip learners with knowledge and skills to convert innovations from science researches to marketable products for commercial gain. It was the view of the paper that lesson delivered using ICT materials would be faster and more fascinating. Also, learners and Nigerian youths would be eager to put what they learned into practice independently. This paper also highlighted the importance of digitalization, which will strengthen the confidence of science teaches and learners. In view of the above, the paper recommended the teaching of digital science in both secondary and post – secondary institutions, especially in Nigeria, as this would promote science innovations necessary for tackling the state of apathy of Nigerian youth and unemployment.

Key words: Digitalization, Science Education, Apathy, Nigerian youths.

Introduction

The word digital which originates from the word digit, means involving or using numerical digits expressed in a scale of notation, commonly in the binary system, to characterize discretely all variables occurring in a problem. It also means pertaining to, noting, or making use of computers and computerized technologies, including the internet (dictionary.com). Digitalization, simply put, means the act or process of converting to digital.

Quality education is a major key to any national development and advancement. The role of education in building the economy, technological advancement and lifestyle of any nation cannot be overemphasized. A progressing nation is one that focuses on the quality of education received by her citizens and creates platform for her citizens to express and apply their knowledge. The advanced countries are characterized by citizens enriched with quality education and apply their knowledge towards the progress of the nation. Science education is concerned with the sharing of science concepts and application processes with individuals that are not considered to be part of a scientific community.

Nigerian education system is governed by the Ministry of Education which includes the management of federal tertiary institutions and schools. The State public schools and tertiary institutions are governed by the Ministry at state level (Olawale 2018). This suggests that the quality of education across states will vary subject on the standard each state can provide. Nigeria has been faced with a lot of criticisms and setbacks in the quality of education recently. The government had been heavily criticized for overlooking the challenges facing the education of her citizens and focusing on other problems. Efforts have been made to develop education in Nigeria, various policies in the interest of education have been formulated, unfortunately, these efforts have not produced the desired result. The state of education in Nigeria is still appalling. It is so bad that some resourceful Nigerians prefer to send their children to Europe, America and

even nearby African countries such as Ghana that has fewer universities as against universities in Nigeria that lack adequate learning facilities (Okoroma, 2006). Okoroma 2006 also highlighted problems facing the educational sector that;

- the implementation of educational policies is also often hindered by the interplay of politics, which may sometimes relegate reality to obscurity
- facilities such as classrooms, offices, laboratories, workshops, libraries, power, water et cetera are basic requirements in every school system. These have been found to be grossly inadequate in most Nigerian educational institutions. The Academic Staff Union of Universities (ASUU) has confirmed this in its numerous publications.
- insufficiency of funds for implementing educational policies in Nigeria is a problem that has recurred in almost every
- implementation study that has been carried out. The importance of funds for carrying out any activity need not be over-emphasised.
- government lacks the political will for effective implementation.
- corruption at all levels hinders the implementation of educational policies and programs.

Nigerian youths are faced with a lot of challenges where education is one of them. An average Nigerian student will have to go through a lot of pressure viz: financial, transportation, emotional and educational, before he/she can succeed in academics. The exponential growth in population has raised apprehensions and pressure mounts on the country's overstretched educational system. The rate of drop – outs among Nigerian students, especially in the northern part of the country is high. At present, Nigeria has the highest number of out – of – school children in the world and about 60 percent of its uneducated population are girls born and raised in the northern part of the country (Jumia Travels 2015). This dropout rate is a great concern as the Nigerian youth is wasting away and becoming inconsequential to the development of the country. The youths are now being engaged with a lot of redundant activities which does not benefit the nation in anyway. Most of them turned criminal in the wake of trying to make ends meet. The criminal rate is also a major concern in the country, as many Nigerian youths fall in this category. Engaging in diabolical means to make money, fraudsters home and abroad, prostitution, terrorism and kidnapping has become the order of the day. The list is endless and at the middle of these evil and backward acts is where the youths of this country are found. All these is because the education of the Nigerian youth has depreciated rapidly and the quality of education is nothing to write home about. This research has been birthed from the perceived failure of Nigerian youths in the development of the country.

In the past, Nigerian youths enjoy many privileges and education then was perceived easy. The undergraduates enjoyed sumptuous meals (breakfast, lunch and dinner) freely. They also had access to free laundry services. Job opportunities were very high for an undergraduate. Nowadays, all these privileges are not there and to access any of these privileges, it involves lots of processes to go through. Due to the academic pressure, most youths look for option to make fast money. Hence engage in lots of criminal and evil acts. With the recent progress in advanced nations, where computer and its technology has been employed in almost all aspects of life, it is therefore expedient to look into areas where computer and science will meet to serve as an remedy to the apathy of the youths in Nigeria.

Digitalizing Science Teaching

Information Technology has transformed every sector. It has grasped and currently modifying academia. Digital growth is altering the orientation of industries, churches, companies, schools and the government today. Digitalization in education industry has totally changed the teaching and learning process to a very large extent. It has made impartation of education stress – free for both students and educators. Schools are gradually employing digital teaching solutions to embrace generation of learners familiar with the likes of PlayStations and iPads and trying to make the classroom atmosphere more extensive and participatory. Currently, students live in a world that is constantly connected and alive outside the classroom, so traditional methods does not apply nowadays (Johari, 2013). The digitalization of science education is imperative so

that learners can learn at their own speed within and outside the walls of the classroom.

Science teachers need to be abreast of the digital equipment in the present dispensation. It is a fact that teaching method can either motivate or discourage a learner in the classroom. Therefore, science teachers need to be vast with the ways science teaching can be digitalized to embrace learners and make the classroom accommodating.

Creating a Digital Classroom

A digital classroom is one that employ the use of modern technology and communication tools in order to provide learners with information. A digital classroom is an avenue or platform for presenting information to learners via text messaging, email, audio conference call, video conference call, social media and computing (Jegede, Olatunbosun, Ajayi and Olugbuyi, 2018). It is more than a geographical location, it is a global platform. A digital classroom can either be virtual classroom or a real classroom.

A real digital classroom is one that is geographically bound, where the teacher and learners converge to teach and learn. Digital teaching tools are used instead of the traditional teaching aids. The use of interactive board or projector instead of the chalkboard or whiteboard. Science concepts can be prepared in a CD/DVD and be projected. Also class attendance can be digitalized, where students names had been entered in an excel format and marks allotted for each column instead of the traditional attendance register. The real classroom makes the teacher and learner to be familiar with technological tools like Class Dojo, Cacoo, Pixton, Voice Thread Kahoot etc. This type of classroom is geographically and time bound.

A virtual digital classroom is one where teaching and learning can take place online. The participants may see themselves and may not see themselves. A virtual classroom can be closed or open. A closed platform is one where the learners and teachers are limited to a group and a class. This is one where teaching and learning takes place within that group and a class. The number of participants are restricted and information shared are within the group. For example Group Chats, Online group(s), etc. An open platform is one where information and ideas shared is open for all. There is no restriction to number of participants. Here anyone can assess ideas and information online. This type of classroom is neither time bound nor geographically bound.

A physics teacher can make presentations of physical concepts such as motion, force of gravity, Archimedes principles and other physical concepts in a CD or DVD and show the class with use of overhead projector or interactive board. Concepts like geometry, statistics probability and other mathematical concepts can be prepared likewise. Also chemical concepts like electrolysis, chemical bonding, state of matter and biological concepts like cells, respiration, and reproduction can be prepared and delivered in the classroom or online. Science teachers need to embrace digitalization as to become a global science teacher and not just a local one.

Digitalization: a Panacea for Redundancy of Nigerian Youth

An average Nigerian likes to get things easily and fast. It is unfortunate that education is not one of those things a Nigerian youth can get so easily and fast. The educational system is so unpredictable in that an undergraduate studying for a four year programme may eventually spend extra years due to many exigencies. These exigencies can be closure of school due to ethnical clash, strike action of staff, political clash, among others. Several Nigerian youths are on the streets trying to make ends meet and engaging in various activities. The widespread of entertainment industries in the country has become another option for the education of the youths. Entertainment industries have witnessed a mass exodus of the youths into sports, music, acting, reality shows, comedy and beauty pageant to mention a few, rather than going to the classroom. This is because it is easier to access these activities than education in Nigeria.

One of the major problems facing Nigerian students is that the processes of getting admitted into a tertiary institution in Nigeria is discouraging. Every year millions of Nigerian students, which apply to get admission into tertiary institutions, are disappointed. It is not because they did not study hard for entrance examinations, there isn't enough room for them all (WES, 2017). Data from Nigeria's National Bureau of Statistics and

the Joint Admissions and Matriculation Beard (JAMB) shows that between 2010 and 2015, of the 10million applicants that sought entry into Nigerian tertiary institutions, only 26% gained admission. As shown in figure 1.

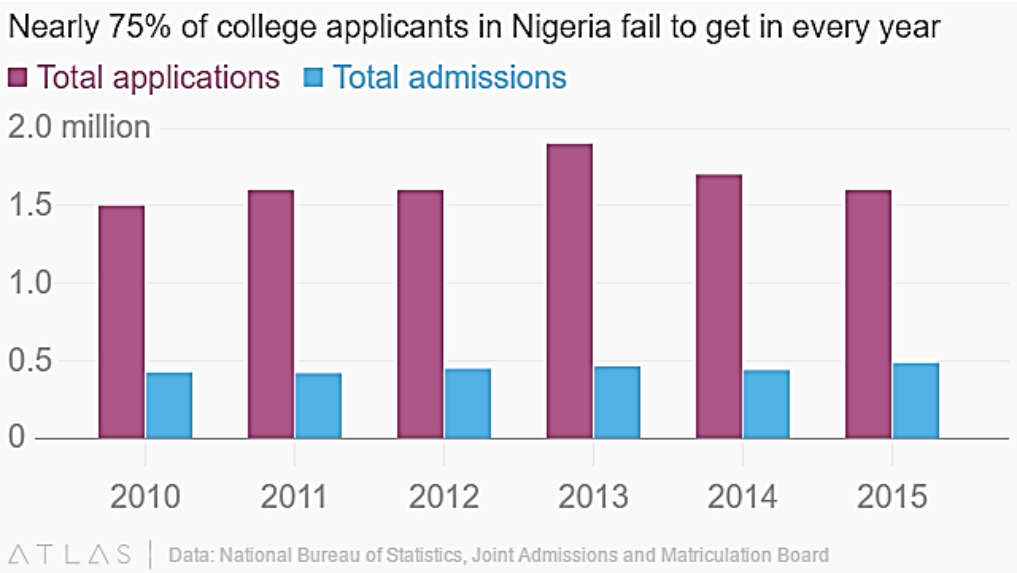

Figure 1. Statistics on admission into tertiary institutions in Nigeria. Kazeem (2017)

The disappointments and heartbreaks from not being admitted into a Nigerian University has prompted many youths to find their way abroad for better life and education. The better education programme had been possible with the implementation of digital education. Many universities abroad do utilize digital tools and resources to express their ideology into the learner, which attracts learners from Nigeria. According to data from the UNESCO Institute of Statistics (UIS), the number of Nigerian students abroad increased by 164percent in the decade between 2005 and 2015, i.e. from 26,997 to 71,351 (WES, 2017) as shown in Figure 2

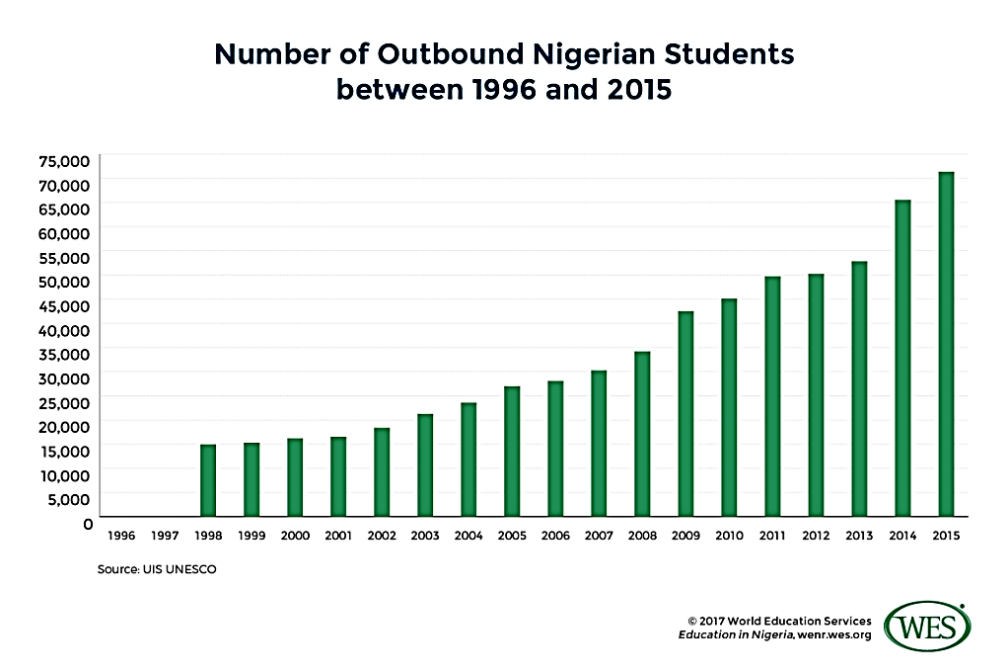

Figure 2. Number of Outbound Nigerian Students (WES, 2017)

While it is evident that Nigerian students travel out for education and better life, it is therefore expedient to digitalize science education for Nigerian students to become an effective citizen. Digitalization of science education will not only reduce the exodus of students abroad, it will provide a better platform for projecting Nigerian education positively. Also, digitalization will help provide education to many Nigerian students, especially those denied the privilege of admission into her tertiary institution.

Advantages of Digitalization of Science Education

Science concepts taught in tertiary institutions will be archived online and be accessible to many, even those that do not have admission. Online libraries are incorruptible and can last longer. Teaching and learning of science education becomes global, promoting the educator as well as connecting him/her to other science educators across the globe. Also science learners can compete with other science learners across the globe, hence there will not be any inferiority complex. Digitalization also will help the educators and learners to become vast in dealing with modern resources, building their confidence in teaching and learning of science.

Discussion

The quality of Nigerian education has been perceived as poor and it obviously cannot accommodate the Nigerian students. There are more secondary schools than tertiary institutions, which has given rise to more students finishing WASSCE, NECO and NABTEB than student getting admitted. The total number of recognized universities in Nigeria as at 2017, is 152, 40 Federal universities, 44 State universities and 68 private universities as accredited degree – granting institutions while the National Board of Technical Education (NBTE) recognizes 107 Polytechnics, 27 monotechnics and 220 Colleges in the country (WES, 2017). This will not accommodate the students finishing WASCCE, NECO and NABTEB, coupled with the rigorous processes to gain admission yearly. One of the ways to motivate the students is to digitalize science teaching and learning, (Sunjun & Minying 2003), (Jegede et al. 2018)

Conclusion

There is a worldwide concern that the educational system in Nigeria is failing to promote the necessary skills that will adequately prepare our children for the future (Jegede et al. 2018). This in mind, science teachers need to be up to date in what to teach with the use of digital equipment to promote the educational system of the community.

Education in Nigeria at a time was free, this encouraged youths to study. It is a different story nowadays as students would have to go through rigorous processes to pay their fees. The focus of Nigerian education is now hinging more on getting money from the students than transferring knowledge to the learners. Science teaching takes place in situations and conditions that does not encourage the students to learn. Digitalization of science teaching will motivate these students and encourage them to contribute more to the growth and development of Nigeria. Digitalization will market Nigerian education and help the teachers to be marketable to other countries. It is high time science teachers embrace the modern technology and go digital.

Recommendations

The above discussions gave rise to the following recommendations. Nigerian science teachers should adapt to new technology and be flexible in teaching of sciences. A workshop on digitalization should be organized to educate pre – service and in – service science teachers on the use of modern resources for teaching. The Ministry of Education should encourage digitalization in Nigerian secondary schools.

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A CRITICAL STUDY OF STRUCTURAL ADEQUACY OF PHYSICS TEACHER EDUCATION CURRICULA IN SOUTHWESTERN NIGERIA

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Abstract

This study was carried out to examine the structural adequacy of Physics teacher education curricula in Southwestern Nigeria, with the goal of establishing if the design meets the National University Benchmark on Minimum Academic Standard (NUCBMAS). The descriptive survey research design was used for the study. The instrument Physics Teacher-Education Curriculum Structural Adequacy and a Checklist (PTCSRAC) were used to elicit information for the study. Data were analysed using descriptive statistics of frequency count percentages. The study revealed that the course units assigned by the nine universities under this study were 70% adequate with the NUC standard. The result also revealed that two universities core course units were at <70% and the remaining universities were <70% to NUC standard while all the nine universities were adequate at 70% to NUC standard. It was recommended that all the universities trained secondary school Physics teachers should cooperate to produce a common curriculum structure as established by NUC for the Physics components of the teacher education programme in order to ensure a uniform preparation of secondary school Physics curriculum.

Key: Critical**,** Study, Structure, Adequacy, Curricula. Teacher education, Pre-service teacher

Background to the Study

Education has contributed immensely to increase in developing knowledge, skills and attitude towards the teaching learning processes. It builds human capital required for a potential knowledge economy. Global developments in teacher education programme and the challenging shortage of Physics teachers in Nigeria secondary school system of education however calls for research into the curricula structure of the universities offering the programme (Ojediran, 2015). Realizing the importance of curriculum structure for Physics teacher education in Nigeria, The National Policy on Education (NPE) Federal Republic of Nigeria (FRN, 2004) stated that 'since no educational system can rise above the quality of its teachers, teacher education will continue to be given a major emphasis in all the educational planning and development'. The government is also convinced that if Nigerian universities are to make optimum contributions to national development in professional fields, the course contents should reflect the nation's aspirations. These may be the reason why Nwachukwu (2008) and Nwachukwu (2012) opined that the growth of any nation to do with the level of development of science education which invariably meant that it is the only means of reducing illiteracy and poverty in a country. In corroboration to the National Policy on Education, the National University Commission (NUC, 2007), reiterated the need for trained, qualified and efficient teachers at the university level. It emphasizes the need to produce teachers who will teach Physics effectively at the secondary school level.

Offorma (2005) described the status of curriculum in any educational institution as a vehicle through which education takes place. He described the curriculum as the totality of the student environment where education takes place, the learners, the teachers, the content, the subject, the resources, the methods of teaching, evaluation

styles as well as the physical and psychological environment are involved for learning to take place. A distinctive feature of the undergraduate Physics education programme structure in Nigeria universities has division of courses into segments and units (Omosewo, 1991 and Ojediran, 2015). These units are often taught by a large range of specialists for a specified period. The unit courses are available under the areas of Mechanics, Atmospheric Physics, Electronics, Waves and Vibrations, Electromagnetic theory, Modern Physics, Quantum Physics in the various cognate faculties presented in each university's curriculum. Each course has its structure which depicts the credit point attached to it in terms of Lecture hours (L), Tutorial hours (T), Practical sections/hours (P), Units attached to it (U) (known as LTPU) (NUC, 2007). Each university has the autonomy of redesigning its courses and their codes to suit the purpose of their programmes which in turn allows each institution to design their curricula based on the National University Commission (NUC, 2007) standard known as benchmark on minimum academic standard (BMAS). In order to achieve the objectives of Physics education at the university level, laboratory activities and tutorial sections are provided for every unit of each of the Physics Teacher Education Curricula (PTEC).

Despite efforts made in the design and development of the curricula by various universities, gap is still exist in the training of teachers. These gaps have been agitating the mind of the science educators in the decades (Omosewo, 2009 and Ojediran, 2015). The existing gaps in structural adequacy is a challenge to the curricula in Physics teacher education programme as found in various universities housing the programme in Southwestern Nigeria.

The Structure of Academic Discipline in Physics

University operates a complex academic oriented curriculum structure. The structure combines remarkable stability and resilience. It has an internal structure with a characterized pattern organized with an in-built mechanism for transformation of the society and individual development. Emphases on the structure of discipline are intensively established by Brunner (1974) and Schwab (1962) and the identification of Survival Logically Distinctively Forms Knowledge (SLDFK) is postulated by (Pheniz, 1964 and Hirst, 1974). The authors are of the view that disciplines such as Physics teacher-education program (PTEP) has a boundary that is simply an instrument of social control while relatively sum did not however allow the disciplines to have single logical structure of concepts, theories and generalizations. It also organizes the more specific facts in the discipline, forms of knowledge relating to the criteria of logic, methods and epistemology which are emphasized. Each university has its organized curriculum structure depending on the specific criteria and procedural bound up within the particular range of problems for content adequate, societal adequate and individual development as presented in NUCBMAS (NUC, 2007).

Ehindero (2014) viewed that curriculum structure for each discipline especially Physics teacher education programme should be such that will provide a fertile and complex framework for knowledge construction. There reacher emphasized that each child or learner should learn how to construct their knowledge models of learning and understanding within the curriculum structure of its discipline (Physics teacher education). Hence, effective construction of knowledge has a lot to do with addressing the curriculum structure of each discipline. The PTEC structure can be grouped according to the predominant kind of epistemological objectives that is pursue in terms of causal generalisation, interpretation of each course outline and evaluation. The curriculum structure should be such that will bring about developmental modes of content and of constructions (knowledge construction and interpretation of meaning by learners). Schwab (1962) explains that the structure of any discipline should focus on two broad and connected aspects: the substantive structure and the syntactical structure. The substantive structure is the pattern of the body of knowledge relating to the concepts and models it employs. The substantive process entails the discipline concepts and their related questions and issues that are required in knowledge construction and meaning-making in the classrooms. Substantive structures are formed by the basic concepts, principles or themes that organise the more specific facts in Physics. The

syntactic structure has to do with the rules and procedures in developing and testing knowledge. The syntactic structure according to Schwab (1962) in Posner (1995) establishes way scholars in a discipline such as in Physics establish truth and reality. Therefore, the researcher deduce that the difference in the conceptual schemes between or within the disciplines has attribute of syntactical structures.

The Physics teacher education curriculum is meant to train pre-service Physics teacher to teach Physics in secondary schools (NUC, 2007). The curriculum should provide a framework for student's construction of unique models of knowing the meaningful interpretation of experiences. It is organized to meet the essentials of the teachers' professional qualifications concerning the subject matters, as well as, didactical and their pedagogical competences. These will enable the Physics teachers after the training to become expert not only on the content knowledge of the subject matter but also paying attention to students' knowledge in the classrooms **(**Omosewo, 2009**).**

The studies tend to view the logical and epistemological conditions that affect the organisation of knowledge within particular structures of the curriculum. Pheniz (1964) and Hirst (1974) are the exponents of structure within disciplines which also tend to be pre-occupied with the conditions of logically systematic organisation of knowledge. Therefore, it is noteworthy that the discipline structure such as PTEC has to be philosophically backed as a collective enterprise and institutionally organized. This serves as the basis for NUC accreditation of courses for every discipline in the universities. Within the context of any discipline there is relatively frequent innovation and revision in concepts and theories, the methods and techniques although less frequently, and even the basic objectives are subjected to revision (Ehindero, 2014).

The syntactical structures such as the models, procedures, methods and rules as a proof for meaning-making an interpretation processes which make up the Physics education like any other programmes in the universities. The PTEC was structured so that the first two years of the university programme present an introduction to the major theories of Physics; classical mechanics, special relativity, electricity and magnetism, statistical physics, atomic physics, and occasionally some quantum mechanics (NUC, 2007).

During the third year of students in the university. some special branches of Physics are introduced; however, the principal objective is to master the mathematical foundations of quantum mechanics. Most other programmes such as advanced laboratory are studied in the fourth year. Practicum is a demonstration in which the students could learn how to illustrate physical phenomena and the laws of Physics as they would have to do in secondary schools. Pre-service Physics teachers receive instructions in research methodology and research in their subject studies and pedagogical studies with certain credit units or hours assigned to it for them to qualify as Physics teachers. A minimum of 86 credits hours for Physics related courses (core courses, restricted electives courses and laboratory courses) are obligatory for qualification under four years of preparation designed for teachers (NUC, 2007). These with a view to ensure that graduates of the programme are:

i. securely grounded in the fundamentals of Physics;
ii. sufficiently aware of curriculum changes and strictly move with the changes;
iii. prepared to discuss current ideas in Physics with their students;
iv. aware of the various sources of apparatus, how to buy, use and care for them; and
v. prepared to teach in at least one other field.

Therefore, for Physics teacher education to be of standard to produce competent teacher to teach Physics in secondary schools, substantive and syntactic structure are embedded in the course structure (core course units, specialization course units and Elective course units structure). Thus the significance of substantive and syntactical structure cannot be underestimated in the professional training of pre-service Physics teacher in Nigeria. It is against this background that there is a need to critically studied the Physics teacher education curricula in Southwestern Nigeria so as to compare the programme structured for adequate with NUCBMAS.

Statement of the Problem

Physics education is one of the teacher-education programmes in Nigerian universities'. The curricula were developed in line with the criteria established by the National University Commission (NUC, 2007) and are meant to produce competent Physics teachers for senior secondary schools. The perennial poor performance of students in Physics is worrisome and may be adduced to poorly equipped laboratories, inappropriate teaching strategies and insufficient number of quality teachers that universities produced. These may question the standard of such curricula structure and its relativity to the national standard. Studies have been carried out on issues relating to teaching methods, classroom interaction pattern in Physics classrooms, and curriculum evaluation in Nigeria, yet relative improvement in students' performance in Physics has been found (Ajayi, 2000; Mankilik, 2006; Ajayi, 2007; Ibidapo-Obe, 2007; and Abdulraheem, 2012). There is therefore the need to critically study the underlying curriculum structure for Physics teacher education in Southwestern Nigerian universities. Hence the study.

Purpose of the Study

The study examined the structural adequacy of Physics teacher education curricula in Southwestern Nigerian universities in line with National universities commission benchmark on minimum academic standard (NUCBMAS). The specific objectives of the study are to:

a. examine the relevance of Southwestern Nigerian Universities Physics teacher education curricula course units structured in line with the National universities commission benchmark on minimum academic standard.
b. examine the adequacy of the Southwestern Nigerian Universities Physics teacher education curricula core course units structured in line with the National universities commission benchmark on minimum academic standard.
c. examine the adequacy of the Southwestern Nigerian Universities Physics teacher education curricula specialization structure in line with the National universities commission benchmark on minimum academic standard.; and
d. examine adequacy of the Southwestern Nigerian Universities Physics teacher education curricula elective units structure in line with the National universities commission benchmark on minimum academic standard

Research Questions

1. Do the Southwestern Nigerian Universities Physics teacher education curricula course units structured in line with the National universities commission benchmark on minimum academic standard?
2. How adequate are the Southwestern Nigerian Universities Physics teacher education curricula core course units structured in line with the National universities commission benchmark on minimum academic standard?
3. How adequate are the Southwestern Nigerian Universities Physics teacher education curricula specialization structure in line with the National universities commission benchmark on minimum academic standard?
4. How adequate are the Southwestern Nigerian Universities Physics teacher education curricula elective units structure in line with the National universities commission benchmark on minimum academic standard?

Significance of the Study

The study will provide information on the existing gaps in course units structure, core course units structure, specialization course units structure and elective course units structure adequacy to NUC standard. These will afford the stakeholders in Physics teacher education programme the opportunity to adjust each curriculum with respect to NUCBMAS.

Methodology

The study adopted the descriptive survey design, which enable the researcher to provide systematic and accurate description of the variable of interest related to curricula issues in Physics education in the universities. The population comprises of all the universities offering Physics teacher-education programmes in Southwestern Nigerian. All the nine universities (A, B, C, D, E, F,G, H and I) that house Physics teacher-education curricula were used for the study and the Benchmark on

minimum academic standard has established by NUC (2007) were purposively used for the study because all the nine universities in the study area already had the programme accredited by NUC. The instrument for data collection was Physics Teacher - Education Curriculum Structural Adequate and Adequacy Checklist (PTECSRAC). PTECSRAC has two sections (A and B). Sections A and B are extracted from NUCBMAS and the selected universities Physics teacher-education curricula. Section A elicited the adequacy of course structure units (core courses units, restricted electives units and course specialization units). Section B considered the extract of the NUC course units/contact hours/structure for Physics courses alone. Physics teacher-education curricula structures of each university in Southwestern Nigeria were cross checked for adequate using deskwork analysis. The course structure such as core courses units, restricted electives units and specialization course units were also compared to NUCBMAS. The instrument was validated using expert judgments since it is extracted from a validated document from the universities and the NUC.

Data Analysis

The data collected were analysed using descriptive statistics of simple proportion, frequency count and percentages based on the research questions raised.

Results

Research Question One: How adequate are the structure of PTEC in Southwestern Nigerian universities in line with NUCBMAS?

In answering this question, structure of discipline as raised by Schwab (1962) was used as the basis for this study. Schwab emphasizes on both substantive and syntactical structures and these are embedded in NUCBMAS for UPTEC. It was used as the yardstick for adequate for this study.

Table 1: Content Analysis of Universities Course Units Structure Adequacy to NUCBMAS

Universities	Course Units Assigned 120/90	NUC Course Units Accrued	Remark
A	166 (96.5)	172	Adequate
B	158 (91.9)	172	Adequate
C	186 (108)	172	Adequate
D	194 (112.8)	172	Adequate
E	165 (95.3)	172	Adequate
F	88 (51.2)	172	Not Adequate
G	160 (93.0)	172	Adequate
H	123 (71.5)	172	Adequate
I	156 (90.7)	172	Adequate

Source: Extract form UPTEC, NUCBMAS (2007) Percentage in Parenthesis

Table 1 presents the Physics teacher education core course units against the NUCBMAS. It was found that the course units assigned by each university to their courses for students to graduate from Physics teacher education against the NUCBMAS for UPTEC of all the universities (A-I) listed above were adequate at above 70% except the university F with percentage (51.2%) far less than 70%.

Research Question Two: How adequate are the Physics teacher education curricula Core Course Units structure in Southwestern Nigerian Universities adequately in line with the National universities commission benchmark on minimum academic standard?

Table 2: Analysis of Universities Core Course Units Structure Adequacy to NUC Standard

Universities	Core Courses Units	NUC Core Courses Units	Remark
A	50 (96.2%)	52	Adequate
B	77 (148.1%)	52	Adequate
C	43 (82.7%)	52	Adequate
D	30 (57.7%)	52	Not Adequate
E	29 (55.8%)	52	Not Adequate
F	19 (36.5%)	52	Adequate
G	59 (113.5%)	52	Adequate
H	41 (78.9%)	52	Adequate
I	58 (111.5%)	52	Adequate

Source: *Extract from UPTEC, NUCBMAS (2007) Percentages in parenthesis*

Table 2 present the universities Core Course Units for PTEC adequacy against the NUC standard. The Universities D, E and F were not adequate to NUCBMAS while the remaining universities A,B,C,G, H and I were adequate to the NUCBMAS UPTEC standards units for Physics teacher education.

Research Question Three: How adequate are the Physics teacher education curricula specialization structure in Southwestern Nigerian Universities in line with the National universities commission benchmark on minimum academic standard?

Table 3: Analysis of Universities Specialization Course Units Structure Adequacy to NUC Standard

Universities	Specialization Credit Units	NUC Specialization Credit Units	Remark
A	63 (100%)	63	Adequate
B	54 (85.7%)	63	Adequate
C	109 (173.0%)	63	Adequate
D	123(195.2%)	63	Adequate
E	127 (201.6%)	63	Adequate
F	65 (103.2%)	63	Adequate
G	73 (115.9%)	63	Adequate
H	60 (92.2%)	63	Adequate
I	91 (144.4%)	63	Adequate

Source: *Extract from UPTEC, NUCBMAS (2007) pp 267-276 Percentages in parenthesis*

Table 3 present the Physics teacher education specialization course units to NUCBMAS. All the universities specialization course units are adequate to NUC standard.

Research Question Four: How adequate are the Physics teacher education curricula specialization structure in Southwestern Nigerian Universities in line with the National universities commission benchmark on minimum academic standard?

Table 4: Analysis of Universities Elective Course Units Structure Adequacy to NUC Standard

Universities	Electives Units	NUC Electives Units	Remark
A	63 (185.3%)	34	Adequate
B	27 (79.4%)	34	Adequate
C	32 (94.1%)	34	Adequate
D	41 (120.6%)	34	Adequate
E	09 (26.5%)	34	Not Adequate
F	04 (11.7%)	34	Not Adequate
G	28 (82.4%)	34	Adequate
H	22 (64.7%)	34	Not Adequate
I	14 (41.2%)	34	Not Adequate

Source: *Extract from UPTEC, NUCBMAS (2007) pp 267-276 Percentages in parenthesis*

Table 4 present the electives course units approved by NUC against each University's electives course units for PTEC. Result reveal that universities E (26.5%), F (11.88%), H (64.7%) and I (41.2%) were not adequate to NUCBMAS specialization course units with the percentage less than 70%. The remaining universities were adequate at above 70% to NUC standard.

Discussion

The study revealed that the total course units among the universities in terms of adequacy were 70% to NUC Benchmark. The result was not in consonant with the findings of Monk and Osborn (1996) in whose study supported Schwab's (1962) who expounded that most curriculum have forgotten the important distinction between substantive and syntactic structure which is expected to be in universities curricula. The analysis of The universities core course units structure are adequate to NUC standard, hence, the results revealed that out of nine universities curricula sampled; three universities do not adequately comply with NUC standard. Ivowi (2004) reported that the components of the science teacher-education programme should contain enough depth and breadth to enable the teacher to be adequate and effective in teaching senior secondary school Physics.

It can also be observed from the result that out of nine universities, only University A had specialization course units for PTEC less than 50 units. This according to Ivowi (1987) who expounded that as Physics teacher is expected to teach Physics in secondary school, he or she need to be equipped in specialized courses in Physics which are adequate to the needs of society and secondary schools. He exonerated courses such as special relativity, low temperature physics, geomagnetism, plasma physics among others. Whereas he emphasized on the teaching of solid state physics, modern physics (adequate aspect of atomic and nuclear physics) and elementary instrumentation as being very necessary. He then suggested that adequate specified courses will afford an opportunity for student teachers to develop interest in the course and in teaching.

Conclusion

The study concluded that there is structure inadequacies of Physics teacher education curricula (PTEC) in few Southwestern Nigerian universities. Also the larger percentage of the universities adequately observes the structure as recommended by NUC. A reasonable conclusion one can drawn is that NUC policies (NUCBMAS) are clear and consistent over the years and there is a well-designed curriculum for PTEP by NUC that aim at satisfying the needs of the society especially at the secondary school level. Going by the findings of this study and assessment of the Physics teachers produced, the conclusion reached is that the efforts of implementing the NUC standard have not been sufficiently articulated to produce the desired results.

Recommendations

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

1. Each of the nine universities should ensure that its curricula structure is adequate to NUCBMAS and must be unified among the universities.
2. All the universities faculties of Education should cooperate to produce common curriculum structure for Physics teacher education as established by NUC for the Physics components of the teacher education programme in order to ensure a uniform preparation of teachers for the same secondary school Physics curriculum.

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EFFECTS OF INQUIRY-BASED METHOD AND COMPUTER-ASSISTED-INSTRUCTION ON STUDENTS' PERFORMANCE IN PHYSICS IN NIGERIA FEDERAL GOVERNMENT COLLEGES

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Abstract

The study focused on Effects of Inquiry-Based Method and Computer-Assisted Instruction on Students' Performance in Physics in Southwest Nigeria Federal Government Colleges. The purpose of the study was to compare the effectiveness of Inquiry-Based method and Computer-Assisted-Instruction method on students' achievement in physics. A quasi-experimental design of the three groups pre-test, post-test, control design was employed. The treatment groups include the Computer-Assisted-Instruction group and Inquiry-Based method group. The CAI group was thought using Instructional package while the Inquiry-Based method group was exposed to questioning, searching and examing of books, investigating and probing. The sample for the study consisted of 90 senior secondary school (SSS) class two Physics students who were randomly selected from three Federal Government Colleges in Southwest Nigeria. Two null hypotheses were raised for the study and tested using one way ANOVA and Analysis of Covariance ANCOVA respectively. The study ensured the homogeneity of the three groups. The study showed that Inquiry-Based method is the best among the three and that Computer Assisted Instruction group performed better than the Conventional group.

Key words: Physics, Achievement, Inquiry-Based method; Conventional method, Computer-Assisted-Instruction.

Introduction

The pursuit of science as an imperative effort for achieving prosperity and advancement is conspicuous in many national development plans in both develop and developing countries. This trend has been to produce scientifically literate citizens among a sizeable proportion of the society. For Nigeria to realize accelerated development in the 21st century, she needs qualitative science education in schools, especially Secondary Schools.

Science is an organized body of knowledge in forms of concept, laws, theories and generalization (Urevbu, 2001). One of the objectives of science is to develop students' interest in science and technology. The teachers are expected to devise ways of making their students develop positive attitude toward science and science related disciplines.

Most importantly, teachers need to get used to teaching methods that will help students achieve their learning objectives. Teachers must be aware that many factors contribute to the overall performance of students, notable among these are teachers' personality, learning environment, availability/choice of instructional materials, students' attitude to learning and the teachers' methodology.

In recent years, the issue of how science is taught to individual especially to students, has been more important than it used to be since the idea about the nature of scientific knowledge has radically changed owning to the work of epistemologist. The focus on the nature of science and scientific inquiry in science education in the world is rapidly increasing (Osborne, Smith & Collins, 2003). Science, being a fundamental part of everyday life and essential to our understanding of the world, teaches us a way of finding out about the world.

Physics in particular is central to the field of human endeavours and is a branch of science that is concerned with the properties of matter and energy and the relationship between them. Physics is very critical to technological development and as such, its teaching and learning must be a matter of national concern. Physics is considered a difficult subject by many students and teachers because they face many difficulties in teaching and learning process (Owolabi & Ogini, 2013). Before a teacher can succeed in teaching, he has to improve his/her method of teaching.

The importance attached to Physics by Federal and State Governments in Nigeria has been clearly stated in section five of the revised version of the National Policy on Education (FRN, 2004). The inclusion of Physics as a core subjects for Science bound students within Nigeria Education System calls for studies on how to teach it effectively.

Skillfulness in science and technology could easily be discovered in young learners when investigative or Inquiry-Based method is used in teaching and learning Physics. Inquiry learning involves developing questions, making observations and doing research to find out what information is already recorded. It also involves developing instruments for data collection, collecting, analyzing, interpreting data and outlining possible explanations and creating predictions for future study. (Ashiq, Azra and Muhammad, 2011). Inquiry-Based method is also defined as the method of teaching, where the leaner, with minimum guidance from the teacher, seeks to discover and create answers to a recognized problem through procedure of making a diligent search (Adedoyin, 1990). Inquiry equally has a learning goal and teaching approach. The students are engaged in learning through Inquiry-Based Method which is helpful for increasing their learning in scientific concepts, positive reception of how students know what to know in science subjects and their nature. The goal of Inquiry-Based learning contains ability to understand the Science subjects by Inquiry-Based method.

Computer-Assisted-Instruction (CAI) is one of the teaching methods that can be used in teaching Physics. The concept of CAI originated from the presentation of program instruction through computer. The development of Computer-Assisted –Instruction transforms the application of Computer in education from the simple administration of record keeping and student scheduling procedures into a widely implemented method of instruction (teaching). Chen (2006) was of the opinion that CAI is becoming a more and more widespread used method and it has been very relevant at teaching difficult subjects in Science, most especially Physics and Mathematics. Computer-Assisted-Instruction has been defined by Collete & Collete, (2001) as a method, which uses Computer in learning media, strengthening students motivation and educational process. It gives the students and teachers the opportunities to learn at their own speed and combine active learning with Computer technology. Steinberg (2000) opined that CAI has many methods incorporated into it. These include direct and exploratory lessons, drills, games and simulations. The learning takes place through the students' interaction with Computer and appropriate feedback.

The specific objective of this study is to compare the effect of Inquiry- Based method and Computer-Assisted-Instruction method on students' achievement in Physics in Federal Government Colleges.

Hypotheses:- Two Null hypotheses were formulated for this study

HO_1: There is no significant difference in the Pre-test achievement mean scores of Physics students in the three groups

HO_2: There is no significant difference on the Post-test achievement mean scores of Physics students in the three groups.

Materials and Methods

The study adopted the quasi- experimental design using Pre-test, Post- test three groups design. The three groups were:

- Inquiry-Based Method (IBM) group which was exposed to learning Physics through posing questioning, searching of books and investigative approach.

- Computer-Assisted-Instruction group which was exposed to Computer instruction Packages
- Conventional group, the third group was exposed to classroom teaching.

The design of the study is as follows;

Inquiry Based Method group

$G_1 \quad O_1 \; X \quad O_2$

Computer-Assisted Instruction group

$G_2 \quad O_3 \; Y \quad O_4$

Conventional group

$G_3 \quad O_5 - \quad O_6$

The third group is used as the Control group.

The subjects for the study comprised 90 senior secondary school two (SS2) Physics students randomly selected from the fourteen (14) Federal Government Colleges in Southwest Nigeria. The multistage sampling technique was used to select the sample. The first stage involved the selection of the three States within the 6 Geo-political statess in South-west which include Oyo, Osun and Ekiti State. The second stage involved the selection of three Federal Government Colleges from each selected State, using purposive random sampling. The third stage was the selection of 30 students from each school using stratified random techniques. Two of the schools were assigned to the experimental groups while the remaining one was assigned to the Control group.

The instrument used to gather data for the study was a Physics Achievement Test (PAT). The Instrument consisted of 40 Objective test items which was constructed by the researcher based on the topics in the package. These include Projectile, Linear Momentum, Production and Propagation of Light waves (Reflection and Refraction). The instrument was subjected to screening by experts in Physics to ensure face and content validity procedures.

The reliability of the instrument was ascertained using test-retest method, the reliability coefficient of 0.85 was obtained at 95% level of significant which was adjudged high enough for the study of this type

The research was carried out in three stages, administration of Pre-test, the treatment and Post-test administration. The students in the groups were exposed to different treatments. Group G_1 was exposed to investigative method, searching books and asking questions on the topics given, i.e Inquiry Based Method. Group G_2, the Computer-Assisted-Instruction were taught using the specifically designed package; and the third Group G_3 was exposed to Conventional method for a period of six weeks. All the students in the three groups attempted the Pre-test, Post-test before and after the treatment respectively. The performances of the students were analyzed using Inferential Statistics. One-way Analysis of Variance was used to test the Hypothesis 1. While Analysis of Covariance was used to test for Hypothesis 2 raised for the study.

Results

Hypothesis 1 was tested using one-way ANOVA (F-statistics) at 0.05 level of significance (Table 1).

Table 1: ANOVA showing achievement mean scores of students in three groups before treatment.

Source of Variation	***SS***	***df***	***MS***	F_{cal}	***p***	***Results***
Between group	32.822	2	16.411	2.660	0.076	Not significant
Within group	536.733	87	6.169			
Total	569.556	89				

P>0.05

The F-calculated value (2.660) was less than F-table (3.070), P= 0.076 > 0.05. This means that the null hypothesis was not rejected . This implies that there was no significant difference in the achievement means scores of students in three groups before treatment. Hence, the equality of the baseline knowledge of the sample prior to the treatments is hereby established for the three groups involved in the study. It was then concluded that the students selected for the study were homogenous

Hypothesis 2 was tested using Analysis of Covariance (ANCOVA). F- Statistics at 0.05 level of significance. (Table 2).

Table 2: ANCOVA showing Post-test achievement mean scores of students in the three groups after treatment.

Source of variation	***SS***	***df***	***MS***	F_{cal}	***P***	***Result***
Corrected Model	2354.044	3	784.681	47.642	0.000	Significant
Covariate (pretest)	7.977	1	7.977	0.484	0.488	Not Significant
Group	2295.031	2	1147.515	69.671*	0.000	Significant
Error	1416.456	86	16.470			
Corrected total	3770.500	89				
Total	36833.000	90				

*P<0.05

In Table (2), the calculated value of F-cal = (69.671), P= 0.000< 0.05. This means that the null hypothesis was rejected, implying that there was significant difference in the Post-test mean scores of students in the three groups after treatment.

A post-hoc analysis on pairs of the group significant differences was carried out using Scheffe's analysis. The result is presented in Scheffe's summary as shown in table 3.

Table 3: Scheffé Post-hoc analysis of students' achievement in Physics in three groups

Groups	***Control***	***Computer-Assisted Instruction***	***Inquiry***	***N***	***Mean***
Conventional method		*	*	30	12.30
Computer-Assisted Instruction			*	30	20.67
Inquiry-based method				30	24.53
Total				90	19.17

*P<0.05

Table 3 revealed that there was significant difference between the achievement mean scores of students in the Computer-Assisted- Instruction and Control group at 0.05 level of significance. Similarly, the mean difference between the achievement of students in the Inquiry and Control, Computer-Assisted Instruction and Control groups were statistically significant at 0.05 significant level in each case. The results above revealed that the Inquiry-Based Method was the most effective method. This implies that Inquiry-Based Method had the greatest effect on Students' achievement in Physics.

Discussion

The findings of this study revealed that students' achievement in Physics both experimental and control groups in Pre-test were low and did not differ statistically. This implies that there was no significance difference in the Pre-test mean score of the students in the experimental groups (Computer- Assisted- Instruction and Inquiry-Based method group) and Control group

(Conventional group). This established the homogeneity of the three groups involved in the study prior the treatment. In other word, it could be said that the knowledge baseline for the groups involved in the study were equal.

The findings of the study also showed that there was significant difference in the achievement mean scores of the groups after the treatment. This implies that there was improvement in the performance of the students resulting from their exposure to the treatment. The implication is that the use of Inquiry-Based method and Computer-Assisted-Instruction are teaching strategies for enhancing students' achievement in Physics. The study further found out that there was significant difference in the performance of students exposed to Computer-Assisted-Instruction and Inquiry-Based method whereby the students exposed to Inquiry-Based method performed better than those exposed to Computer-Assisted Instruction. This is in agreement with Ashiq (2011) that students assimilated and accommodated information better when they are left alone to make observation, pose questions, examine books and other source of information which include experimental evidences, use tool to gather, analyze and interpret data, propose answer, explain predictions and communicate the results. Alexander(2001) also reported that students' achievement and motivation for the study of Physics improves tremendously if the students are active participants in constructing their own knowledge through self -learning strategies using CAI and applying such knowledge to analyze Scientific processes. Azar and Sengulec (2011) asserted that CAI materials are more effective in developing favourable attitude and in capturing students' interest toward learning Physics.

The result of this research work therefore revealed that Computer-Assisted-Instruction is better than Conventional method but among the three tested groups Inquiry-Based method of instruction is the best.

Conclusion and Recommendation

The study concluded that there is significant difference in students' achievement mean scores in the three groups. The use of Inquiry-Based method was most effective for the teaching and learning of Physics. The idea of active teacher, passive students that characterized Convectional method was relegated as students were allowed to develop methods for experiments, develop instruments for data collection, analyzing, interpreting data and outlining possible explanations and to create predictions for study on their own.

Also, the Computer-Assisted-Instruction with characteristics of individualization, self-pacing and feedback had enhanced the teaching and learning of Physics. The result of analyses showed that the Inquiry-Based method was the best among the three groups.

Physics teacher should be made to recognized the potentials of Inquiry-Based method of teaching and Computer-Assisted Instruction and utilize them for better performance of students in Physics.

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EFFECTS OF TARGET-TASK MODEL ON SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE IN PHYSICS IN ILORIN, KWARA STATE.

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Abstract

The study investigated the effects of target-task model on senior secondary school students' performance in physics. The research design was a quasi-experimental, pretest-posttest, non-equivalent and non-randomized control group design. The study was conducted in two schools randomly selected schools and involved a total of 120 Senior Secondary School II physics students. The objectives were to find out the difference in the students' performance, and difference in the performance of male and female students when taught using the Target-task model. The physics performance test designed by the researcher was the instrument for data collection. The data collected were analyzed using analysis of covariance (ANCOVA), and the two hypotheses put forward were tested at an alpha level of 0.05. The study revealed that the students that were exposed to the target task model performed better than those that were not exposed to the target-task. Other findings, implications, recommendations and suggestions for further studies were explored.

Introduction

Science has been regarded as the bedrock of modern day technological breakthrough. Nowadays, countries all over the world, especially the developing ones like Nigeria, are striving hard to develop both technologically and scientifically, since the world is turning into a scientific village and has made life easier and comfortable to all living things on earth. Science is basically studied as Biology, Chemistry and Physics.

Physics is the study of matter, energy and their interactions in the environment. It is an enterprise which plays a key role in the progress of mankind. The study of physics generates fundamental knowledge, which is essential for the required technological advancement to propel the economic engine of the world. Physics is sometimes referred to as the science of measurements and its knowledge has contributed greatly to the production of instruments and devices that are of tremendous benefits to the human race (Olaniyan & Omosewo, 2015).

Physics, a subject in the secondary schools has been plagued by one major problem. This is the problem of poor performance of students in the Senior School Certificate Examinations (Omosewo, 2002). Physics is perceived abstract and difficult (Nwankwo & Madu, 2014). Research reports by Adedayo (2008) revealed that the performance of students in physics is very poor, hence, calls for attention. Oderinde (1979) stated that the enrollment figures in physics at the secondary school level in the developing countries are quite low. For example, in Nigeria between 2005 and 2010, an average of less than 30% of the students who registered for West African Senior Secondary Certificate Examination (WASSCE) entered for physics. Out of these, only 40% passed at the Credit level (WAEC, 2010). Some of the reasons for this poor enrollment and performance in physics have been blamed on the way science in general and physics in particular is being taught in secondary schools (Ogunneye & Lasisi, 2008). Survey from schools by Ajayi (2007) revealed that one of the factors that

negatively affects the effective learning of physics in secondary schools is the teacher's method of teaching. Angago (1990) stated that among the causes of students' poor performance in physics globally is lack of students involvement in teaching and learning activities.

Problem-solving involves going through a series of solution to solve the given problem. Mayer (1983) defined problem-solving as a multiple step process where the problem-solver must find the relationship between past experience and the problem at hand and then acts upon a solution. Problem-solving interventions could make use of models adopted or developed for a specific set of learners in order to achieve a desired academic achievement. There were many models available for teaching and learning which include: Polya's model (1957), Newell and Simon (1992) and many more. The choice of a model for an intervention depends on the nature of the problem to be solved (Olaniyan & Omosewo, 2015). Related to physics or education generally, student were seen as; passive learners, dependent on the teacher and books, hence poor performance and absence of skills is the result (Adeniran, 2011).

Problem-solving is a process in which a learner perceives and resolves a gap between a present situation and a desired goal, with the path to the goal blocked by known or unknown obstacles (Huitt, 1992). Huitt, (1992) mentioned four stages of problem-solving, these include:

1. An input phase in which a problem is perceived and an attempt is made to understand the problem
2. A processing phase in which alternatives are generated and evaluated and a solution selected
3. An output phase, which includes planning for and implementing the solution, and
4. A review phase in which the solution is evaluated and modifications are made

According to Olaniyan & Omosewo (2015), the target-task model involves presentation of a major problem, the solution of which requires the application of rules and principles, with which the students may not be familiar. It is expected that the teacher presents some solutions similar to the target-task and guides the students to solve the problem. It is an adaptation of the guided-discovery method. The authors identified six stages of this model, they include:

1. Pre-task: The teacher introduces the topic, explains the topic in detail and ensures the students understand what to do at the task stage
2. Task: The students complete the task in pairs or groups, while the teacher observes and offers encouragement
3. Planning: Students prepare a written report on what they went through during the task in their groups
4. Report: The students make their reports available to the teacher for assessment. After corrections the teacher presents the reports back to the students
5. Analysis: The teacher highlights relevant parts of the learning on the board
6. Practice: The teacher selects area of practice for the students

This model presents the concept first by presenting a problem (called the target-task) which will require the application of a rule, principle or formula which the students may have known. This problem may not be easy for students to solve. Then the physics teacher will guide the students to solve other similar but easier graded examples to the task. When these problems are being solved, the teacher gives hints or clues that can aid the students in participating and conceptualizing the solution to the problems. Obodo (1990) stated that, the target-task approach is the meeting point of Brunner's and Gagne's theory of teaching. The approach is the combination of Brunner's discovery method of teaching and Gagne's hierarchical approach to teaching. It also makes use of inductive method of teaching starting a lesson with a target-task, solving other graded work examples and generalizing is a form of inductive method starting from particular principles to general ones.

Eryilmaz (2004) observed that gender contributes to poor achievements of students in physics. Gender according to Yang (2010) refers to the social attributes and opportunities associated with being male and female and the relationships between women and men, girls and boys, as well as the relationship between women and those between men. Habor-Peter (2000) reported a

significant increase in students' performance in problem-solving technique using polya's model strategy with the male students performing better than females. Also, in a research carried out by Olaniyan, Omosewo, and Nwankwo (2015), results show that there is no significant difference in the performance of male and female students taught physics using polya problem-solving model. There is a need to inculcate innovative methods to physics teaching in Nigeria. These include inquiry method, collaborative learning, target-task model, discovery method, and so on. These methods encourage child-centered approaches to learning of physics. The students are guided by the teacher to discover facts and construct their own ideas and understanding the concepts of the study.

The impact of teachers in the performance of students is important because teachers are the facilitators who are to impact on the students the concepts to be learned (Achufusi, 2015). Nwagbo (2001) is of the opinion that ignorance of teachers and neglect of activity oriented methods by teachers grossly contributes to students' low performance in physics. One thing is to be grounded in conceptual understanding of a subject and another is to be well acquitted with the best method to pass the concepts across to learners for proper comprehension. It is obvious that the study of physics cannot be effectively carried out without an empirical analysis of some of the factors that impede the study of the subject and some of the factors that may improve students' performances in the subject, some of which have been listed above. Therefore, this present study sought to determine the effects of target-task model on senior secondary school students' performance in physics in Ilorin, Kwara State.

Literature Review

Harbor-Peters (1989) carried out a study to determine the effect of target-task model approach on students' retention of some geometric concepts. The study was conducted using two schools (1 male and 1 female) in Nsukka urban as sample. The study lasted for three weeks and four geometric theories were taught. The findings indicated that both the experimental (target task) and control (formal approach) groups performed alike in the pretest. However, the experimental group performed better than the control group in the posttest. Ozofor (1993) also investigated the effects of the target task approach on SS3 students' achievement in conditional probability. The subjects of the study consisted of 240 SS3 students drawn from two senior secondary schools in Udi Local Government Area of Enugu Education Zone. Results of the data analysis showed that there was no significant difference between the experimental and control groups in their achievement in conditional probability, there was a significant difference between the methods and gender. Ezeh (2002) researched on the effects of target-task approach on students' achievement and interest in senior secondary school physical chemistry. A sample of 160 SS2 chemistry students were drawn by simple random sampling technique from four senior secondary schools in Nsukka Local Government Area were used for the study. The result of data analysis showed that the target task was superior to the expository method in enhancing students' achievement and interest in the units of physical chemistry. Therefore, this present study investigated the effects of target task model on students' performances in physics in Ilorin South Local Government Area, Kwara, drawing samples from three secondary schools.

Purpose of the Study

The main purpose of this study was to investigate the effects of Target-Task Model on senior secondary school students' performance in physics in Kwara State, with specific emphasis on Ilorin South Local Government Area. The study also sought to investigate:

1. The difference in performance of students in physics before and after being exposed to target-task model.
2. The difference in performance of students who were taught physics using the target-task model and those taught physics without target-task model.
3. The difference in the performance of male and female students who were taught physics using the target-task model.

Research Questions

The following research questions were raised and answered to guide this study:

1. What is the difference in performance of students in physics before and after being exposed to target-task model?

2. Is there any difference in the performance of students who were taught physics using the target-task model and those taught physics without target-task model?

3. Is there any difference in the performance of male and female students who were taught physics using the target-task model?

Research Hypotheses

The following research hypotheses were stated based on the research questions raised in this study and were tested in the course of the study:

Ho_1: There is no significant difference in the performance of students when taught physics using the target-task model and those taught physics without target-task model.

Ho_2: There is no significant difference in the performance of male and female students when taught physics using the target-task model.

Significance of the Study

The findings of this study may form part of the efforts that are being made to have greater achievement of students in physics. The findings may contribute empirical information that would be of immense benefit to teachers, students, researchers. The findings of this study may help teachers to adopt different teaching approaches that will make the teaching and learning of physics to be more stimulating, interesting and activity-based. Teachers may also find the study helpful in developing and strategized their lessons with appropriate steps involving the target-task. The findings of this study may help physics students to gain better understanding of concepts in physics, which will enhance their performances in internal and external examinations. It may also make students to be proficient in solving different problems associated with inquiry based activities in the classroom. The findings of this study may serve as a reference point for future researchers on related research works in science education.

Methodology

The population for this study was all senior secondary school students offering physics in Ilorin. The target population was all senior secondary school two (SSSII) students offering physics in Ilorin South Local Government Area Kwara State, Nigeria. The choice of SSII was necessary because the concept of electric field is expected to be taught in SSII as scheduled in scheme of work. Two schools were randomly selected and 120 physics students in two intact classes of the sampled schools were involved in the study. The experimental group contained 57 students, while the 63 students formed the control group.

The instruments for this study were in two categories; Physics Performance Tests.

Physics Instructional Package.

The Physics Performance Tests; were designed by the researcher. It involved questions adapted from the WASSCE past questions. The Pre-PPT included 20 questions and the Post-PPT included 25 questions in total respectively. The content area of the Pre-PPT was topics from the SS1 physics syllabus while the POST-PPT content involved questions on electric fields. The PRE-PPT tested for knowledge levels while the POST-PPT tested for understanding, comprehension, application, an achievement levels. The tests were given to three experts to scrutinize and determine the suitability. All corrections made by these experts enabled the researcher to eliminate the ambiguous and reconstruct some items in the instrument. This instrument was administered to a set of 20 students that were not part of the participating schools which enabled the researcher to subject the test items to item analysis and discrimination. Based on that, the researcher reconstructs and ruled out some items that seemed to be too difficult and too easy in the Physics Performance Test (PPT). The reliability of the instrument was carried out using split half method. Then their scores in the two halves were subjected to reliability using Cronbach Alpha Method and the reliability coefficient of 0.71 was therefore obtained at 0.05 alpha level.

Physics Instructional Package, was designed by the researcher based on the content of electric fields (electrostatics, coulomb's law and electric force, electric field lines of force, electric current

and ohm's law, resistors and resistance, capacitors and capacitance), process and steps involved in the TTM was explored and implemented. The package consisted of lesson plans for four weeks.

The package was administered on students in the intact class of the selected schools during the second to fifth weeks of the experiment. The experimental group was taught using the TTM while the control group was taught without TTM. During the TTM instruction, the teacher first introduced the topic to the students, explained it in details while the students took down relevant notes. Relevant illustrations and materials were used to teach the students. After the students must have understood the topic, the teacher presented the target-task, explained what is expected in the task stage and instructed the students to carry on with the task in groups after which the teacher went round to crosscheck while rendering relevant corrections. After the students finished with the task, the teacher went through their answers and for those who didn't get it, the teacher solved easier related examples and asked them to re-solve the target task, after which the students present their results to the rest of the class. During the sixth week, the experimental and control groups were given posttest.

Data Analysis and Results

The data gathered from both the experimental and the control groups were analyzed using frequency and percentage to present the demographic data of the participants. Mean and standard deviation were used to answer the research question one while the other research questions were formulated into hypotheses and tested with Analysis of Covariance (ANCOVA) at 0.05 alpha level.

Results

Research Question: What is the difference in performance of students in physics before and after being exposed to target-task model?

Table 1: Descriptive Statistics of Students' Performance in Physics before and after the Treatment

Groups		Mean	S.D.	Min	Max	Remark
Experimental	Pre-test	9.29	2.50	4.00	15.00	Low
(Target Task Model)	Post-test	18.12	2.50	13.00	23.00	High
Control	Pre-test	6.96	1.90	2.00	11.00	Low
	Post-test	12.14	3.45	3.00	20.00	Fair

As revealed in Table 1, the performance of students (both the experimental and control groups) in the post-test was higher than their performance in the pre-test. This implies that the performance of students (both the experimental and control groups) before the treatment was low, however after the treatment, the performance of students taught target task approach (18.12) was higher than the performance of students taught without (12.14).

Hypothesis One: *There is no significant difference in the performance of students when taught Physics using the target-task model and those taught without target-task model.*

Table 2: Analysis of Covariance Showing the Difference in the Performance of Students when Taught Physics Using the Target-Task Model and Those Taught Physics without

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1200.219[a]	2	600.110	73.005	.000
Intercept	1034.743	1	1034.743	125.880	.000
Pre-test	130.107	1	130.107	15.828	.000
Treatment	554.978	1	554.978	67.515	.000
Error	961.747	117	8.220		
Total	29102.000	120			
Corrected Total	2161.967	119			

a. R Squared = .555 (Adjusted R Squared = .548)

**Significant at p<0.05*

Result in Table 2 showed that the *F*-value of 67.515 was obtained with a *p*-value of 0.000 computed at 0.05 alpha level. Since *p*-value 0.00 was less than alpha level 0.05, the null hypothesis was not retained and thus, there was a statistically significant difference in the performance of students when taught Physics using the target-task model and those taught without ($F_{(1, 117)} = 67.515$, $p<0.05$).

Table 3: Pairwise Comparisons Analysis Showing the Effect of the Treatment on Students' Performance in Physics

Treatment	Mean	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Experimental(I)	18.12[a]	5.98*	0.59	0.00	3.70	6.05
Control (J)	12.14[a]	-5.98*	0.59	0.00	-6.05	-3.70

Grand Mean = 15.13

* the mean difference is significant at 0.05 level

b. Adjustment for Multiple Comparisons: Bonferroni

To ascertain the direction of the significance, the Multiple Comparison Analysis was depicted in Table 3 to show where the difference lies. Table 3 showed that students who were taught Physics using target task model had higher mean score of 18.12 and those taught Physics without the target task model had a mean score of 12.14. This implied that students taught with the use of target task approach performed better than those taught without in Physics Performance Test (PPT).

Hypothesis Two: *There is no significant difference in the performance of male and female students when taught Physics using the target task approach.*

Table 4: Analysis of Covariance Showing the Difference in the Performance of Male and Female Students That Were Taught Physics Using the Target Task Approach

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	89.332[a]	2	44.666	9.178	.000
Intercept	663.689	1	663.689	136.370	.000
Pre-test	80.601	1	80.601	16.561	.000
Gender	.400	1	.400	.082	.775
Error	262.808	54	4.867		
Total	19073.000	57			
Corrected Total	352.140	56			

a. R Squared = .254 (Adjusted R Squared = .226)

**Insignificant at p>0.05*

Table 4 revealed that the *F*-value of 0.082 was obtained with a *p*-value of 0.775 computed at 0.05 alpha level. Since *p*-value (0.775) was greater than alpha level (0.05), the null hypothesis was retained and thus, there was no statistically significant difference in the performance of male and female students that were taught Physics using the target task approach ($F_{(1,54)} = 0.082$, $p>0.05$).

Discussion of Findings

Findings from this study revealed that the performance of students (both the experimental and control groups) before the treatment was low, however after the treatment, the academic performance of students taught target task model was higher than the performance of students taught without. This may due to the fact that target task model exposed students beyond the traditional and regular method thereby resulting in students' higher performance in Physics. This outcome corroborates Wambugu, Changeiywo and Ndiritu (2014) whose findings indicated that the integration of modern teaching approaches in instructional delivery resulted in high students' understanding of the subjects and academic performance when compared with the use of traditional teaching method alone.

Results obtained from this study showed that there was a statistically significant difference in the performance of students when taught Physics using the target-task model and those taught physics without. Students taught with the use of target task model were found to academically perform better than those taught without. This finding is in line with Omosewo and Olaniyan (2015) who found that students taught with the target task model performed better than those taught using lecture methods when exposed to the performance test on current electricity. In correlation with this, Ezeh (2002) discovered that

the target task was superior to the expository method in enhancing students' achievement and interest in the units of physical chemistry.

In addition, this study showed that the performance of male and female students exposed to target task teaching approach do not differ as insignificant statistical difference was found in the performance of male and female students that were taught Physics using the target task approach. This result is in support of Harbor-Peters (1989) and Ozofor (1993) whose findings revealed no significant difference in the mean performance of male and female students taught Mathematics using target task model. However, this outcome disagrees with Shaibu and Mari (1997) who observed a gender difference in achievement in science process skills in favour of the female students.

Conclusion

The Target Task Model enhanced better performance of students in physics. It could also be concluded that the use of target task model did not reveal any bias in the results towards gender as both male and female students that were exposed to target-task model performed well in Physics.

Recommendations

With respect to the findings of this study, the following recommendations are proffered;

1. Physics teachers should expose students to target task model while delivering classroom instruction so as to improve students' problem solving skills in physics and hence their academic performance.
2. Physics teachers should take into consideration that both male and female students while teaching using the target task model since performance is not influenced by gender.
3. There should be seminars, conferences and workshops where in-service teachers should be trained in the knowledge and skills of effective implementation of target task model in schools since the approach was found to improve students' academic performance.
4. School authorities and educational administrators should encourage teachers to employ target task model into implementation of the secondary school science curriculum in all the subjects

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PREDICTING SCIENCE ACHIEVEMENT IN SENIOR SECONDARY SCHOOL IN IJEBU NORTH LGA, OGUN STATE: ROLE OF EMOTIONAL INTELLIGENCE AND SELF EFFICACY

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Abstract

The cutting edge trend in classroom pedagogy has shifted activities in the classroom from the teacher to the learners to make room for active involvement in the instructional process. To achieve this, learners' characteristics have to be explored and understood to enable the teacher to tap them for the benefits of the learners. Consequently, the researchers investigated learners' emotional intelligence and self-efficacy as predictors of academic achievement in Senior Secondary School Science. Correlational research design was adopted. Four research hypotheses were tested at 0.05 alpha level. 250 SS II Science students drawn from 10 randomly selected schools within Ijebu Igbo Metropolis participated. Three instruments were used viz; Trait Emotional Intelligence Questionnaire Adolescent Short Form (r = 0.85), Self-Efficacy Scale (r = 0.80) and Science Achievement Test (r = 0.75). Pearson Product Moment Correlation Coefficient and Simultaneous Multiple Regression Analysis were the analyses techniques used. Result showed that Emotional Intelligence had significant relationship with academic achievement (r = .351, p < .05), Self-efficacy had significant relationship with academic achievement (r = .400, p < .05), the predictors had significant relative contributions and their composite contribution was equally significant at ($F_{(2,243)} = 25.679$ P < 0.05). It was concluded that Emotional Intelligence and Self efficacy are essential learner features that influence achievement in Science. Though both predictors are necessary ingredients, Self-efficacy was better at predicting achievement (29.0%) than Emotional Intelligence (16.0%). Part of the recommendations was that both traits be developed or improved upon in learners, through designing activities that will lead to the development of emotional intelligence and self-efficacy.

Key Words: Emotional Intelligence, Self-efficacy, academic achievement

Introduction

It is the strong intention of every student to excel in every subject offered in the school and this excellence is also a major concern of teachers, parents and other stakeholders in education. This becomes particularly so for those subjects like Science and Mathematics that have become a must pass for all science students at the Senior Secondary School level wishing to study Science and Science-related courses at the tertiary level. Incidentally, Chemistry, Physics and Biology which are the focus of this study are regarded as core subjects for Science students (NPE, 2014) and this makes them mandatory for science students both to offer and to pass. In this paper these researchers have collectively labeled these three subjects as Science. A certain level of this pass (credit) is required in then in order to proceed to higher levels of academic aspirations or pursuits (JAMB Brochure, 2014).

Beyond the mandatory requirement of these subjects in the academics, Science has a lot of implications for the development of nations. Ezike (2007) wrote that the role of Science and Technology in raising the level of the productive

forces and hence the standard of living of any given society is well known. No wonder Boyler (2016) commenting on the importance of Science and Technology, noted that both are widely recognized as instruments of economic growth in advanced industrialized nations and once an economy achieves a "developed" status, innovation is the only sustainable driver of economic growth. Chopra (2015) said today Science is advancing at an amazing speed and everything of our life has changed beyond recognition. Science constitutes an attempt to conquer the forces of nature and aim to give man an increasing power over his surroundings. In this direction, invisible diseases can be cured or prevented entirely, and it can still provide hope for those with as-yet incurable diseases, people who love each other can talk to themselves whenever they want no matter how far apart they are in the world and can be together the next day (Brotherton, 2010). One of the most important things Science gave to humanity according to Barbos (2014) was security. The world would have been sluggish and even more torturous and deadly without Science. Science is therefore the reason for the ever increasing understanding that people have about the world around them. Susman (2013) however had some reservation about science. She argued that a lot of the time, what we are learning about and discovering in Science is not good news, it is a bummer to learn about climate change, and equally it is an unpleasant experience to think about cancer. On-going human-caused mass extinctions are kind of depressing to think about let alone to acknowledge.

For a field with this magnitude of importance, it should be expected that students would have flair for it with its associated outstanding achievements. But what is observed is almost a yearly recurrence of underachievement in the subject (WAEC 1999; 2000, Ezike, 2007). With this observation, the performance is not encouraging for a country like Nigeria seeking for technological advancement and self-sustaining economy through the exploration of Science and Technology. To qualify for admission into any Nigerian University to study any science-related course, the student must score at least a credit level pass in five subjects (Ezike, 2007) which must include at least two of the core Science subjects.

This situation has attracted the attention of various stakeholders in general education, Science Education, parents, teachers, institutions, academic societies and the society at large (Adeyemo, 2007) and a way forward is being sought. Different researchers have come up with various reports listing factors that might be responsible for underachievement of students not only in Sciences but other subjects as well, since these factors permeate the entire achievement continuum. For example, Alao (2014) identified student factors or causes arising from the learners such as academic interest (Ezike, 2018). Adeyemi (2010) found that inadequate facilities and instructional aids were responsible for the observed students' underachievement. Dike (2007), Smith (2013) contend that students perform poorly due to lack of adequate preparation, shortage of qualified teachers, inadequate teaching aids, lack of good school environment and infrastructural facilities. Ezike (2007), Bamiro (2011) identified faulty instructional strategies as factors contributing to underachievement among students. Most of these factors responsible for underachievement as identified here are extraneous or external to the students. This present study therefore intends to examine those factors that are inherent and innate to the learners which they come into the classrooms with. Such innate characteristics being investigated in this study are emotional intelligence and self-efficacy.

Salovey and Mayer (1990) in Sania and Sehrish (2016) defined emotional intelligence as the ability to monitor one's own feelings and emotions, to discriminate among, and to use this information to guide one's thinking and action. It is the ability to recognize one's own and other people's emotions, to discriminate between different feelings and label them appropriately and to use emotional information to guide thinking and behaviour (Coleman, 2008). It is also defined as the ability to identify, use, understand and manage emotions in positive ways to relieve stress, communicate effectively, empathize with others, overcome challenges and defuse conflicts (Segal and Smith 2015). These definitions according to Baron (2005) capture the

basic skills associated with emotional intelligence which are;

- the ability to recognize, understand and express emotions and feelings,
- the ability to understand how others feel and relate with them,
- the ability to manage and control emotions,
- the ability to manage change, adapt and solve problems of a personal and interpersonal nature, and
- the ability to generate positive effects and be self-motivated.

Supporting Baron (2005), Ogundokun and Adeyemo (2010) wrote that emotional intelligence is a confluence of developed abilities to

- know and value self
- build and maintain a very strong, productive and healthy relationships
- get along and work well with others in achieving positive results and
- effectively deal with pressures and demands of daily life and work.

In other words, emotional intelligence as an ability enables the student or learner to recognize and understand his or her emotions and using this awareness or understanding to manage himself or herself and relationship with others. This study is of the view that the basis of communal existence, collaborative activities that define present day lifestyle is espoused or incorporated by the principles of emotional intelligence. This becomes more important for classroom interactions where learners through the help of others are able to attain certain learning objectives. Understanding each other's emotions, feelings, likes and dislikes therefore is a defining factor for a successful group-oriented learning and other active learning processes. Emotional intelligence is therefore not only important in self-realization but also a strong ingredient in collaborative and cooperative classroom activities as it is important in the development of productive and healthy relationships and appreciation of other's emotion.

Although Ogundokun and Adeyemo (2010) reported a paucity of research on the influence of emotional intelligence on academic performance, some works however have shown the predictive effects of emotional intelligence on academic achievement (Ogundokun & Adeyemo 2010, Chamundeswari, 2013, Preeti, 2013). Since emotional intelligence is a master aptitude, a capacity that profoundly affects all other abilities, either facilitating or interfering with them (Goleman, 1995), an investigation of the predictive effect of emotional intelligence on academic achievement becomes imperative. Maizatul, Hassan and Norhafizah (2013) in the study of the relationship between emotional intelligence and academic achievement found that the two domains investigated were significantly and positively associated. Similar results were also obtained by other researchers (Mohammad, Asghar, Ejaz, Masud & Mohammad, 2011, Banat & Rimawl, 2014, Bunyan, Tan, & Loo 2015). Contrary results have also been obtained for example Sania and Sehrish (2016) in their study with Business students in Pakistan found a weak relationship between emotional intelligence and academic performance of students, Fatum (2008) equally found a weak, positive, significant relationship between emotional intelligence and academic achievement of students in English Language Arts, but a no statistically, significant relationship is indicated between academic achievement in Mathematics or Science and emotional intelligence.

As emotional intelligence assists individuals to know and value oneself, it therefore has implications for self-efficacy. This is why Pajares (2006) wrote that the physical and emotional states that occur when someone contemplates doing something provide clues as to the likelihood of success or failure. This current study is of the view that stress, anxiety, worry and fear (which are emotional states) all negatively affect self-efficacy and can lead to a self-fulfilling prophecy of failure or inability to perform the feared tasks. Bandura (1997) defined self-efficacy as an individual's belief in his or her capacity to execute behaviours necessary to produce specific performance attainments while Ormrod (2006) described it as the measure of one's own ability to complete tasks and reach goals. It is the belief in an individual's competence to tackle difficult or novel tasks and to cope with adversity in specific demanding situations (Luszczynska, Gutierrez-

Dona & Schwarzer, 2005). From these definitions, it implies that self-efficacy refers to the extent one trusts his or her ability or potential to execute a given task. So, if an individual believes and has the confidence of completing a task such as titrating or dissection, it is to a very large extent sure that such tasks will be completed with success. Self-efficacy is therefore a very important socio-psychological factor required for school subjects like the physical sciences and mathematics that relies heavily on confidence, will power and conviction to tackle. Bandura (1997) therefore noted that a strong sense of confidence and competence facilitates information processing and performance in a variety of settings, including quality of decision-making and academic achievement.

In 1999, Bandura showed that those who are high in self-efficacy are more successful in solving conceptual problems at school. Hawthorne (2004) noted that students who are self-efficacious are more likely to undertake difficult and challenging tasks than students who are not self-efficacious. They are also more likely to engage more, work harder, exert more effort and persist longer in the face of difficulties (Zimmerman, 2000). Empirical findings show that self-efficacy positively predicts achievement (Galyon, Blodin, Yaw, Nalls & Williams, 2012, Richards, Bond & Abraham, 2012, Ezike & Ajayi 2015). Shkullaku (2013) in a study exploring the gender difference in self-efficacy and academic achievement among Albanian students (using 102 females and 78 males) found a significant relationship between students' self-efficacy and academic performance. Also a research on Australian science students carried out by Wilma (nd) of the University of Wollongong, Australia (Wikipedia) showed that those with high self-efficacy showed better academic performance than those with low self-efficacy. Goulão (2014) working in Portugal with 63 adult students found a significant relationship between self-efficacy and academic achievement. From the foregoing theses, the researchers conclude therefore that an investigation on the correlative powers of emotional intelligence and self-efficacy on students' academic achievement in Science is worthwhile.

Statement of the Problem

One of the major concerns of teachers, parents and other stakeholders of education is the level of achievement by the learners. This is particularly so following the high rate of failure in the externally conducted examinations (WAEC & NECO). Results from these examination bodies have shown that students' achievement in the Science is not quite outstanding. Efforts have also been made by researchers and government to reverse this trend. Research efforts have mostly been geared towards extrinsic factors without much improvement. It is therefore the desire of this study to look closely at factors emanating from the learners themselves. Hence, a study of emotional intelligence and self-efficacy of the learners as predictors of Science achievement becomes compelling.

1.4 Research Hypotheses: The following null hypotheses guided the study

H_{O1}: There is no significant relationship between emotional intelligence and academic achievement of students in Senior Secondary School Science.

H_{O2}: There is no significant relationship between self-efficacy and academic achievement of students in Senior Secondary School Science.

H_{O3}: There is no significant composite contribution of emotional intelligence and self-efficacy to academic achievement of students in Senior Secondary School Science.

H_{O4}: There are no significant relative contributions of emotional intelligence and self-efficacy to academic achievement of students in Senior Secondary School Science.

Research Design

Descriptive survey research design using correlational approach was adopted for this study. The design was appropriate for the study as it sought for relationship among variables and manipulation of variables was not attempted.

Population

The population for the study comprised all the Senior Secondary School Science students in all the Senior Secondary Schools in Ijebu Igbo Metropolis, Ijebu North Local Government Area

of Ogun State, Nigeria but the target population was SSII Science students.

Sample and Sampling Technique

A random sampling technique was adopted for the selection of ten schools and participants to be used for the study from the population. The sample comprised two hundred and fifty SSII students.

Instruments

The following instruments were used for the collection of data. They are the Trait Emotional Intelligence Questionnaire–Adolescent Short Form (TEIQUE-ASF), Self-efficacy Scale (SES) and Science Achievement Test (SAT) The Trait Emotional Intelligence Questionnaire – Adolescent Short Form (TEIQUE-ASF) is adopted from Petrides, Sangareau, Furnham and Frederickson (2006). The TEIQue-ASF is a simplified version, in terms of wording and syntactic complexity, of the adult short form of the Trait Emotional Intelligence Questionnaire (TEIQue). The ASF comprised 30 short statements, two for each of the 15 trait EI facets, designed to measure *global* trait EI. The TEIQue-ASF consists of sections A and B. Section A dealt with the biodata of the respondents while B contained the item statements arranged on a four-point Likert scale type of SA, A, DA and SD. The instrument was administered to a parallel sample of students that did not take part in the study. Data generated were used for the calculation of reliability using Cronbach alpha and the r obtained was 0.85.

The instrument consists of two sections, A and B. Section A contains the biodata of the participants while section B contains twenty two items based on a four-point Likert scale type of strongly agree (SA), agree (A), disagree (DA) and strongly disagree (SD). The items used for the development of this scale were generated from the works of Sherer et al (1982) and Schwarzer and Jerusalem (1995) and adapted for local use (r = 0.65) by Ezike and Ajayi (2014). It is in this form that the instrument was adopted and used. The earlier validation notwithstanding, the instrument was revalidated and administered to a parallel sample of a school that did not take part in the study. Data generated were used for the determination of reliability using Cronbach's alpha, r = 0.80.

Science Achievement Test (SAT)

This is a thirty-item multiple choice objective test developed by the researchers with options lettered A-D, chosen from all the topics already covered by the sampled schools. Ten items were taken from each of the three core Science subjects. The SAT was administered to a parallel sample of SS II students who did not partake in the main study. The result of this administration was used for the determination of the reliability of the instrument using Kuder-Richardson 20 (KR-20) and r obtained was 0.75.

Data Analysis

The data analysis techniques used were Pearson Product Moment Correlation which was used to determine the extent of relationship between the two predictor variables (each) with the criterion variable and Multiple Regression Analysis was used to estimate the prediction power (composite and relative) of the two predictors on achievement.

Results

Hypothesis one ($\mathbf{H_{O1}}$): There is no significant relationship between emotional intelligence and academic achievement of students in Senior Secondary School Science. This hypothesis was tested using Pearson Product Moment Correlation Coefficient and the result is presented in table 4.1 below.

Table 4.1 Summary of Pearson Product Moment Correlation Coefficient showing relationship between emotional intelligence and academic achievement of students in Senior Secondary School Science.

Variable	Number	Mean	Std dev.	R	Sig	Remark
Emotional Intelligence	244	96.4	9.39	.351**	.000	Significant
Science Achievement	244	14.7	3.62			

***P < 0.01**

Results of analysis show that the correlation coefficient(r) is significant at P < .05 (r = .351, P < .05). This implies that the null hypothesis of no significant relationship is rejected, indicating a significant relationship between emotional intelligence and academic achievement of students in Senior Secondary Science.

Hypothesis one (H_{O2}).There is no significant relationship between self-efficacy and academic achievement of students in Senior Secondary School Science. This hypothesis was tested using Pearson Product Moment Correlation Coefficient and the result is presented in table 4.2 below.

Table 4.2 Summary of Pearson Product Moment Correlation Coefficient showing relationship between self-efficacy and academic achievement of students in Senior Secondary School Science.

Variable	Number	Mean	Std dev.	r	Sig	Remark
Self Efficacy	244	70.3	6.09	.401**	.000	Significant
Science Achievement	244	14.7	3.62			

***P < 0.01**

Result of analysis shows that the correlation (r) is significant at P < .05 (r = .401, P < .05). This implies that the null hypothesis of no significant relationship is rejected indicating a significant relationship between self-efficacy and academic achievement of students in Senior Secondary School Science.

Hypothesis three (H_{O3}): There is no significant composite contribution of emotional intelligence and self-efficacy to academic achievement of students in Senior Secondary School Science. This hypothesis was tested with Simultaneous Multiple Regression Analysis and the results are presented in the following tables.

Table 4.3(a): Model summary of the R, R square and adjusted R square in the Multiple Regression Analysis.

Model	R	R square	Adjusted R square	SE of the Estimate
1	.419[a]	.176	.169	3.29605

a. predictors: (constant), emotional intelligence and self efficacy.

From the table above, the R^2 is .176, which indicates that 17.6 percent of the variance in the dependent variable achievement is explained by the independent variables as listed below Table 4.3(a). This means that the two independent variables influenced achievement to the tune of 17.6%. The remaining unexplained 82.4% could be attributed to the effect of several other variables not covered by this study. This composite contribution is further interpreted by the ANOVA Summary below.

Table 4.3(b): ANOVA summary of significance level in the multiple regression analysis

Model		Sum of squares	df	Mean Square	F	Sig
1	Regression	557.942	2	278.971	25.679	.000[a]
	Residual	2618.205	241	10.864		
	Total	3176.147	243			

a. predictors: (constant), emotional intelligence and self efficacy.

Though the R^2 is slightly low (See Table 4.3a), the Analysis of Variance is highly significant (0.000, $F_{(2,243)} = 25.679$ P < 0.05). This indicates that there is a statistically significant relationship between the predictor variables (emotional intelligence and self-efficacy) and the criterion variable (achievement). Therefore it can be assumed that the two predictor variables could reasonably predict achievement in Senior Secondary School Science. The null hypothesis is therefore rejected.

Hypothesis four (H_{O4}): There are no significant relative contributions of emotional intelligence and self-efficacy to academic achievement of students in Senior Secondary School Science. This hypothesis was tested with Simultaneous Multiple Regression Analysis and the result is presented in the table below

Table 4.3(c): The beta (**β**) coefficients in the Multiple Regression Analysis showing relative contributions of Emotional Intelligence and Self Efficacy to academic achievement of students in Senior Secondary School Science.

Coefficients[a]

		Unstandardized coefficients		Standardized coefficients		
Model		**B**	**SE**	**Beta**	**t**	**Sig**
1	(Constant)	-3.674	2.577		-1.426	.155
	Emotional Intelligence	.062	.029	.160	2.111	.036
	Self-Efficacy	.177	.045	.298	3.926	.000

a. Dependent Variable: Mathematics Achievement

From table 4.3(c); the Beta (β) weightings of the two predictor variables are given in the standardized coefficient column. The constant is -3.674. Relative to each other, Emotional Intelligence has a positive effect on achievement. ($\beta = .160$) and this is statistically significant at (0.036, $P < 0.05$), Self-Efficacy had a positive effect on achievement ($\beta = .298$). From the result presented, it can be concluded that the independent variables had a statistically significant effect on achievement of students in Senior Secondary School Science. Their different Beta values represent their relative contributions to achievement in Senior Secondary School Science. Emotional Intelligence made a contribution of 16.0% and Self Efficacy made a contribution of 29.8%. Therefore self-efficacy predicts achievement in Senior Secondary School Science more than emotional intelligence.

Discussion

This study investigated the relationship between emotional intelligence, self-efficacy and academic achievement of Senior Secondary School students in Science. Four null hypotheses were tested in the course of investigation. The first hypothesis sought to establish a relationship between emotional intelligence and academic achievement of students in Senior Secondary School Science. The result of the analysis showed that a positive, significant relationship exists between the predictor and criterion variables. This result affirms the importance of emotional intelligence in learning among students. Emotional intelligence enables the learner not only to monitor but to understand his feelings and emotions and equipped with this information, he makes the right decision as to learn effectively and profitably. This right information will guide his thinking and actions in relation to any learning situation. Understanding his or her emotions will also enable him or her to develop a viable learning style and habit as he knows how and when to learn best. The capability to also recognize other peoples' emotions will enable him or her to interact successfully and meaningfully with others in group activity and in the process achieve the desired learning goal. This result agrees with the findings of Maizatul et al (2013), Banat and Rimawl (2014), Bunyaan et al (2015) but does not agree with Fatum (2008) who found a weak but significant relationship between emotional intelligence and academic achievement among English Language Arts students and a no statistically significant relationship between emotional intelligence and academic achievement among Mathematics and Science students. The disagreement arose because this present study found a positive and significant relationship between EI and academic achievement in chemistry while Fatum (2008) found that the variable does not influence achievement among mathematics and science students. The disparity might be due to differences in environmental conditions of the respondents and possibly other psycho-social factors.

The study also found a significant relationship between self-efficacy and academic achievement of students in Senior Secondary School Science. As a psycho-concept that deals with individual's competence to tackle difficult or novel tasks, it

follows that learners who are self-efficacious will have stronger belief in their capacity to complete learning tasks and achieve stated goals. Believing in one's ability is a strong intrinsic motivator to accomplish given tasks and goes a long way in determining level of success. This result agrees with Galyon et al (2012), Bond and Abraham (2012), Shkullaku (2013) and Goulão (2014).

Findings from the study indicated that the predictor variables (emotional intelligence and self-efficacy) jointly and separately made significant contributions to the achievement of students in Senior Secondary School Science. This is so because emotional intelligence helps the learner to monitor and understand his or her feelings and emotions. This positively affects the self-efficacy of the learner who as a result exerts more efforts to influence his or her ability to meet specific goals and or expectations even in difficult situations. The interaction between these two predictors in enhancing learning in children is therefore crucial. Though the two variables jointly explained 17.6% of the variance in the criterion variable, analysis further showed that self-efficacy made greater contribution (30%) to achievement than emotional intelligence that contributed 16.0% which was only slightly significant. This observation is congruent or consistent with many features of self-efficacy such as people having beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives, fostering intrinsic interest and deep engrossment in activities, setting for themselves challenging goals and maintaining strong commitment to them and heightening and sustaining their efforts in the event of failure (Bandura, 1994).

Conclusions and Recommendations

From the results of this study and several other related materials reviewed, the researchers reached the following conclusions. That emotional intelligence and self-efficacy are subtle but active ingredients for the academic achievement of students in various school subjects. That self-efficacy which is an individual's personal judgement of his capabilities to organize and execute courses of action to attain designated goals is a powerful psychological weapon to overcome fear of failure. That since emotional intelligence and self-efficacy are significantly related (Mikolajczak & Luminet, 2007), both constructs can be gainfully harnessed to fortify or strengthen each other in the learners.

It is therefore recommended that both traits be developed or improved upon in learners, through designing activities that will lead to the development of emotional intelligence and self efficacy. The development activities/strategies may include providing mastery experiences, vicarious experiences or modeling, social persuasion, providing empathetic environments and activities that can lead to building up of trust and creating situations that will exert pressure on the learners' emotions to test their levels of stress management

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EFFECTS OF JIGSAW INSTRUCTIONAL STRATEGY ON CHEMISTRY STUDENTS' ACHIEVEMENT IN SOLVING ELECTROLYSIS PROBLEMS

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Abstract

Electrolysis as a concept in School Certificate Chemistry is considered abstract and researches have indicated that students find it difficult to understand. There is at present, a persistent poor achievement of Nigerian students in Senior School Certificate Chemistry Examinations, and this is partly traceable to ineffective classroom instructional strategies utilized by classroom teachers. This study sought to determine the effects of Jigsaw Instructional Strategy on Nigerian Senior School Chemistry students' achievement in solving electrolysis problems. The study adopted a non-randomized and non-equivalent pre-test, post-test, control group quasi-experimental design. Two intact classes of students were involved; one serving as the experimental group and the other serving as the control group. The instrument used for the study was the Electrolysis Achievement Test (EAT) which was duly validated and whose reliability coefficient (r) was found to be 0.87 using Pearson Product Moment Correlation Statistic. The data obtained from pretest and post-test were analyzed using mean scores, standard deviation and t-test statistics. The findings revealed significant difference in the achievement of students taught electrolysis using the Jigsaw instructional strategy and students taught using the conventional strategy ($t_{117} = 5.325$, $p=0.005<0.05$). However, there was no significant difference in the achievement of male and female students taught electrolysis using Jigsaw ($t_{51} = 0.416$, $P = 0.486 > 0.05$). It is recommended among others that chemistry teachers should consider using Jigsaw instructional strategy to teach electrolysis.

Keywords: Jigsaw, Gender, Achievement, Electrolysis, Secondary school

Introduction

Chemistry is one important subject and discipline that has an overwhelming influence on the human life. Our body is Chemistry, so is our environment. Chemistry is a cornerstone to nearly every field of science and technology (Adebayo, 2007). Knowledge of chemistry is brought into play in the manufacturing of fertilizers, herbicides, insecticides drugs and fungicides. Also, the study of chemistry is necessary for the management of natural resources, provision of food, health facilities and adequate food supply (Ezendu, 2000). Besides, chemistry is one of the science subjects that provide the basic knowledge and understanding of principles that could be applied to improve the quality of life of man. Consequently, it stands in a central position among the basic sciences (Abubakar & Eze, 2010). It is also worthy of note that a credit pass in School Certificate Chemistry is a prerequisite for admission into any science and technology based course in higher institutions of learning. The knowledge of chemistry can be found in all types of manufacturing processes; for instance, the production of most consumer products are directly or indirectly dependent on chemical technology know-how and this covers a large spectrum (Okanlawon, 2004).

Electrolysis is the chemical decomposition of a compound brought about by direct current. The passage is through either a solution of the compound or the molten compound. Electrolysis as a concept is considered abstract, and students often find it difficult to explain or even solve problems involved in it (Oyelekan, 2006).

In Nigeria, secondary school students experience difficulty in solving electrolysis problems just like their counterparts worldwide (Oyelekan, 2006; Olorundare, 2014). According to Gabel (1996), the complexity of chemistry is viewed from both research on problem solving and misconceptions. These misconceptions are not only traceable to the complexity of the subject, but also to the manner in which the concepts are taught in the classroom. Available report also indicates that despite the fact that science (and chemistry in particular) is needed for technological development of the nation, the achievement of students was always poor (Abimbola, 2013). Olorundare (2014) described students' recent achievement in the sciences as worrisome. The figures presented showed undulating achievements in such a manner that we cannot affirm improvement in the students' general achievements.

The academic achievement of students has been of concern not only to parents and students but the wider society. Yusuf and Adigun (2010) stated that many parents believed that the academic achievements of students are determined by gender and consequently many consider the dominant gender of schools before enrolling their wards, with a majority of them preferring single sex schools to co-educational (mixed-sex schools). Many studies have been conducted to unravel factors influencing students' academic achievement. Kissau (2006) and Bosede (2010) asserted that gender and location of school do influence students' academic achievement in some subject areas. In most science-related fields, there are more males than females. Igboegwu and Okonkwo (2012) found that female anxiety level was higher than that of their male counterparts in educational statistics. The finding corroborates those of Clark and Gorski (2002) that females do not perform well in science because of their low level of confidence rather than their ability level.

The use of inappropriate instructional strategy is one of the causes of students' poor achievement in quantitative problems (O'Connor, 2000; Opolot-Okurot, 2005). Tran and Lewis (2013) observed that students offering chemistry courses did not have enough tutoring and sufficient inquiry skill. They therefore suggested that the use of cooperative instructional strategy could assist in assuaging this problem. Cooperative instructional strategy is a method used by educators to help students develop necessary social skills (Johnson & Johnson, 1999). Zakaria, Chin and Daud (2010) concluded that, there were positive changes when a teacher changes his teaching approach from being teacher-centered towards a more student- centered approach. In cooperative learning for example, students work to maximize their own and others learning potentials to reveal new ideas and their solution. This is probably why Johnson and Johnson (1999) suggested that more can be obtained through group work and cooperative approaches to learning in chemistry.

Many kinds of cooperative learning techniques exist. They include Learning Together (LT), Teams-Games-Tournaments (TGT), Group Investigation (GI), Jigsaw grouping, Team Accelerated Instruction (TAI) and Student Teams Achievement Division (STAD). In order to encourage students to improve their achievement and promote more positive attitude to chemistry, there could be many alternatives to lecture-based teaching method.

Jigsaw as proposed in this paper is also a form of cooperative learning strategy in which individual students become experts in a particular aspect of a topic and teach those aspects to their fellow students. It utilises a concept called task specialization which demands that different students take up specialized roles in achieving the objectives of the lesson. In this strategy, students become experts on a particular aspect of a topic and teach their counterparts based on their knowledge of that particular expert.

The various stages involved in Jigsaw are listed as follows:

1. Identifying Topics and Specifying Learning Objectives
2. Designing Learning Materials
3. Identifying Topics and Specifying Learning Objectives
4. Forming Student Teams
5. Assigning Experts
6. Designing Assessments (Slavin, 1986)

The first stage involves the teacher selecting the topic of the lesson and formulating appropriate learning objectives that are expected to be achieved at the end of the lesson. These

objectives are best formulated in terms of what the students are expected to know, and be able to do at the end of the lesson. This is followed by selection of learning materials to be used to get the students to learn the topic at hand. During this stage, the teacher may design his own instructional materials as well as materials that students could use in their respective groups in carrying out the tasks that may be assigned to them. The teacher then divides the students into groups (teams), based on the class population. Each person is made an expert to master a particular aspect of the task assigned and explain it to the other members of the group. The teacher then designs the instruments he intends to use to assess the learners after the lesson, on the basis of the objectives set for the lesson.

Catapano (2017) also listed six simple steps to follow in using the Jigsaw instructional strategy.

1. Organize students into a group of 4-6 people.

2. Divide the day's reading or lesson into 4-6 parts, and assign one student in each group to be responsible for a different segment.

3. Give students time to learn and process their assigned segment independently.

4. Put students who completed the same segment together into an "Expert group" to talk about and process the details of their segment.

5. Have students return to their original "Jigsaw" groups and take turns sharing the segments they've become experts on.

6. Have students complete a task or a quiz that's reliant on them having understood the material from the contributions of all their group members (p.1).

Jigsaw strategy facilitates social interaction among students and provides opportunity for students to learn from one another. As an instructional strategy, Jigsaw expands the act of teaching beyond the teacher and gives opportunity for learners to express their talents. It is based on this student-centred nature of Jigsaw that this study sought to find out whether the Jigsaw instructional strategy would assist students in solving electrolysis problems, having been identified as one of the problem areas in School Certificate.

Literature Review

Reports about the effectiveness of Jigsaw as an instructional strategy are mixed. According to Slavin (1996), the achievement outcomes of cooperative learning methods like Jigsaw in which tasks are specialized are unclear. Slavin (1995) asserted that research on the original form of Jigsaw has not generally found positive effects of the strategy on student achievement. Similarly, Johnson and Johnson (1994) did not find Jigsaw a better alternative to individualistic methods except only when group rewards were introduced. This was alluded to by Mattingly and Van Sickle (1991). Conversely, there are evidences that when Jigsaw is well implemented, students' achievement could be significantly improved (Al-Salkhi, 2015; Mbacho & Changeiywo, 2013; Maden, 2011).

Al-Salkhi (2015), researched into finding out the effectiveness of Jigsaw Cooperative Learning Strategy on the motivation and achievement of 7th primary grade students in Amman, Jordan. A total of 53female students took part in the study, 26 of which were in the experimental group, while the remaining 27 were in the control group. The study utilized an achievement test and a Motivation Learning Scale on Islamic Education. The result showed that the experimental group achieved significantly more than the control group, and that a positive relationship existed between students' achievement and their learning motivation.

Maden (2011) sought to determine the effects of Jigsaw I instructional technique on Ataturk University Turkish teacher candidates in written expression. A total of 70 students of the Department of Turkish Teaching in the academic year of 2009-2010 were involved in the study. Two intact classes of students comprising of 34 and 36 students were assigned as experimental and control group respectively. Using a Success Test for Written Expression (STWE) as pre-test and post-test, the results obtained from the study indicated a non-significant difference in the academic achievement of the two groups, in favour of the Jigsaw group. Similar results in favour of Jigsaw were obtained by Burns (1984), Mbacho and Githua (2013) and Sharan and Shachar (1988).

Mbacho and Changeiywo (2013) sought to find out the influence of gender on the use of Jigsaw Cooperative Learning Strategy in Mathematics. One hundred and sixty students were randomly sampled from about twenty thousand Form III students from Laikipia East District in Kenya. Using a Mathematics Achievement Test, the results indicated that there was no statistically significant difference in Mathematics achievement of the students when they were taught using Jigsaw cooperative learning strategy.

Conflicting reports arise from research on practical classroom applications of Jigsaw without group reward. Some studies presented evidence that group processing activities could enhance the achievement effects of cooperative learning strategy like Jigsaw (Yager, Johnson, Johnson, & Snider, 1986). In contrast to this however, Rich, Amir, and Slavin (1986) found that team building activities had no effect on the achievement of students with Jigsaw. Slavin (1995) generalized that group strategies that did not make provision for specific group rewards based on the learning of all members of the group were not more effective than traditional instruction in increasing student achievement, although there was evidence that these methods could be effective when group rewards were incorporated into the strategy. These conflicting research reports necessitate further research into the use of Jigsaw instructional strategy.

The presence of high achieving students may be more threatening to boys than to girls (Schwalbe & Staples, 1991). It is therefore assumed that boys will react to high achieving students in a more competitive manner than girls do. Attribute such as warmth and sympathy are particularly preferred in girls (Seem & Clark, 2006). Gender role stereotypes are likely to attribute success of females to effort and the success of males to ability. Girls are thought to be more relationship oriented and expectedly should therefore be more interested in maintaining a good relationship with peers; even with high-achieving ones. This is expected to impact positively on their achievement with Jigsaw. This study sought to find out whether this could be true.

Theoretical Framework

Jigsaw is one of the major cooperative learning strategies, hence, the theoretical framework for this study rests on the four major theoretical perspectives of cooperative learning and achievement as presented by Slavin (1996). These perspectives are: The motivational perspectives, the social cohesion perspectives, the cognitive perspectives and the motivational perspectives.

The main thrust of the motivational perspective is the motivation brought about by the reward system under which the Jigsaw strategy operates (Johnson & Johnson, 1992; Slavin, 1995). In this arrangement, individual success is dependent on group success, hence, members of a group are obliged to assist others in achieving a common goal. The overall success of the group is a combination of the efforts of individual members of the group The social cohesiveness theoretical perspective holds that the cohesiveness of the group impacts significantly on the ability of the group to improve their achievement with cooperative learning strategy. This theoretical perspective is hinged on the believe that students can help one another to learn when engaging in group work since members of a group often comprise of students with various degrees of learning abilities. According to Slavin (1996), task spacialisation is used in Jigsaw, Group Investigation, and Finding Out is used to facilitate interdependence among members of a group, with a view to enhancing social cohesion among the learners.

The cognitive perspectives holds that in cooperative learning, improvement in learners' achievement can be traceable to their mental processing resulting from interaction with members of their group. On the other hand, the developmental perspectives assumes that interaction among members of a group in solving an academic problem has the propensity to improve group and individual achievement. Members of a group, even though they belong to the same age group could differ slightly in their developmental status, hence, the more capable ones on the basis of development could impact positively on the learning of the less capable ones in the group.

Purpose of the Study

The main purpose of the study was to determine the effect of Jigsaw instructional strategy on chemistry students' achievement in solving

electrolysis problems. Specifically, the study aimed at finding the:

(i) difference in the achievement of students taught electrolysis using Jigsaw instructional strategy and students taught using Conventional Lecture-Based Strategy (CLBS).
(ii) difference in the achievement of male and female students taught electrolysis using Jigsaw instructional strategy.

Research Questions

Answers were sought to the following research questions:

i. What is the difference in the achievement of students taught using Jigsaw instructional strategy and students taught using lecture method in solving electrolysis problems.

ii. What is the difference in the achievement of male and female students taught using Jigsaw instructional strategy in solving electrolysis problems.

Research Hypotheses

Two research hypotheses were tested in the study:

HO_1 There is no significant difference in the achievement of students taught electrolysis using Jigsaw instructional strategy and students taught Conventional Lecture-Based Strategy (CLBS).

HO_2 There is no significant difference in the achievement of male and female students taught using the Jigsaw instructional strategy and those taught using Conventional Lecture-Based Strategy (CLBS).

Methodology

This study was a non-randomised, non-equivalent 2x2 quasi experimental research which utilized a pre-test and post-test. The design indicates two levels of independent variables (i.e. the Jigsaw instructional strategy and conventional lecture-based strategy), and gender at two levels of male and female. The population for the study was all senior secondary school II (SS II) chemistry students in Oyo, Nigeria. The choice of SS II was based on their pre-requisite knowledge in basic chemistry concepts and especially electrolysis concept that is normally taught to the class. Two schools were purposively selected on the basis of having a minimum of 10 years of experience in fielding candidates for the West African Examinations Council (WAEC) and National Examinations Council's School Certificate chemistry; having chemistry teachers with teaching qualifications and who have taught chemistry in the school system for at least five years, and having a co-educational system of students' enrolment.

The two schools were randomly assigned to the experimental and control groups. An intact SSII class in each of the schools was selected for the study. 53 students were involved in the experimental group, while 66 students were involved in the control group, hence the sample consisted of 119 students.

The instrument used for the study was the Electrolysis Achievement Test (EAT). It consisted of twenty multiple choice objective questions with four options A – D and five theory questions of school certificate chemistry standard. The instrument was validated by two university chemistry lecturers, two experienced secondary school chemistry teachers as well as two chemistry educators in a university. The reliability of EAT was determined by using the test-retest method of two weeks interval, in which the EAT was administered to twenty senior secondary chemistry II students from non-participating but equivalent school. The data obtained were subjected to Pearson products moments correlation formula. A reliability coefficient of 0.87 was obtained for the instrument.

The Electrolysis Achievement Test (EAT) was of two types; Type A (test before the treatment) and Type B (test after the treatment). Both Type A and Type B consisted of the same 20-multiple choice items with four options (A-D), and five word problems except that the questions were scrambled so that they are not arranged in the same sequence. The EAT was used to determine students' achievement in chemistry. The duration for the tests was one hour thirty minutes. The multiple choice items were adopted from the West African Senior School Certificate Examination (WASSCE) Chemistry questions in the period

between 2005-2012. Each correct test item in the multiple choice was scored 5 marks to give a total of one hundred since there were 20 – multiple choice items. Also each word problem was scored 20 marks and a total of one hundred score again was obtained since there were 5-word problems. Then, the two scores were added together and an aggregate of one hundred marks was obtained.

Permission was sought from the authorities of the two schools and the consent of the students was sought through a students' consent form. The initial equivalence of the two groups was determined using the Students' Achievement Score (SAS) which consisted of students aggregate score in Chemistry for the first, second and third term examination for the immediate past session. This score was assumed to be the true reflection of the students' ability in Chemistry. The chemistry teachers in the schools cooperated by providing all necessary assistance, especially in the area of time tabling.

Data collection was in three main phases and it lasted for six weeks. The pretest was held during the first week, treatment lasted for the next four weeks and the post-test was conducted during the last week. The EAT was administered as pre-test to the students during the first week of the study before treatment commenced. The main treatment was teaching using Jigsaw instructional strategy to an intact class of 53 students. The students in the experimental group were taught electrolysis by their regular chemistry teacher based on the training he had received from the researchers on Jigsaw. The teacher was also closely monitored but care was taken not to disrupt the lessons. The duration was two periods per week with each period lasting for 40 minutes. The control group was simultaneously taught using conventional lecture-based strategy (CLBS) to an intact class of 66 students by its regular teacher as well. By the sixth week, Type B of EAT was administered to the students as post-test. The data obtained were analyzed. The mean scores and standard deviations were calculated. The hypotheses were tested using t-Test at 0.05 level of significance.

Results

The data obtained are presented and interpreted as follows:

Research questions 1: What is the difference in the achievement of students taught using Jigsaw instructional strategy and students taught using conventional lecture-based strategy (CLBS) in solving electrolysis problems.

Table 1: The Mean of Pre-test and Post-test Scores of the Experimental and the Control Groups.

Strategy	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Exp. (Jigsaw)	53	29.79	8.393	35.57	11.487	5.78
Control (CLBS)	66	22.85	6.907	25.76	8.60	2.91

Table 1 shows the mean scores of students who participated in the Electrolysis Achievement Test. The pretest and post-test mean scores of students taught using the Jigsaw instructional strategy were 29.79 and 35.57 respectively, while those of the students in the control group were 22.85 and 25.76 respectively. While the mean gain score of the experimental was 5.78, that of the control group was 2.91. This means that students taught using Jigsaw performed better than those taught conventionally.

Research Question 2: What is the difference in the achievement of male and female students taught electrolysis using Jigsaw instructional strategy and those taught using the conventional lecture-based strategy (CLBS).

Table 2: The Mean of pre-test and post-test scores of male and female students taught using Jigsaw instructional strategy in solving electrolysis problem.

Gender	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Male	17	30.12	7.705	36.53	11.248	6.41
Female	36	29.64	8.800	35.11	11.727	5.41

Table 2 shows the mean gain scores of male and female students taught using the Jigsaw instructional strategy. The pre-test and post-test mean scores of male students were 30.12 and 36.53 respectively. It gives a mean gain score of 6.41. The pre-test and post-test mean scores of the females were 29.64 and 35.11 respectively. It gives a mean gain score of 5.41. The male students had a slightly higher mean gain score than the females.

Hypothesis testing

Hypothesis 1: There is no significant difference in the achievement of students taught using Jigsaw instructional strategy and students taught using the conventional lecture-based instructional strategy in solving electrolysis problems.

Table 3: Independent samples t-test achievement of post-test scores of students taught using the Jigsaw Instructional Strategy and those taught using the conventional lecture-based strategy (CLBS).

Instr. Strategy	N	Mean	SD	Mean Diff.	df	t	p
Exper. (Jigsaw)	53	35.57	11.487	9.808	117	5.325	.005
Control (CLBS)	66	25.76	8.601				

Table 3 shows t-Test result of the comparison between the achievement of the experimental group and the control group. It reveals that the calculated p is less than 0.05 level of significance fixed for the t-Test. Hence the null hypothesis is rejected. This means that there was a significant difference in the mean scores of students in the post test when taught electrolysis using the Jigsaw instructional strategy as compared to when taught using CLBS (t_{117} = 5.325, p=0.005<0.05). The significant difference is in favour of students taught using Jigsaw, an indication that Jigsaw facilitated better achievement of the students in electrolysis.

Hypothesis 2: There is no significant difference in the achievement of male and female students taught using the Jigsaw instructional strategy in solving electrolysis problems.

Table 4: Independent samples t-Test achievement of post-test scores of male and female students taught using Jigsaw instructional strategy in solving electrolysis problems.

Gender	N	Mean	SD	Mean Diff.	df	t	p
Male	17	36.53	11.248	1.418	51	0.416	0.486
Female	36	35.11	11.727				

Table 4 shows the post-test scores of male and female students taught electrolysis using Jigsaw instructional strategy. The calculated p-value is greater than 0.05 level of significance, hence, the hypothesis is retained. This means that there was no significant difference in the mean scores of male and female students taught using Jigsaw instructional strategy (t_{51} = 0.416, P = 0.486 > 0.05), hence, the influence of students' gender when taught electrolysis using Jigsaw instructional strategy was not significant.

Summary of the Findings

From the analysis and interpretations of the data collected for the study, the following are the major findings:

i. Students taught electrolysis using Jigsaw instructional strategy achieved significantly better than those taught with conventional lecture-based strategy (t_{117} = 5.325, p=0.005<0.05).

ii. There was no significant difference in the achievement of male and female students when Jigsaw instructional strategy was used to teach them electrolysis (t_{51} = 0.416, p = 0.486 > 0.05), hence gender had no significant influence with Jigsaw.

Discussion

The study found that students taught electrolysis using Jigsaw instructional strategy achieved better than those taught using the conventional lecture-based strategy. The finding is similar to that of Burns (1984), Mbacho and Githua (2013), Sharan and Shachar (1988), and Ogundiran (2013). This finding cuts across various school subjects. For instance, while Ogundiran (2013) found out that Jigsaw and Team game had significant effects on the achievements of students in Social Studies, Mbacho and Githua (2013) found out that learners taught Mathematics using Jigsaw cooperative learning strategy performed better than those taught using the conventional learning methods. Other studies (Johnson & Johnson, 1994; Mattingly & Van Sickle, 1991) found Jigsaw a better alternative to individualistic methods only when group rewards were introduced. This suggests that teachers intending to use Jigsaw should as part of the procedure incorporate some group reward mechanisms as a way of taking full advantage of the strategy. Similar findings were also reported by Barrett (2005); Cadopi and Winnykamen (2002); Johnson and Ward (2001) and Ward and Lee (2005). A few other studies however (Slavin, 1995; Rich, Amir, & Slavin, 1996) found no significant difference in students' achievement with Jigsaw over the conventional learning strategy.

This study also revealed that gender had no significant influence on the post-test scores of students taught electrolysis using Jigsaw instructional strategy. This means that male students could achieve as much as female students in electrolysis when taught with the Jigsaw strategy. This finding is similar to previous research findings of Mbacho and Githua (2013) and Adebayo (2007). Both Mbacho and Githua (2013) and Adebayo (2007) found no significant difference in the achievement of male and female students when Jigsaw was used as the instructional strategy. Hence, no special treatment is required for either of the gender in using Jigsaw.

Conclusion

It is established in this study that Jigsaw instructional strategy could enhance students' achievement in electrolysis, thus making it possible to place the topic appropriately in the conflicting reports on the effectiveness of Jigsaw instructional strategy. The study therefore establishes the effectiveness of the Jigsaw instructional strategy in teaching electrolysis to students at the level of School Certificate Chemistry. Also established is the fact that emerged from the study that gender had no significant influence on students' achievement when Jigsaw was used to teach the topic. This is in spite of the fact that male students achieved slightly higher than their female counterparts when Jigsaw was used to teach them electrolysis.

Recommendations

On the basis of the research findings, the following recommendations are made:

1. Electrolysis as a topic in school Certificate chemistry should be taught using Jigsaw instructional strategy and teachers intending to use Jigsaw should as part of the teaching procedure, incorporate some group reward mechanisms as a way of taking full advantage of the strategy.

2. Teachers should be trained on how to utilize the Jigsaw instructional strategy to teach as a means of improving students' overall achievement in chemistry.
3. Jigsaw instructional strategy should be used as an instructional strategy for male and female students without discrimination.

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IMPACT OF TEACHERS' QUALITY AND SCHOOL VARIABLES ON THE ACADEMIC PERFORMANCE OF SENIOR SECONDARY SCHOOL STUDENTS' IN MATHEMATICS IN ONDO STATE

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Abstract

The study investigated the impact of teachers' quality and school variables on the academic performance of senior secondary school students in Mathematics in Ose Local Government Area of Ondo state. The study adopted descriptive research design of the survey type. The sample was 200 senior secondary school II students, selected purposefully from four schools. The instrument for data collection was a structured Mathematics questionnaire developed by the researchers. Analysis of Variance (ANOVA) was used for hypothesis one while Multiple Regression Analysis was used for hypothesis two generated for the study. The hypotheses were tested at 0.05 level of significance. Findings from the study revealed that, there is no significant difference in the quality of teachers across the selected schools. The result also showed that, there was a significant positive multiple correlation between the predictor variables (class size, student's behavior, school environment and laboratory adequacy) and academic performance of students in Mathematics in Ondo State. Based on the findings, it was recommended that teachers should endeavour to help the students improve their attitude towards Mathematics so as to enhance their better performance in the subject while the government needs to provide quality education for its people by building more schools and provide the basic infrastructure needed by the schools.

Keywords: Teachers' quality, School variables, Performance, Students, Mathematics.

Introduction

Mathematics education is a vital tool for the understanding and application of science and technology, the discipline plays the vital role of a precursor and harbinger to the much needed technological and of course national development, which has become imperative in the developing nations of the world. Mathematics is generally recognized as the bedrock of several subjects in school curriculum and it is indispensable to the national goal and objectives. Kolawole and Popoola (2009) opined that, Mathematics is an instrument that facilitates the learning of all subjects. Due to the uniqueness of Mathematics, it is classified as a compulsory subject right from the primary school to secondary school and a subject examination that must be passed in the senior school certificate examination.

Mathematics is an essential subject for consideration for successful outing in certificate examinations like the Secondary School Certificate Examination (SSCE) conducted by West Africa Examination Council (WAEC) and the National Examination Council (NECO) as well as placement examinations like unified tertiary Matriculation (UTME). Stressing the usefulness of Mathematics, Kolawole (2004) described Mathematics as a backbone of a nation. Different teaching techniques have been adopted by pedagogues in order to shore up students'

performance in Mathematics ranging from teacher centre-techniques to other learner-centre methods.

Mathematics teaching can only be result oriented when students are willing and the teachers are favourably disposed, using the appropriate methods and resources in teaching the students. With the current increase in scientific knowledge all over the world, much demand is placed and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole process of teaching and learning of Mathematics because of its importance. Despite the importance of Mathematics to mankind and the efforts of research to improve on its teaching and learning, the performance of students in the subject remains low in Nigeria. It is on this premise that the present study is based to examine the students' perception on the impact of school variables on their academic performance in senior secondary school Mathematics. The researchers consider some variables of the school as those instruments that could tailor the level of students' academic performance. The school variables include the school size, student behaviour, teacher's quality, school laboratory and school environment.

Environment refers to everything (physical and social factors) external to the systems (students that have the potential to affect all parts of the organization). The environment provided the input as well as make use of the output from the system. Students and teachers comfort is indicated as the most important aspect of any school environment (Zins, Weissberg, Wang and Walberg 2004), if students are comfortable, then learning becomes much easier. Being comfortable is a combination of different factors, adequate usable space, noise control and climate control. The classroom is the most important area of the school because it is where students and teachers spend most of their time and where learning process takes place. Classroom must be designed with effective communication and interaction in mind. Students should be able to see easily and hear the instructor (teacher) and other students' noise must be controlled.

Class Size in Mathematics is an important factor in relation to academic performance of students, large classes may likely have an adverse effect on students' performance in Mathematics class. A class with highly populated students may result in the teachers not been able to monitor the performance of the students and thus reducing the students' academic performance. Adeyemi (2008) opined that, students in smaller classes, tends to receive adequate attention from the teachers and have better access to the facilities and equipment and therefore able to learn and perform better than the students in larger classes. Teacher/pupil ratio is one of the important factors determining good academic performance of students. The implication of this is that, ratio should be the basis for determining the qualities of teachers required in a school to ensure good quality.

Teaching of Mathematics involves some practical works which can only be effectively taught in the laboratory for easy access to geometrical instruments or instructional materials; however, most schools do not have Mathematics laboratory while the schools that have lack essential facilities. The teaching and learning experience centre on the extent of adequacy of laboratory facilities in the schools and the teachers' effectiveness in the use of materials in the laboratory with the aim of facilitating and providing meaningful learning experiences in the learners. It is generally believed that, constant practice leads to proficiency in what the learner learns during classroom instruction. According to Mamlock-Naaman (2011), he stated in his paper that, laboratory contributed in no small measure to the academic achievement of students. This has given rise to the expectation that laboratory facilities should be adequately provided to secondary schools for effective teaching and learning of Mathematics.

Quality of teachers is another factor considered to have influenced the performance of students' in Mathematics. The importance of teachers is acknowledged all over the world, as they play unique role in educational development of any nation. The quality of teachers in a school will determine the quality of the school system, and the students' performance in public examinations. In any school administration, attitude of a teacher can be likened to the moral conduct, behaviour and acceptance of an administration. Those exhibiting the above are regarded as good teachers. Besides the students' description, bad teachers also share many traits in common such as seeming to become angry when students ask

questions. Dalgety, Coll and Jones (2003) opined that good attitude of a teacher cannot be over emphasized, it can be seen in the ability of a teacher to allocate enough time for students to accomplish a task and communicate clear goal for what is expected. The fact that students' performance in Mathematics at the secondary school level is low is no longer news. Several factors have been reported to be responsible for this decline in students' performance in Mathematics. However, we cannot lose sight of the fact that, in any teaching learning situation, the students, the teachers, the curriculum and the learning environment are the four pivots of teaching learning process. It is on this basis that this study is designed to examine the impact of teachers' quality and school variables on their academic performance in senior secondary school Mathematics.

Statement of Problem

Mathematics is one of the compulsory subjects every child must attempt and pass to acquire education. It seems poor performance of students in Mathematics at the senior secondary school level can be attributed to teachers' quality and some school variables such as; school environment, class size, students behaviour, teachers quality and laboratory adequacy. It seems little prominence has been given to these in connection with academic performance of senior secondary school students' in Mathematics. Therefore, the study investigated the impact of these variables on the academic performance of senior secondary school students' in Mathematics in Ose Local Government Area of Ondo state.

Research Hypotheses

The following hypotheses were formulated to guide the study:

1. School variables (class size, students' behaviour, school environment and laboratory adequacy) will not significantly contribute to academic performance of students' in Mathematics.
2. Teacher's quality will not significantly influence academic performance of students' in Mathematics.

Methodology

This study adopted the descriptive research design of the survey type. The population for this study comprised all senior secondary school two students in Ose Local Government area of Ondo State. A total of two hundred (200) senior secondary school two Mathematics Students, purposively selected from the four randomly selected secondary schools constituted the sample for this study. Fifty (50) students were selected from each School.

The instrument for data collection was a structured Mathematics questionnaire developed by the researchers tagged 'Questionnaire on impact of school variables on performance of students' in Mathematics' (QISVSM). The questionnaire was divided into two parts. Part A was used to obtain the bio-data of the respondents and part B was used to obtain information used for testing the hypotheses raised in this study. To ensure the validity of the instrument, it was subjected to face and content validity. The corrected version was used for data collection.

To establish the reliability of the instrument, the instrument was tested with twenty (20) students, who were outside the main study, and a test-retest reliability coefficient of 0.75 was obtained using Pearson's Product Moment Correlation Analysis. The questionnaire was administered to the students by the researchers and some research assistants. Data collected from the students were analyzed using inferential statistics of Regression Analysis and Analysis of variance (ANOVA) and all hypotheses were tested at 0.05 level of significance.

Results

Hypothesis 1: School variables (class size, students' behavior, school environment and laboratory adequacy) will not significantly contribute to academic performance of students' in Mathematics.

Table 1: Multiple Regression Analysis showing school variables (class size, students behavior, school environment and laboratory adequacy) on academic performance of students' in Mathematics.

	Unstandardized Coefficients		Standardized Coefficients		
Model	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	31.241	8.024		1.321	.074
Class size	2.232	.632	.362	1.213	.011
Students behaviour	.604	1.084	.072	.517	.528
School environment	4.122	1.213	.112	1.214	.010
Laboratory adequacy	2.163	.232	.212	1.126	.028
Multiple R= 0.587, Multiple R^2 = 0.329, Adjusted R^2 = 0.315, $F_{4, 195}$=10.312					

P<0.05(significant result), dependent variable: students' academic performance

The following regression can be derived from above table 1.

$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4$

Where X_1= class size, X_2= students behaviour, X_3= school environment, X_4= laboratory adequacy,

bi = (i = 1- 4) regression weight coefficients, a = constant

The multiple regression relationship between the dependent and independent variables can therefore be given as follow;

$Y= 31.241+ 2.232X_1 + 0.604X_2 + 4.122X_3 + 2.163X_4$

From the above, the school variables (class size, students behaviour, school environment and laboratory adequacy) significantly contributed to academic performance of students in Mathematics ($F_{4, 195}$=10.312, P<0.05). The null hypothesis is rejected. The table above reveals that there is a significant positive multiple correlation between the predictor variables (R=0.587, P<0.05). This implies that, all the predictor variables are factors that can influence the academic performance of students in Mathematics. The value of number accounted for coefficient of determinant (R^2 = 0.315) indicates that, all the predictor variables jointly accounted for 31.5% of the total variance in academic performance of students in Mathematics while the remaining 68.5% unexplained variation due to other variables that can account for academic performance in Mathematics .

The regression result in the table above reveals that, the most important predictor variable that contributed to the academic performance of students in Mathematics is class size (β = 0.362) this was closely followed by laboratory adequacy (β = 0.212), and school environment (β = 0.112) while the least contribution is students' behaviour (β = 0.072). The calculated F-ratio (10.312) was significant at 0.05 level of significance. This means that, the predictor variables jointly provide a significant explanation for the variation in academic performance of students in Mathematics in Ondo State.

Hypothesis 2: Teachers quality will not significantly influence academic performance of students' in Mathematics.

Table 2: ANOVA showing influence of teachers' quality and performance of students' in Mathematics.

Source	**SS**	**df**	**MS**	**F**	**P**
Between group	12.280	4	3.070	6.850	0.054
Within group	87.400	195	0.484		
Total	99.680	199			

p>0.05

Table 2 shows that ($F_{4, 195}$, p>0.05). The null hypothesis is not rejected. This implies that, teachers' quality will not significantly influence academic performance of students' in Mathematics across the selected schools.

Discussion

The results also showed that, there was a significant positive multiple correlations between school variables (class size, students' behavior, school environment and laboratory adequacy) and academic performance of students' in Mathematics. This implies that, the variables

jointly provide a significant explanation for the variation in students' academic performance in Mathematics. In terms of magnitude of the weight of regression coefficient, class size had the highest contribution to students' academic performance in Mathematics. This implies that, the less the class size, the better the academic performance of students. This findings was in agreement with the findings of Adeyemi (2008) who asserted that, students in smaller classes tend to receive adequate attention from the teacher and have better access to the facilities and equipment and therefore able to learn and perform better than the students in larger classes. It is also in line with the findings of Egede (2005) who pointed out that, an alarming class size of 100 or more students in the secondary school leave the teacher overworked and therefore unable to exercise patience and positive attitude.

The finding revealed that, laboratory adequacy also affects the performances of students in Mathematics. This corroborates the findings of Adeyegbe (2005) that laboratory adequacy affect the performance in Chemistry. It also supports the findings of Mamlock-Naaman (2011) that laboratory contributed in no small measure to the academic achievement of students. School environment also has effect on the performance of students in Mathematics. This conforms to the findings of Onukwo (2004) who concluded that, a conducive environment enhances a child's growth and development. Students feel happy in a peaceful and friendly environment, where schools located in a noisy urban street are associated with deficits in students' mental concentration, leading to their poor academic performance in Mathematics.

The study revealed that, students' behaviour has effect on their performance in Mathematics; the findings revealed that, some of the students see Mathematics as very difficult, abstract and complex subject and these influence their performance towards the subject and eventually affects their performance in the subject. This corroborates the findings of Eshun (2004) who found that, emotional dispositions have an impact on an individual's behaviour, as one is likely to achieve better in a subject that one enjoys. The finding, however, contradicts that of Nasser and Birenbaum (2004) that students' behaviour had minor and insignificant effects on Mathematics achievement.

The finding of the study revealed that, teachers' quality has no significant influence on academic performance of students in Mathematics across the selected schools. The result negates the study of Obemeata (1995) who argued that, the quality of teachers is an important input in effective learning and that such high quality outputs expected from students require the input of high quality from the curriculum implementation.

Conclusion

From the findings of this study, it is concluded that four out of five variables could predict the dependent variable. For student's academic performance, school environment, class size, laboratory adequacy and students attitude were predictors as they have significant effects on the academic performance of Mathematics students especially at secondary school level. Quality of teachers was found to have no significant effect on students' performance in Mathematics. This finding was a true reflection of student's perception on the effects of the identified variables on the performance in Mathematics.

Recommendations

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

1. Teachers should make use of available resources in the school for effective teaching and learning of Mathematics.
2. Teachers should endeavour to help the students improve their behaviour towards Mathematics so as to enhance better performance in the subject.
3. Government should attempt to encourage and improve the attitude of students to academic work by providing laboratories so that the learning experiences of the students can become more meaningful and the same time interesting.
4. Government should build more classrooms and make sure adequate provisions for seats especially in urban schools to ease the problems of overcrowded classrooms and poor sitting arrangement that presently make learning difficult in public schools.

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ANALYSIS OF SECONDARY SCHOOL CERTIFICATE CHEMISTRY EXAMINATION QUESTIONS CONDUCTED BY NATIONAL BUSINESS AND TECHNICAL EXAMINATIONS BOARD (NABTEB) FOR COGNITIVE COMPLEXITY

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Abstract

Current trends in educational reform laid emphasis on assessing higher order cognitive skills in educational assessment. This study analyzed the cognitive complexity of Chemistry examination questions conducted by NABTEB from 2012 to 2017. The study adopted the content analysis method in which a total of 285 Chemistry questions were analyzed using the revised Bloom's taxonomy. Findings from the study revealed that majority of the questions required students to operate in the lower order cognitive process skills of "remember", "understand", and "apply" while, few of them assessed students in the analyze category. The study therefore concluded that Chemistry examination questions conducted by NABTEB assessed students in the LOCS with very few questions in the "apply" category. It was recommended among others that examination bodies should ensure that questions are distributed across all levels of cognitive domains since most teachers and students rely on these questions for practice.

Keywords: Assessment, Examination, Complexity, Taxonomy.

Introduction

Assessment in education is closely connected to curriculum and instructions. It is described as the bridge between the teaching and learning process. It gives insight to whether instructional activities results to the objectives of teaching (Wiliam, 2013). It serves as a means to provide feedback to teachers and students regarding the progress of their teaching and learning activities. Therefore, it can be regarded as an educational tool that is used to measure teaching and learning effectiveness.

Assessment could be formative or summative (Garrison & Ehringhaus, 2010). Formative assessment provides timely information regarding the teaching and learning processes while instruction is ongoing. However, the summative assessments are periodical assessment given to learners at the end of a course. They are associated with standardized test such as West Africa Senior School Certificate Examinations (WASSCE), Senior School Certificate Examinations (SSCE) and National Business and Technical Examinations Board (NABTEB) examinations. They are also used as part of classroom management in grading processes and used to identify effectiveness of educational programmes.

Senior Secondary Certificate Examinations in Nigeria

Standardized examinations are conducted after completion of a three year secondary school education in Nigeria. The examination bodies saddled with the responsibility of conducting such examinations include the West African Examinations Council (WAEC), National Examinations Council (NECO) and National Board for Technical Education Board (NABTEB). The results of these assessments with a combination of the Unified Tertiary Matriculation Examinations (UTME) are prerequisite to securing admission into any tertiary institution in Nigeria. The WAEC and NECO conduct two series of examinations in a year namely; the West African Secondary School Examination (WASSCE) and Secondary School Certificate Examinations (SSCE) which are conducted in May/ June and November/ December respectively. The May/ June examination is conducted for students who had just completed their secondary school

education while the November/ December are for private candidates.

The WASSCE examination has been autonomous in Nigeria before the establishment of NABTEB in 1992 and NECO in 1999. The establishment of NECO and NABTEB becomes imperative to reduce the work load of WAEC. The NABTEB was established to oversee the craft level examinations which were conducted by City and Guilds, Pittman's and Royal Society of Arts in UK. The NABTEB conducts examination such as National Business Certificate (NBC), National Technical Certificate (NTC), as well as advanced level examinations of NBC and NTC, and Modular Trade Certificate (MTC) Examinations. Owing to the mission of the board to be a globally acknowledge body for craft men and technicians aimed at preparing candidates for the world of work, it is important that the board conducts examinations that adopts the current reforms in educational assessment. This current reform emphasizes on the need to assess students in higher order cognitive skills and metacognitive knowledge. This study therefore is concerned with cognitive complexities of chemistry questions conducted by the National Business and Technical Examinations Board in Nigeria.

Overview of the Revised Bloom's Taxonomy

Bloom's taxonomy is a framework for classifying the intents of teaching and learning. It is a means of facilitating the exchange of test items to create banks of items measuring the same behavioural objectives (Krathwohl, 2002). The taxonomy was originally initiated by Benjamin Bloom and it consists of six categories which are knowledge, comprehension, application, analysis, synthesis and evaluation. These categories are arranged in their order of complexities (simple to complex; concrete to abstract). The Bloom's taxonomy is used to classify curricular objectives and test items to show their intensity across the spectrum of categories. This original taxonomy encapsulates the noun phrase (subject matter) and the verb phrase (what will be done to the subject matter) recognizing one dimension.

Anderson and Krathwohl (2002) revised the original taxonomy and identified the cognitive process dimension and the knowledge dimension. The knowledge dimension in the revised taxonomy emphasized what the subject matter assesses. It contains four subcategories in order of abstractness. It includes; factual, conceptual, procedural and metacognitive knowledge respectively. The factual knowledge is the least abstractive while the metagcognitive knowledge is most on the taxonomy table. The factual knowledge deals with the knowledge of terminologies, specific details and elements that students should be acquainted with in a discipline. The conceptual knowledge includes knowledge of classification and categories, principles, themes e.t.c while the procedural knowledge includes knowledge of specific skills, techniques, methods and criteria to use appropriate procedures in a given instance. The metacognitive knowledge deals with the knowledge of one's cognition. It includes; strategic knowledge, knowledge about cognitive tasks and self-knowledge (Krathwohl, 2002).

The cognitive process dimension retains the original Bloom's taxonomy with some modifications. The subcategories of knowledge, comprehension and synthesis were renamed as remember, understand and create respectively while application, analysis and evaluation were retained as apply, analyze and evaluate respectively. Hence, categories of the cognitive process dimension in the order of simple to complex include; remember, understand, apply, analyze, evaluate and create. The "remember" subcategory involves retrieving of relevant knowledge from the long term memory. It includes, recognizing and recalling. In the "understand" category, it involves deducing meaning from instruction while, "apply" subcategory demands that students carry out or use a procedure in a given situation. The "analyze" category involves the ability of learners to differentiate, organize and attribute in a specific instance while "evaluate" involves checking and critiquing to make judgment. To create is the most complex of this subcategory and it includes, generating, planning and producing new products. It involves learners' ability to put elements together to form a whole (Krathwohl, 2002).

Research Questions

The following questions have been formulated to guide the study:

i. What cognitive process skills are represented in the Chemistry examination questions constructed by the National Business and Technical Examinations Board?

ii. Are all categories of cognitive process skills represented in the Chemistry examination questions by National Business and Technical Examinations Board?

iii. Are all categories knowledge components featured in the Chemistry examination questions constructed by National Business and Technical Examinations Board?

iv. What percentage of knowledge components is measured in Chemistry examination questions constructed by National Business and Technical Examinations Board?

Review of Related Literature

Several studies have been conducted to assess the cognitive complexities of test items in standardized examinations (Okanlawon, 2016; Okoye & Nwafor, 2009; Upahi, Isreal & Olorundare, 2016; Dempster, 2012; Tikkanen & Aksela, 2012). Dempster (2012) investigated exit-level biology examinations in four countries; Ghana, Kenya, Zambia and South Africa. The study assessed the cognitive demand of the test items using the revised Bloom's taxonomy. Findings from the study revealed that a high percentage of the questions measured remember and factual knowledge and none of the questions measured metacognitive knowledge. This finding was similar to the findings of Okanlawon (2007); Okoye and Nwafor (2009) that compared the cognitive complexity of SSCE and WASSCE chemistry examinations. Okanlawon (2016) utilized the revised Bloom's taxonomy by Anderson and Krathwhol (2002) while Okoye and Nwafor (2009) utilized the original Bloom's taxonomy when they compared SSCE essay questions set by WAEC and NECO in Biology, Chemistry and Physics between years 2004 to 2007.

The findings of a more recent study by Upahi, Isreal and Olorundare (2016) on analysis of WASSCE chemistry examination using the framework of the revised Bloom's taxonomy revealed that 80% of the test items require students to operate on the lower order cognitive domain while 49.4% and 19.5% measured the conceptual and procedural knowledge respectively. This finding is contrary to the findings of Tikkanen and Aksela (2012) that analyzed Finnish chemistry matriculation examination questions who reported that 77% of the examination questions required learners to operate in higher order cognitive skills. Also, 79% of the questions assessed procedural knowledge but none of the question assessed metacognitive knowledge.

It is therefore evident from literature that chemistry examination questions conducted in Nigeria have focused its attention on measuring the lower order cognitive skills of learners without emphasis on their metacognitive knowledge. Hence, it is expected that examination bodies like the NABTEB that deals with technical and craft level examinations will differ from others, owing to their mandate. Therefore this study sets out to analyze the cognitive complexity of the board's chemistry examination questions.

Methodology

The study utilized the content analysis method. Purposive sampling technique was used to select May/June National Business and Technical Certificate Examinations questions in Chemistry conducted between the periods of 2012 to 2017. Specifically, the section B of Paper code; 005-1 Chemistry questions for the selected years were analyzed. The questions were designed such that each of them has a sub unit. However, in this study, each of the sub units was recognized as independent questions for ease of analysis. The sample for this study consisted of two hundred and eighty five (285) chemistry questions of the senior school certificate examination for the period of five years. The revised Bloom's taxonomy by Anderson and Krathwohl (2001) was used to categorize the questions into their cognitive complexities. Questions in "remember", "understand" and "apply" are categorized as lower order cognitive skills (LOCS) while the questions in "analyze", "evaluate" and "create" are categorized as higher order cognitive skills (HOCS).

To ensure validity of the items, an inter rater reliability was conducted by randomly selecting 20% of the items for two raters that have an understanding of the revised Bloom's taxonomy. The reliability was calculated using Cohen Kappa statistics. k-values of 0.71 and 0.62 were obtained for the knowledge and cognitive process dimension respectively which signifies a substantial agreement between the two raters.

Data Analysis and Results

Research Question 1: What cognitive process skills are represented in the Chemistry examination questions constructed by the National Business and Technical Examinations Board?

Table 3 presents the distribution of the 285 chemistry questions according to the years of the examinations and the cognitive process skills such examination questions were designed to measure. Only 12.7% of the chemistry questions were at the higher levels of the cognitive domain (analyze and evaluate) while none of the test items measures "create" category. On the other hand, 87.3% of the questions were at the lower levels of the cognitive domain (25.6%, 36.5% and 22.3%) of the questions as they require students to "remember", "understand" and "apply" respectively.

Table 3: Distribution of Chemistry examination questions constructed by NABTEB according to year and the cognitive process dimension

Year	Remember		Understand		Apply		Analyze		Evaluate		Create		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
2012	8	23.5	12	35.3	8	23.5	6	17.6	0	-	0	-	34	11.9
2013	10	28.6	15	42.9	4	11.4	6	17.1	0	-	0	-	35	12.3
2014	17	34.0	14	28.0	8	16.0	11	22.0	0	-	0	-	50	17.5
2015	8	15.0	22	41.5	16	30.2	7	13.2	0	-	0	-	53	18.6
2016	11	28.2	14	35.9	11	28.2	3	7.7	0	-	0	-	39	13.7
2017	29	39.1	33	44.6	9	12.2	2	2.7	1	1.4	0	-	74	26.0
Total	**83**	**29.1**	**110**	**38.6**	**56**	**19.6**	**35**	**12.3**	**1**	**0.4**	**0**	-	**285**	**100**

Research Question 2: Are all categories of cognitive process skills represented in the Chemistry examination questions by National Business and Technical Examinations Board?

Table 4 presents the distribution of the number of questions that assess the students' Lower Order Cognitive Skills (LOCS) and Higher Order Cognitive Skills (HOCS). The percentages of questions that assess students' in HOCS are represented in the "analyze" and "evaluate" category only. This category (HOCS) recorded the highest percentage in 2014 showing 22% of the questions in the "analyze" level while the lowest was recorded in 2017 with 4.1%. However, none of the questions assessed the HOCS in "create" level. In the LOCS category featuring "remember", "understand" and "apply" level, the highest percentage of questions was recorded for 2017 (95.9%) while the lowest was recorded in 2014 (78.0%).

Table 4: Distribution of the number of questions that assess the students' LOCS and HOCS

Years	LOCS		HOCS		Total	
	Freq	%	Freq	%	Freq	%
2012	28	82.4	6	17.6	34	11.9
2013	29	82.9	6	17.1	35	12.3
2014	39	78.0	11	22	50	17.5
2015	46	86.8	7	13.2	53	18.6
2016	36	92.3	3	7.7	39	13.7
2017	71	95.9	3	4.1	74	26.0
Total	**249**	**87.4**	**36**	**12.6**	**285**	**100**

Research Question 3: Are all categories knowledge components featured in the Chemistry examination questions constructed by National Business and Technical Examinations Board?

Table 5 presents the distribution of the questions based on the knowledge dimension. The questions under the year of study featured the factual, conceptual and procedural knowledge. However, none of the questions assess the students' metacognitive knowledge about chemistry.

Table 5: Distribution of Chemistry examination questions according to year and the knowledge dimension

Year	Factual		Conceptual		Procedural		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
2012	8	23.5	15	44.1	11	32.4	34	11.9
2013	7	20	17	48.6	11	31.1	35	12.3
2014	14	28	21	42	15	30	50	17.5
2015	6	11.3	30	56.6	17	33.1	53	18.6
2016	10	25.7	19	48.7	10	25.6	39	13.7
2017	26	35.1	30	40.1	18	24.3	74	26.0
Total	**71**	**24.9**	**132**	**46.3**	**82**	**28.8**	**285**	***100***

Research Question 4: What percentage of knowledge components is measured in Chemistry examination questions constructed by National Business and Technical Examinations Board?

Table 5 shows the distribution of the questions based on the years of examination and the knowledge dimension assessed by the questions. It revealed that 24.9%, 46.3% and 28.8% of the examination questions assessed the factual, conceptual and procedural knowledge respectively. However, metacognitive category of knowledge dimension was not featured in the questions across the years.

Discussion

Findings on the cognitive process skills measured by these examination questions revealed that few (12.6%) of the chemistry questions assessed the higher order cognitive skills. This implies that a large number (87.4%) of chemistry questions requires learner to operate at the lower level of cognitive process skill. This could be attributed to the fact that, not so much emphases is placed on the development of students' HOCS during teaching; hence students are not assessed based on these skills. This finding is contrary the findings of Tikkanen and Aksela (2012) who reported that majority of the Chemistry examination questions required higher order cognitive skills in university entrance and matriculation examination questions. On the other hand, the findings are similar to the findings of Upahi, Isreal and Olorundare (2016) and Okanlawon (2016), that reported that the cognitive levels of understand and apply were over-represented in chemistry examinations.

The findings on the subcategories of the knowledge dimension measured by the Chemistry questions revealed that 24.9% of the examination questions measured factual knowledge, 46.3% of the examination questions measured conceptual knowledge, while 28.8% measured procedural knowledge of algorithms and experimental procedures. These findings contradicts the findings of Tikkanen & Aksela (2012) that reported a high proportion of questions that measured procedural knowledge in chemistry examination. However, similar proportion of examination questions that measured conceptual and metacognitive knowledge was reported. The poor representation of metacognitive knowledge in the questions could be because assessing students' metacognitive knowledge could be a tedious task in a summative assessment like the National Business and Technical Examination Board (NABTEB) Examination.

Conclusion

The study therefore concluded that majority of the chemistry examination questions do not seek to assess students' higher order cognitive skills (HOCS) and none of the questions assessed the metacognitive knowledge of the students. The uneven distribution of the chemistry examination

questions observed in this study could possibly impact on curriculum and instruction. This is because of the likely event that students and teachers will rely on such questions for practice and assessment.

Recommendations

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

(i) Examination bodies should ensure that examination questions are evenly distributed among the categories of the cognitive process skills and the knowledge dimension; as such, students should be presented with questions that assess higher order cognitive skills;

(ii) Chemistry teachers should teach and prepare their classroom examination questions using the framework of the revised Bloom's taxonomy.

(iii) Teacher education programmes in Nigerian universities should provide adequate theoretical and practical training to prospective teachers on assisting learners to operate at various levels of cognition.

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MOBILE PHONE AS A COST-EFFECTIVE OPTION FOR M-LEARNING IN TERTIARY EDUCATION IN NIGERIA: PROSPECTS AND PROBLEMS

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Abstract

One major tertiary education objective is to educate its students to become flexible graduates, excellence-driven, global in perspective, innovative, creative and life-long learners that can easily adapt to the changes eminent in the information society. Achieving these requires among other factors, the adoption of appropriate and cost-effective means which supports the inculcation of collaborative and lifelong learning skills, technology use skills, knowledge sharing skills and social networking skills into students. Therefore, this paper looks at the prospects of adopting mobile phone as a cost-effective M-Learning in Nigeria tertiary education. It looks at the concept of M-Learning, as well as the problems in form of challenges associated with the use of mobile phone for M-Learning in tertiary education in Nigeria. The paper recommended that institutions should create awareness for the learners to make use of mobile phone facilities and functionalities.

Keywords: *M-Learning, Tertiary Education, Mobile Phones*

Introduction

The proliferation of Information and Communication Technologies (ICTs) and the increase in the quest for their use in educational institutions have not only affected the structure of tertiary education but has also affected the way teaching and learning is done in these institutions. Over the years, several efforts have been made to improve the quality of education instruction delivery through electronic media. The traditional method had always been complemented with the use of projectors, audio, and video cassettes. Recently, special attention has been directed to the influence of Information and communication technology (ICT) on instructional content design and delivery.

The emergence of internet technology as a means of information creation, manipulation and dissemination has also heralded new approaches to instructional delivery and content design where methods of communication to the learners are achieved through various means. Many aspects of the learning process, from the presentation of information to assessment of learning outcomes and performance, can now be supported using widely accessible information and communication technologies. Unlike classroom based learning, or traditional Computer-Based Training (CBT), which require groups of learners attending a central training location, the Internet allows the delivery of instructions anytime, and in any place (Walters, 1999). The benefits from Internet-based are typically seen in relation to cost saving and improved training efficiency. It offers flexibility and considerable improvement on learning process by allowing learners to access instructional contents on demand.

Towards this vision, tertiary education is committed to the appropriate, effective and sustainable use of ICTs to broaden access to and improve the quality and efficiency of tertiary education service delivery. It evolves and nurtures an information and communication technology framework designed to enhance, broaden, strengthen and transform learning to develop the learner into a person who is excellence-driven, global in perspective, innovative, ingenious and creative, with a deep sense of community and concern harmony and the common good (Brewster, 2001). The quality of and access to

tertiary education substantially remains the overriding goal of educational development. Thus, all educational interventions are been geared towards ensuring the empowerment of learners with life-long skills through the use of appropriate technologies. Hence the need for a cost-effective option for m-learning for Nigerian tertiary institutions.

The Concept and Meaning of M-Learning

In the traditional classroom environment, learning is static and fixed and learners have to go to a site of learning such as school or college at specific times. In addition, learning is also, most of the times, teacher-centred with lack of instructional facilities and heavy reliance on the textbooks as the exclusive teaching and learning materials. However with M-Learning, learning can take place anytime and anywhere. Brown (2003) opines that M-Learning is a sub-set of e-learning, the macro concept that includes online and M-Learning environments.

Wikipedia (2009) defines M-Learning as any sort of learning that happens when the learner is not at a fixed, predetermined location; or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies. And that M-Learning focuses on the learner interacting with portable technologies such as handheld computers, Mp3 players, note books, and mobile phones. M-Learning technologies have ceased to be the preserve of technicians and experts, as teachers and learners have begun to integrate them into the normal teaching and learning practices. M-Learning is often blended with other types of learning, as a mobile device could act as a tool for thinking. For instance, when learners know that everything they say is being recorded or is easy to record, their behaviour would change positively.

Alexander (2004) describes M-Learning as a form of learning that has established the legitimacy of nomadic learning. This is because, like the nomads, learning moves with the learner. M-learning is convenient, in that, it is accessible anytime, anywhere and like other forms of E-learning, it is collaborative and instant feedback and tips can be received by the learners. It is also engaging. It brings new technology into the classroom and uses different types of activities. In other words, it uses a blended learning approach. It can also be a useful add-on tool for students with special needs, for instance, the deaf. Attewell (2005) reiterates that M-learning is not just about learning using portable devices, but learning across contexts. In M-Learning (ML), education is delivered by means which enable the students to communicate free of classroom pressure and to help teachers in remote locations or working across a range of schools. It is learning that reflects a focus on how society and its institutions can accommodate and support an increasingly mobile population (Network Tutorials, 2007).

Sharples (2009) opines that M-learning gives the opportunity to design learning differently, to create extended learning differently, to create extended learning communities, to provide expertise on demand, and to support a lifetime of learning. According to Chinnery (2006), M-Learning environments might be face-to face, distance, online, self-spaced, or calendar-based. It is also a great way to achieve personalized learning because students can, choose what, and how they learn, when and where.

However, Brown (2003) opines that, the strength of M-learning should be on communicative and interactive rather than on content and that M-learning should be a supportive mode of education and not a primary mode of education. Also that, possibilities and latest development in mobile technology must be tested against practicality, usability, and cost-effectiveness. Mobile technologies should offer endless opportunities for empowering individuals and communities through access to knowledge, means of expression and coordinated action.

Wikipedia (2010) observes that M-Learning currently serves not only as a primary source of education for students but also supports the retention and utilization of newly acquired skills. And that through mobile participation in short exercises and tasks, learners are able to keep their talents sharp while reducing the risk of degradation of value, skills, and ability. Attewell (2005) writes that M-Learning is unique, in that, it does not only allow anywhere, anytime and personalized learning but also enliven the learners by adding variety in conventional lessons or courses. Also that M-Learning helps to remove some of the formality from the learning experience and engages reluctant students.

Kukulska-Hulme (2006) opines that M-learning helps to deliver closer integration of learning with everyday communication needs and cultural experiences. It empowers learners to give them a greater say in their learning experience with a view to increase their motivation.

The purpose of M-Learning is to make computers really enter human lives, just as air, water and electronic and easy to use just as our pen or paper. This thought has been widely accepted and catching many people's eyes since the late 1990s. M-Learning is a new paradigm shift. The core idea of M-Learning is to change past technology centered computing made to humanize computing paradigm. In this kind of computer paradigm, computer itself will disappear from the sights of use, take an inconspicuous supporting roles imperceptibly embedded in our environment, which will at last make human focus on the task to complete not on the machine.

Properties and Characteristics of M-Learning

M-Learning is effectively a sub-category of the lager concept of e-learning. According to Quinn (2000), M-Learning is the intersection of mobile computing and e-learning, accessible resources wherever you are, strong search capabilities, rich interaction, powerful support for effective learning, and performance based assessment e-learning in dependent of location in time and space.

Klopfer et al (2002) gives five properties of mobile devices which can produce educational benefits. These are: Portability, Social Interactivity, Context sensitivity, Connectivity and Individuality

Other characteristics of M-Learning include:

a. Accessibility: Learners have access to their documents, data or videos from anywhere. The information is provided based on their request. Therefore, learning involved is self-directed.

b. Interactivity: Learners can interact with experts, teachers or peers in the form of synchronous or asynchronous communication. Hence the experts are more reachable and the knowledge is more available.

c. Situating of Instructional Activities: The learning could be embedded in and out of daily life. The problem encountered as well as the knowledge required are all presented in their natural and authentic forms. It helps learners to notice the features of problems situations that make particular actions relevant.

d. Adaptability: Learners can get the right information at the right place in the right way.

e. Immediacy: Wherever learners are, they can get any information immediately. Therefore learners can solve problems quickly. Otherwise, the learner may record the questions and look for answers later.

f. Permanency: Learners can never lose their work unless it is purposefully deleted. In addition, all learning processes are recorded continually every day.

The Prospects of Mobile Phone as Cost-Effective Option for M-Learning

Out of all the mobile computing systems, mobile phone has been widely accepted as an instructional delivery medium or device and its use should be continually encouraged because of the following considerations:

a. Price: The cost of obtaining a mobile phone is declining. In the early 90s when mobile phone was introduced, it was very expensive and considered a luxury. Today, the emergence of the Asian countries in the business of mobile phone manufacturing has brought the prices down to an affordable level.

b. Increased Ownership: Few years back, mobile phone is owned only by the rich and the elites and used only when it is absolutely necessary. Today, mobile phone has become an essential commodity among the rich, elites, maids, school children, artisans, market women and even beggars on the-street. The ownership structure had been expanded such that mobile phone now becomes an indispensable tool both for the rich and the poor.

c. Improved MobileTechnology: There has been tremendous improvement in mobile technology. Mobile phones now come with improved and sophisticated functionalities. The emergence of large scale integration of miniaturized chips has also reduced the size of mobile phones. The situation now is the smaller the device, the higher the functionalities, the lower the cost, and the more durable. Mobile phones now come with enriched web functionalities that qualify them for use as m-learning tools.

d. Low Maintenance Cost: The call rates of mobile phones are declining while the volumes of data that can be transferred through mobile phones continue to increase at lower costs. The transfer rates of data had also improved tremendously. The cost of repairing mobile phone is very low while the mean time between repairs has come down tremendously.

e. Extensive Training Not Required: One aspect of mobile phones is that the user does not need any extensive training to be able to use it as a basic tool. The device applications are user friendly and can come with local languages. A complete illiterate can use it almost immediately after acquiring it. This makes it a useful tool for delivery of instructional content.

f. Video and Audio Functionalities: Visual content can be delivered conveniently while audio functionality is readily embedded in any mobile phone. The quality of broadcasting video and audio content had continued to improve and can be received anywhere and anytime.

g. Proliferation of Platforms: Even though mobile phones are produced by different manufacturers, the content delivered to anyone can be exchanged. The content delivered to any mobile phone can also be ported to any device on any platform irrespective of the maker without distortion or manipulation.

h. Convenient Feedback: Mobile phone can be used as a synchronous device because the instructor can respond to learner's requests immediately. It can also be used as asynchronous device where instructor's response to learner's requests are delayed and acted upon at a convenient time.

i. Increased Awareness: The awareness of mobile phone as a cheaper medium of exchange of data and voice had continued to build up. The service providers are helping out in the crusade and they seize every opportunity to dash out data and voice bundles to deserving customers. The manufacturers of mobile phones are not left out of the awareness crusade as they also dash out the equipment to customers during business promotions.

j. Mobile Number Portability: This gives opportunity for mobile subscribers to switch from non-performing service provider to a preferred provider without the loss of their mobile number.

Dawson, (2007) noted that many mobile phones are cheaper to purchase than desktop computers and laptops, and that introducing the mobile phone as a low-cost teaching and learning tool is quite possible. He also stated that mobile devices require less technical support than computers and laptops. When considering the adult learners, the mobile phones allow the learner to learn autonomously, collaboratively and provide opportunities to conduct learning experiences outside the teacher-managed classroom by expanding learning beyond the four walls of the classroom and thus allowing interactions in the real world including new interactions to be brought into the classroom.

Another relevance of the mobile phone is its image capture function allowing teachers and students to bring the outside world into the classroom (Ekamuake & Wishart, 2010). The mobile phones' video camera helped student to capture an event of interest that could be otherwise be missed. Mobile phone can be used to connect the lesson content to students' prior knowledge and correct misconceptions during the classroom. A sensor system for environmental education was developed using mobile phones as a means of enhancing learner participation and motivation. A participatory design approach was used to develop the sensor system. This enables

the learners to collect a range of sensor data using probes and mobile phones. Also, mobile phone video and image capture can be used to produce a snapshot of the conditions they had experienced. On their retain to the classroom, the data were downloaded onto a personal computer.

Challenges or Limitations of Mobile Phones for M-Learning

M-Learning generally is not faultless. Wang and Higgins (2005) opine that M-Learning has technical, psychological, as well as pedagogical limitations. They argue that, if one is to go by the definition of M-learning as anywhere, anytime learning, by people in air planes, trains, buses or in their rooms, for example, there will be psychological limitation. They argue that students or company staff who have worked so much would want to relax while on journey back home or in their rooms instead of learning. Moreover, learning needs effort and brainwork. Wang et al (2005) also add that, consideration of the environment in which learning takes place is paramount. According to them, if learners feel that the mobile environment is not conducive to learning, it can have a detrimental effect on the way activities are undertaken.

On pedagogical limitation, Wang et al (2005) opine that because M-learning theoretically takes place anywhere, anytime, it is hard to follow- up on the learning achievements of those attempting it. They also argue that m- learning, individuals take full responsibility of their own learning whereas, most organizations or individuals like to keep track of who is doing what to whom and when, using some form of learning management systems. They add that in m-learning courses, it is hard to administer supervision, and course organizers have no reason to trust that the answers sent from a mobile phone, for example, are being sent personally by the actual registered mobile phone holder and m-learner. Rovai (2002) also says that studies and statistics show that between 20% -30% of those who begin distance learning (e-learning or m-learning) courses do not finish. According to him, in an m-learning environment, the lack of a firm framework tends to encourage laziness and absence to a learning atmosphere.

On technical limitation, Koole (2009) in her Framework for Rational Analysis of Mobile Education (FRAME) proposes that M-learning occurs in an intersection of device, learner, and social aspects. As a result, it is important to assess characteristics such as the physical characteristics (size and weight), input capabilities (e.g. Keypad or touch pad), output capabilities (e.g. Screen size and audio functions), file storage and retrieval, processor speed, and the error rates, i.e.; malfunctions which result from flaws in hardware, software and/or inter face design. In addition, she proposes that learners' skills also play a central role and prior knowledge and experience with mobile devices for learning as well as feelings towards activities can positively or negatively affect the way in which learners engage themselves with mobile-based tasks. Furthermore, their availability can be limited. Other drawbacks of M-learning include limited non-verbal communication, limited message lengths, lack of cultural context and potentially limited social interaction. Kulkuska-Hulune (2006) also argues that many of the mobile devices that learners have access to are simply not designed for educational purposes, which means that learners will find them difficult to use for the activities that teachers expect them to undertake.

As cost-effective as mobile phones are, they are not without their own problems. Adomi (2006) carried out research on mobile phone usage patterns of library and communication science students at Delta State Tertiary, Abraka, Nigeria. He enumerated some of shortcomings of mobile phones usage as follows:

i. Frequent network failure.
ii. High cost of recharge cards/airtime.
iii. Limited area of coverage.
iv. Occasional scarcity of recharge cards.
v. Power outage.
vi. Lack of privacy in mobile shops/ booths/kiosks.
vii. Interconnectivity problem.
viii. Delay in delivery of text messages.
ix. Congestion in mobile phone shops/booths/kiosks.
x. Handset interception through duplication of SIM cards.
xi. Low memory capacity and
xii. Low data transfer rate.

Conclusion

ICT integration into education has presented avenues to increase learning opportunities and improve teaching and learning processes. However, today's learners want to receive instructional contents at any place, anytime, and at a relatively lower cost. Advancement in technology has made mobile telephony a relatively cheaper option and efforts should be made to encourage the use of mobile phones for the delivery of instructional content in tertiary institutions.

Mobile phones are no longer simple phones, they are powerful and efficient tools for mobile communication and achieving tertiary goals education. 3G enables institutions and their government council to transcend the social and education challenges they face today or may face tomorrow. More so, there is a growing importance of the role of 3G technology, not only as a medium of communication, but also as a tool for the achievement of tertiary development objectives.

Mobile phones represent new and fast growing development in ICTs innovations. Their adoption for teaching and learning that have been adjudged information society compliant has also been growing. The prospects revealed in this paper is that mobile phones posses the potential to become very reliable instructional technology that can be used by teachers and students to achieve feats that have been hampered by technology divide. The fact that mobile phones can be taken to any location where teaching and learning are taking place and still receive Internet signals makes them unique. However, much is still left to be done in terms of harnessing them for education purposes and this may need the collaboration of various stakeholders.

Recommendations

Effective adoption and utilization of mobile phones as a cost-effective option for M-Learning largely depend on the stakeholders of tertiary education. Therefore, I recommend that:

1. Mobile learning as a new way of obtaining learning experiences anywhere and anytime should be embraced by every learner on the move.
2. Every tertiary institution trainer or instructor should be encouraged to package learning experiences in handy formats so that they can be presented to the learners on any mobile computing system.
3. Institutions should embrace mobile learning and evolve policies that will entrench it in their curricula. They should also create awareness for the learners to make use of mobile facilities and functionalities as learning alternative.
4. Institutions should partner with mobile phone service providers to provide m-learning support in their mobile software applications.
5. The service providers should decrease the network congestion and inter-connectivity bottleneck.
6. Maintaining favourable regulatory and investment climate should not be ignored.
7. The government should improve on supporting infrastructure, such as power and transmission facilities.

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IMPROVING STUDENTS ACHIEVEMENT IN SPEED AND ACCURACY BY ADOPTING A BLENDED LEARNING APPROACH

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Abstract

This study investigated the effects of Blended learning approach that is a combination of Computer-Assisted Instruction (CAI) and traditional face to face method, and Demonstration Method on achievement of National Diploma students in Speed and accuracy in Office Technology Management departments in Edo and Delta States Polytechnics. The study adopted quasi experimental research design. The population of the study consisted of 1,721 students of National Diploma students of government owned polytechnics for the 2013/2014 academic session. A sample of 240 students was purposively drawn from three polytechnics. The instrument used for this study was the National Diploma Speed and Accuracy Test (NDSPAT) designed by the researcher to test learners' achievement in Speed and Accuracy, using blended learning approach and a traditional method. Data collected were analyzed using descriptive and inferential statistics. Questions one was analyzed using mean, and bar charts for descriptive statistics, while, ANCOVA was used to analysis question 2 at 0.05 level of significance. Descriptive analysis showed that the three groups were homogenous before treatment, effect of treatment was felt as students taught with blended approach performed better in Speed and Accuracy than those taught with the conventional method of Demonstration. Based on the results of this study, it was recommended that. Lecturers should use blended approach to teach Speed and Accuracy as it has been found to be of great benefit to students at the beginning stage of keyboarding in Office technology and Management departments in Polytechnics.

Introduction

Blended learning refers to the combination of two or more instructional methods or media in teaching and learning activities. Blended learning has been seen, as the combination of face-to-face (traditional classroom learning) and technology-based learning (Stubbs, Martin, & Endlar, 2006). It is a flexible form of learning that constitute a mixed of technologically enabled learning with face to face teaching and interactions by the teacher and the students. It can also be viewed as, blending of different instructional media, blending of different instructional strategies; and blending of different instructional environments (Rooney, 2003; He & Chen, 2008). Tsou (2009) posited that blended learning comprises of at least, the combination of four different methodologies:

a. The blending of different learning contents and the addition of technology-based-learning, such as e-learning or the virtual classroom.

b. The combination of different instructional methods (behaviorist, cognitivist, and constructivist).

c. The blending of different types of instructional technologies (face-to-face, Internet, and CD-ROM).

d. The integration of instructional technology with practical instructional activities.

The major reason for adopting a blended learning approach is to improve pedagogy. The beauty of blended learning is that it combines the advantage of face-to-face teaching (social interaction and inspiration) and on-line instruction (flexibility of access) (Williams, Bland, & Christie, 2008). The term blending was first applied to distance

education and it was referred to as "hybrid," which was developed by the combination of e-learning with traditional learning methods. It is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. Sormunen, (1993) posited that learning technology alone does not necessarily advance learning, well-integrated learning technologies and practices often do. With learning principles and practices in mind, technology is used to service learning. This new approach is learner centered; the learner is no longer treated as an empty vessel, but is credited with knowledge, skills and attitudes from the day he came to life, which requires development, through guidance, encouragement and motivation.

Computer-Assisted Instruction is an instructional design in which, a computer system delivers instructions directly to learners by allowing them to interact with designed lessons that have been programmed into the system, (Kulik, 1980). If the learner is wrong, he/she is told why and is directed to review another frame. Drill and practice has been associated with Computer Assisted Instruction used in education. Drill and practice programme emphasizes content that has already been covered rather than new material. In this process, mastery of learning is an important key element and the learner must reach a level of proficiency to progress to the next level. Petrakis (1996), enumerated Math Blaster, Mental Math Games, Math Wizard, and Shop Series, as good examples of drill and practice programs in CAI, but today Typing tutor has been added to them. Iserameiya & Anyasi (2008), in a study of 80 junior secondary school students in Nigeria found that students were more creative and more interested in learning during introductory technology lessons with the use of CAI in combination with traditional face to face method. Corroborating this assertion Yusuf & Afolabi (2010), stated that, the use of CAI as a supplement to conventional instruction produces higher achievement than the use of conventional instruction and that, Computer Based Education (CBE) and other computer applications produce higher achievement than traditional method of instruction. Yusuf and Afolabi added that, students learn instructional content faster with CAI than with conventional instruction method alone, they retain what they have learned better with CAI than with conventional instruction alone. Khali & Shashaani (1994), used meta-analytic techniques to examine thirty-six studies and found that although CAI increased student achievement in subject matters, time spent with computers was a significant variable for student achievement. Therefore, they concluded that, the most effective time to learn with CAI was four to seven weeks and the effects of CAI disappeared when used less than three weeks. This goes to show that for experimental research using CAI, the study must not be less than six weeks.

Keyboarding is a skill that allows students to interact efficiently with electronic input devices either for educational purpose, personal usage, or future employment. Keyboarding according to Bartholome (1996), is defined as the manipulation of keys on a standard computer keyboard with emphasis on the output or hard copy. An early definition of keyboarding was "the process of using the appropriate fingers on a typewriter keyboard without regard for formatting problems (McLean, 1986). The touch type method of keyboarding is the positioning of fingers on home key (row) using each finger to key specific keys according to the slogan of the keyboard "asdf;lkj" (Rogers, 1997). The goal of keyboarding instruction is to develop a touch type method that will enable an individual to enter information at a speed that is faster than handwriting. The touch type technique is the striking of the correct keys without looking at the finger, on the keyboard and developed automaticity which is the desired level of performance in speed and accuracy.

Speed and Accuracy in Keyboarding

Speed and Accuracy is the ability to type the correct words from a graded and printed passage under a stipulated period. Speed and Accuracy is also referred to as timed writing in keyboarding. It is very common to see advertisement requesting for confidential secretary I and II with 80 to 100 WPM. The role of speed and accuracy which is usually the first task in keyboarding question is useful in identifying appointable graduates for employment. Hence global labour selection of secretarial personnel gives emphasis to speed and accuracy in keyboarding. Roger (1997), posited that straight-copy timed writing has been a major factor determining the progress or achievement of

students in keyboarding. Ultimate goal of speed and accuracy in keyboarding course is to produce in learners, ability to type at a reasonable fast rate with a high degree of accuracy. Ndinechi (1990) opined that, Speed gained in keyboarding results from crowding successive motions ever closer in time so as to reduce delays between motions and facilitates changing of responses, therefore the differences in performance of the expert secretary and the learner is wasted motion. While, accuracy is getting the correct imprint on the screen or paper when printed, using correct fingers. Speed and accuracy are built upon well-developed technique, which should be taught at the beginning and then developed through on-going reinforcement (Crews, North, and Erthal, 2006)

Why Speed and Accuracy Should Be Taught

Despite the advancement in science and technology, the keyboard is the most common device used to interact with a computer. Keyboarding skills remain a top requirement for today's students and workers in secretarial profession. People who use computer to communicate with others are at a disadvantage if they cannot type using the keyboard. Ober (1993) stated that the fingertips will remain the primary means of data entry in the future. In most offices and business there are many individuals impeded by lack of keyboarding skill, and many others hampered by bad habits and improper technique developed over years of using the keyboard, (Olinzock, 1998). These statements point to the fact that lack of good typing skills would hinder and frustrate people who attempt to use the computer, and so effort must be made to improve its teaching and learning. Employers value competency at the keyboard as evidenced by the listing of top priorities. Employers identified problem-solving, computer skills, and communications, using keyboarding as a top priority listed under computer skills, (keyboarding, 2006). Businesses today expect employees to type and edit their own documents using touch keyboarding skills. Proper touch keyboarding is essential since it helps to improve productivity and efficiency.

Statement of the Problem

Mass failure in Speed and Accuracy has become a major concern to lecturers even when keyboarding speed has been reduced by the National Board for Technical Education (NBTE) from 35 WPM to 20 WPM at ND level (NBTE Course Specification, 2005). With the introduction of computer into education system, it has been observed that teaching and learning could be improved upon with the use of Computer-Assisted Instruction (CAI), hence this study to fore the brought to the fore effectiveness of blended learning approach in speed and accuracy in keyboarding in Office Technology and Management Departments in Polytechnics.

Purpose of the study

The purpose of this study was to investigate if blended learning that is a combination of Computer-Assisted Instruction (CAI) and traditional method would make any significant improvement on student's achievement in Speed and Accuracy in office Technology and Management department.

Research Questions

1. What is the level of performance of National Diploma Students in Speed and Accuracy?

2. Is there any difference in the achievement of students in Speed and Accuracy between the experimental and control groups

Significance of the study

The finding could create awareness on the use of blended learning for effective teaching learning of Speed and Accuracy in keyboarding in Nigerian Polytechnics. The result from this study could help lecturers in Office Technology and Management in planning appropriate teaching strategies to be used when teaching speed and accuracy in keyboarding.

Method

A quasi-experimental research design of pre-test; post-test and control group design was used for this study. The independent variables for the study is teaching method, appearing in two level, Computer-Assisted Instruction and traditional method, demonstration method and the Control Group.

The population of the study consisted of 1224 National Diploma year one students of Office Technology and Management for the 2013/2014 academic session in five Government

Polytechnics in Edo and Delta state, Nigeria which were: Auchi Polytechnic, Auchi, Delta State Polytechnic, Ugwashiu-uku, Delta State Polytechnic, Oghara, Edo State Institute of Technology and Management, Delta State Polytechnic, Ozoro

The instrument for this study was National Diploma Speed and Accuracy Test (NDSPAT) designed by the researcher to test learners' achievement. NDSPAT was subjected to, face, content and construct validity. For construct validity a correlation coefficient of 0.82 using Pearson Product Moment Correlation analysis was obtained

A sample of 240 students were purposively selected in three polytechnics in Edo and Delta states, this represent 20% of the entire population. The Researcher used the cluster sampling technique to select two stream (A and B) per school. This was because computers in the laboratory are arranged 40 in each laboratory, this brings the total sample for one group to 80. In all the three schools considered, intact classes were used for the experimental and control groups.

Research Materials and Procedure The research materials used for this study were the Computer software typing tutor by Mavis Beacon (2007) under the license of Creative Commons Attribution- 4.0 education (CC-BY-4.0 education) and keyboarding Textbook.

To investigate the effect of CAI/traditional method, and Demonstration Method on achievement of Speed and Accuracy, a pre-test was administered and there after treatment. The instrument was administered on three groups as pre-test, thereafter experimental group I was exposed to Computer-Assisted Instruction (CAI) along with the traditional method. Experimental Group 2 was exposed to only Demonstration method of teaching. The third group, which was the control group was not exposed to conventional method. Data collected were analyzed using descriptive and inferential statistics of means standard deviation and ANCOVA. Statistical Package for Social Sciences (SPSS) was used for statistical analysis.

Results

Question 1 What is the level of performance of National Diploma Students in Speed and Accuracy?

In order to answer the question, scores of National Diploma year one students on Speed and Accuracy scores were obtained before they were subjected to treatment. These scores were graded based on NBTE grading system as presented below in Table 1 and Figure1

Table 1: Level of Performance of National Diploma (ND) Year One Students in Speed and Accuracy.

Grade	Frequency	Percentage
Fail: 0 – 39	237	98.8
Pass: 40 – 49	3	1.2
Credit: 50 – 69	-	-
Distinction: 70 and Above	-	-
Total	240	100.0

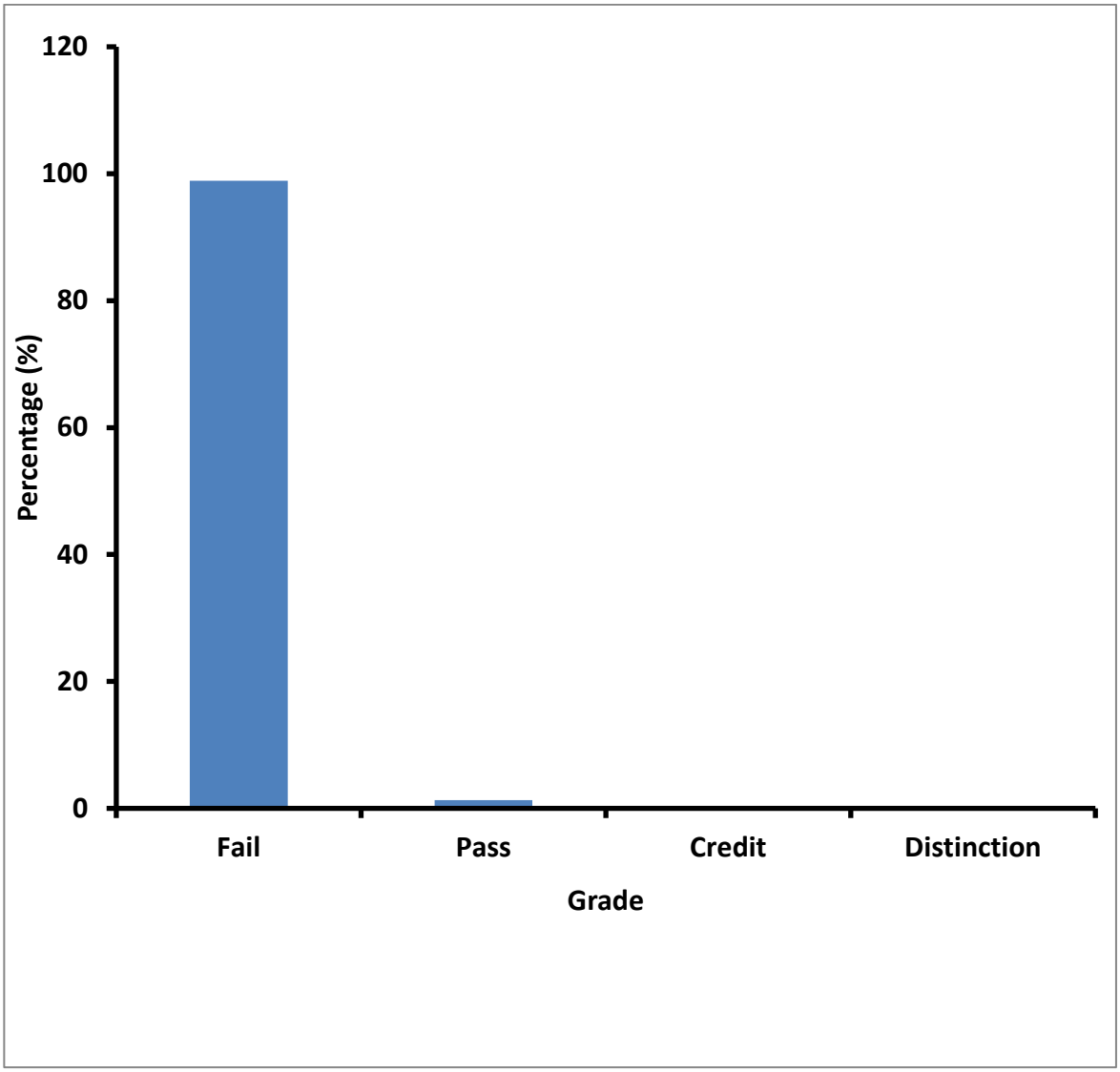

Fig. 1 **Bar Chart showing students performance in speed and accuracy before treatment.**

Table 1 and Figure 1 show that majority (98.8%) of the students failed while, only 1.2% passed speed and accuracy in keyboarding. Therefore, the level of performance of National Diploma Students in speed and accuracy before exposure to instructional strategies was very low.

Question 2. Is there any difference in the achievement of students in speed and accuracy between the experimental and control groups.

Mean scores of students on speed and accuracy in experimental and control groups were computed and compared for statistical significance using Analysis of Covariance (ANCOVA) at 0.05 level. The result is presented in Table 2.

Table 2: ANCOVA of Students' Achievement in Speed and Accuracy by Treatment.

Source	SS	df	MS	F_{cal}	P	F_{table}
Corrected Model	545.865	3	181.955	51.373	0.000	2.60
Covariate (Pretest)	15.232	1	15.232	4.301	0.039	3.84
Group	545.056	2	272.528	*76.946	0.000	3.00
Error	835.868	236	3.542			
Corrected Total	1381.733	239				
Total	2022.000	240				

*Significant **P < 0.05**

Table 2 shows that there is a significant difference in the achievement of students in speed and accuracy between the experimental and control groups (Fcal. = 76.946, P < 0.05). The null hypothesis was rejected. In order to locate the sources of pair-wise significant difference among the experimental and control groups, scheffe post hoc test was applied. The result is shown in Table 3.

Table 3: Scheffe Post hoc Analysis of Students' Achievement in Speed and Accuracy by Treatments.

Groups	CAPI/Demon	Demonstration	Control	Mean	N
CAPI/Traditional		*	*	3.73	80
Demonstration				0.78	80
Control				0.40	80

*** Mean difference is significant at 0.05 level**

Table 3 shows that there is significant difference between achievements mean scores of students in speed and accuracy taught with CAI and traditional method, demonstration and Control. However, there is no significant difference between the mean scores of subjects in Demonstration and Control group. Multiple Classification Analysis (MCA) was also used to determine the effect of treatment on students' achievement in speed and accuracy. The result is shown in Table 4.

Table 4: Multiple Classification Analysis of Students' Achievement in Speed and Accuracy by Treatment.

Grand Mean = 1.63

Variable + Category	N	Unadjusted Devn'	Eta	Adjusted For Independent + Covariate	Beta
CAPI/traditional	80	2.10		2.11	
Demonstration	80	-0.85		-0.86	
Control	80	-1.23		-1.24	
Multiple R					.024
MultipleR^2					.001

Table 4 reveals that, with a grand mean of 1.63, students in the CAI/traditional group had the highest adjusted mean score of 3.74 (1.63 + 2.11). This was followed by those exposed to demonstration method with an adjusted mean score of 0.77 (1.63+(-0.86), while the control group had the least adjusted mean score of 0.39 (1.63+(-1.24). It implies that blended learning has the potency of significantly enhancing students' performance in speed and accuracy.

Discussion

The findings of this study revealed that, there was no significant difference between the pretest mean scores of experimental and control groups. The level of performance of students in National Diploma Year One in speed and accuracy was generally low as those that passed were at the lowest border of 40 marks according to NBTE grading system, before they were exposed to treatments. This is a fact as many students do not pass speed and accuracy task in keyboarding examination in Polytechnics. Effect of treatment was felt as the mean score and standard deviation of experimental groups showed that there was a substantial difference between the pre-test and post-test mean scores of students taught with blended method that is a combination of CAI and traditional method. It was however established that bended method served a very useful purpose for learning basic concepts and practice of speed and accuracy in keyboarding. This finding is supported by Iserameiya, and Anyasi (2008), Yusuf and Afolabi (2010).

Findings on the study indicated that, there was a significant difference in the achievement of students in speed and Accuracy between experimental and control groups. The difference favoured group one that uses Computer-Assisted

Instruction method in addition to traditional method of teaching. This implies that, blended method facilitates achievement in speed and accuracy. This finding is corroborated by Ober (1993) and Olinzock (1998) who were of the opinion that, the fingertips remained the primary means of data entry into any type of computer system in the nearest future and therefore emphasized the mastering of keyboarding skills in speed and Accuracy is imperative. Crews, North, and Erthal (2006) findings also corroborates this finding, when they observed that, speed and accuracy were built upon a well-developed technique, which should be taught at the beginning and then developed through reinforcement and drill and practice.

Findings

1. There was no significant difference between the pretest means scores of experimental and control groups. This indicated that the groups were homogenous.
2. The result shows that blended approach of learning is effective in teaching and learning of Speed and Accuracy in keyboarding.

Conclusion

Blended approach is found to be more effective than demonstration method for teaching and learning speed and accuracy in keyboarding in polytechnics. This implies blended learning is more dependable for good understanding achievement in speed and accuracy. Learning Speed and accuracy with blended approach is an indication that hope is not lost in the teaching and learning of keyboarding in Office Technology and Management Departments in Nigeria Polytechnics

Recommendations

Based on the result and findings it was recommended that;-

1. Lecturers in Office Technology and Management should use Blended learning approach, when teaching Speed and Accuracy in keyboarding, as it has been found to enhance students' achievement.

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THE INFLUENCE OF SCHOOL LOCATION ON PRIMARY PUPILS' ATTITUDE TOWARDS SCIENCE LEARNING

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Abstract

School location can be described as the geographical area of a school and has been observed as one of the factors that influence the distribution of educational resources by stakeholders. The study aimed at investigating the influence of school location on primary school pupils' attitude towards science learning. Descriptive survey method of research was employed for the study and participants in the study were 200 primary five pupils selected through stratified random sampling technique from urban and rural located schools. The instrument used was a questionnaire titled 'School Location and Attitude towards Science' (SLAS) The instrument was validated by experts in Science Education and Education Management. Reliability of instrument was estimated using test retest method and a reliability coefficient value of 0.76 was obtained. Four hypotheses formulated were tested at 0.05 level of significance using t-test and Pearson's Product Moment correlation statistics. The results showed that the geographical location of schools had influence on the pupils' attitude towards the learning of science. It was recommended that science competitions should be encouraged among primary schools.

Keywords: Location, Primary school, Attitude, Science, Pupils

Introduction

A school can be defined as a place of formal education, where a given curriculum is being implemented. Dada in Ofodu (2011) describes the school as a place where learning takes place. The basic role of a school in any Community is changing the general orientation of a child by developing the areas of cognitive, affective and psychomotor domains. It enables a child to develop reasoning and learning skills. Primary school, also referred to as basic school can be described as the onset of formal education of a child, and it involves children of between 5-12 years of age (Esme, 2016). The fundamentals of every subject is being introduced to children and taught in the Primary school. The way teacher present lessons in Primary schools go a long way to lay foundations of various subject and create children attitude towards such subject.

School location can be describe as the geographical area of a school and has been observed as one of the factors that influence the distribution of educational resources by stakeholders. Nigeria has been described by Balogun in Ofodu (2011) when commenting on the improvisation of science teaching equipment in line with location, referred to Nigeria as a Country with overweighing poverty characterized with wide disparity in the distribution of resources and social amenities by the Government. The population has polarized into two; the favorably affected and unfavorably affected. These two groups have been forced on economic reasons and levels of education to organize themselves into two different sub geographical locations which determine what amenities and facilities are made available to each group. According to Mbipom (2000), schools are either situated in one geographical location or the other. These geographical locations are either termed urban, which according to Alokan (2010) is characterized by modern facilities, leisure, cinema, easy transportation, cultural heterogeneity, and cosmopolitan population or rural, where all these are lacking. In rural schools the population is relatively small and the students could identify one another by name. Urban dwellers live individualistic life and only relate with people they

feel like relating with, without any form of permanency. Ogili (2009) posited in his study that the incomes per capital among rural people are low and there is general poverty. About 70% of the rural populations are engaged in farming at subsistence level while the urban populations are mostly civil servants, traders and artisans. This educationally implies that in the rural settlement or location there is poor accessibility to the modern educational facilities and this serves as a hindrance to the motivation of a rural child to learning.

Urban locations are those environments which have high population density containing a high variety, beautiful and common place views like Hotels, Recreational centers, Markets, Banks and good road network, while the rural environment is being characterized by low population density containing a low variety and isolated place. The social environments of an urban Center attract various personnel. Urbanization comes with diverse enlightenment via social media, news media, print media, ICT, rallies, exhibitions, campaign, also social amenities characterizing urban Center can promote pupil's general exposure thus enhancing pupils' attitude towards science learning. Teachers are implementers of science curriculum. Many science teachers prefer working in urban Centers. Government gives preference to urban schools in science equipment distribution. A better atmosphere for science learning is thus presented in urban location, though overcrowding in class is a common problem of teaching science here.

Teacher's role in implementing the science education curriculum is vital. School location affects the settlement of teachers in schools. Most qualified teachers prefer to settle in urban rather than the rural areas. Teachers dodge postings to rural areas because the living conditions are not sophisticated, the social life in these areas is virtually restricted as a result of inadequate amenities; facilities are deficient, playground are without equipment, Libraries are without books while Laboratories are mostly glorified ones having inadequate and improvised equipment. Mamman, Chadi and Jirgi, (2015) opined that if teachers have a comfortable living condition of working, they will be more effective in the teaching-learning process. A critical analysis of location factors, surmised that disseminating science knowledge in rural areas is normally fraught with inadequate qualified teachers, villagers hesitation in sending their children to schools because they are dependent on them for labour-help at farm, parents fright to entrust their daughters to male teachers, lack of roads or satisfactory means of communication makes it difficult to get books and teaching materials to the school which place difficulties in the way of organizing school transport among others.

Science learning is not new in the Nigeria school system. It is a footstool to technological development of the Society. The need to put up every effort and keep hands on deck to make the task easier and effective cannot be overemphasized. For a Society devoid of scientist cannot develop. Science learning in a child begins in Primary school where pupils are introduced to various subjects. The teacher and learning resources available in the environment could stir up pupils' interest in science subjects which could affect their attitude. Attitude towards science in students have been discussed within different research contexts. Among the purposes of science education is to develop a positive attitude towards science regardless of individual differences (Azizoglu and Cetin, 2009) Attitude was defined by Osborne, (2003) as 'feelings, belief and values held about the enterprise of school science, school science and the impact of the science on the Society. Klopfer, as stated in Esme (2016) proposed five dimensions regarding 'attitude towards science' as the manifestation of favorable attitudes to science and scientists; acceptance of scientific inquiry as a way of thought; adaptation of scientific attitudes; enjoyment of science and development of interest in pursuing a Career in science. Attitude can be affected by personal opinion, and these opinions can be formed through personal life experiences and education.

Studies concerning the science learning environment Osborne, 2003; Ogunmade, 2006 and Dinah, 2013 revealed a relationship between this environment and students' attitude to science. Deficiencies of learning environment may results to low self esteem of students which can develop a poor attitude toward learning (US Department of Education, 2003). Concerns over the influence of attitude on students' science learning have been deliberated upon in recent time. Owino, Ahmad and Yungungu (2014) attached the

problem with inadequate supply of teaching and learning resources such as chemicals, charts, apparatus, models, local specimens, Laboratories, textbooks, and Libraries led to poor performance in Biology. Dinah (2013) concluded that, availability of text books, Laboratory apparatus and other learning resources contribute significantly to the learning of Biology. He added that, students with positive attitude towards the subject register better performance than those who had a negative attitude. Many schools lack the essential resources for imparting the knowledge of science concepts to students making many students learn little science, learning tends to be rote and many students find science not interesting and boring (Ogunmade, 2006)

Classroom plays a vital role in the education of the child. According to Nwachukwu (1994), the physical setting for learning affects the learner. The setting must be attractive enough to make students wish to spend long hours there. The present scene in most primary schools does not meet these requirements. The typical village classroom is part of an unattractive building. The roof may still be in place or may have been blown off by wind. If the later is the case, students are forced to study without being protected from the effects of the weather. This is unlike in the urban areas where unattractive classroom buildings are easily noticeable and attended to by Government and stakeholders. There has been disparity in researches on school location and effects on students, Alokan (2010) in her study reported that location do not affect the negative relationship between student problems and academic performance. In another development, Considine and Zappala (2002) studied students in Australia and found out that geographical location do not significantly predict outcomes in school performance. There have been paucity of researches on Primary school locations and students attitude to learning. This has prompted this study on Primary school location and pupils attitude towards science learning.

Problem of the Study

Location of school (rural / urban) is noted to have effect on pupils' exposure to learning in diverse ways, hence attitude towards science learning. It is observed that adequate social infrastructures which may entice pupils to studying science are inadequate in rural locations. Also there is noticeable discrepancy in the distribution of learning resources to Primary schools with regards to location.

Purpose of the Study

The study aimed at investigating the influence of school location on Primary school pupils attitude towards science learning. The study focus on finding out the difference in pupils' attitude towards science learning in rural and urban locations of Ido-Osi Local Government Area of Ekiti State, Nigeria.

Hypotheses

The following hypotheses were raised and tested in the study

1. There is no significant effect of school location on pupil's attitude towards science learning.

2. There is no significant relationship between availability of basic science instructional materials and pupil's attitude towards science learning.

3. There is no significant relationship between urban location and Primary pupils attitude towards science learning

4. There is no significant relationship between rural location on Primary pupils attitude towards science learning.

5. There is no significant difference in the influence of teachers in rural and urban areas on primary pupil's attitude towards science learning.

Methodology

The study was descriptive in design. The population consists of all primary five school pupils in public Primary schools of Ido-Osi Local Government Area of Ekiti state Nigeria. The participants in the study were 200 primary five pupils selected through stratified random sampling technique from urban and rural located schools.

The instrument was a questionnaire titled 'School Location and Attitude towards Science' (SLAS) containing 35 items. It was made of up two sections A and B. Section A was 'fill up the gap' items which sought information on pupils' bio-data, while B was a four likert type scale items based on pupils' attitude to science, school

location, available facilities and instructional materials to be tick according to options; strongly agree (SA) agree (A) disagree (D) strongly disagree (SD)' which sought information on pupil's school location, pupil's attitude towards science and availability of instructional materials for science learning. The instrument was validated by experts in Science Education and Education Management. Reliability of instrument was done through test retest method and a reliability coefficient of 0.76 was obtained. The value was adjudged high enough for the instrument to be reliable. Pearsons' Product Moment Correlation statistics was used to test the hypotheses.

Results

Hypotheses testing

H_{01}: There is no significant influence of school location on Primary pupil's attitude towards science learning.

Table 1: Correlation of School Location and Student's Attitude Towards Science Learning.

Variable	N	Mean	SD	Df	r-calc	r-tab	Remarks
School location	200	50.00	48.500				
attitude towards science	200	82.75	12.487	199	2.916	1.968	Significant

The result above reveals that the r-significant calculated 2.961 is greater than r-significant tabulated 1.968 so the null hypothesis was rejected at 0.05 level of significance. This indicates that there is significant effect of school location on Primary pupil's attitude towards science learning.

H_{02}: There is no significant relationship between availability of basic science instructional materials and pupil's attitude towards science learning.

Table 2: Correlation of Science Instructional Materials and Pupil's Attitude towards Science Learning.

Variable	N	Mean	SD	Df	r-calc	r-tab	Remarks
Science instructional materials	200	50.00	26.736				
Pupils attitude toward science learning	200	82.75	12.487	199	0.323	0.195	Significant

The result reveals that the r- calculated 0.323 is greater than r-table value 0.195 so the null hypothesis was rejected at 0.05 level of significance, meaning there is significant relationship between availability of basic science instructional materials and pupil's attitude towards science learning.

Ho_3: There is no significant relationship between urban location and Primary pupils attitude towards science learning.

Table 3: Correlation of urban location and pupils attitude towards science learning.

Variable	N	Mean	SD	df	r-calc	r-tab	Remarks
Urban location	200	8.25	16.500				
Pupils' attitude toward science	200	82.75	12.487	198	0.527	0.195	Significant

The result reveals that the r- calculated (0.527) is greater than the r-table (0.195) thus the null hypothesis was rejected at 0.05 level of significance. This indicates a significant relationship between urban location and Primary school pupils' attitude towards science learning.

Ho_4: There is no significant relationship between rural location and Primary pupils attitude towards science learning.

Table 4: Correlation of rural location and primary pupils' attitude towards science learning

Variable	N	Mean	SD	df	r-calc	r-tab	Remarks
Rural location	200	41.75	74.684				
Pupils' attitude to science	200	82.75	12.487	198	0.473	0.195	Significant

The result above reveals that the r-calculated, 0.473 is greater than r-table value 0.195. The null hypothesis was rejected at 0.05 level of significance. It thus indicates a significant relationship between rural location and Primary school pupils' attitude towards science learning.

$H_{05:}$ There is no significant influence of teachers' availability on primary pupil's attitude towards science learning.

Table 5: Correlation of teachers' availability and primary pupils' attitude towards science learning

Variable	N	Mean	SD	df	r-calc	r-tab	Remarks
Teacher's availability	200	67.10	41.775	199	0.556	0.195	significant
Primary pupils attitude towards science learning	200	82.75	12.487				

The results above reveals that the r-t calculated (0.556) is greater than the r- table of critical value (0.195) so the hypothesis was rejected at 0.05 level of significance. Therefore there is a significant influence of teachers' availability on primary pupil's attitude towards science learning.

Discussion

The findings show that the geographical location of schools had a significant influence on pupils' attitude towards the learning of science. Rural / urban dichotomy in terms of pupils attitude as highlighted in the result presentation can be attributed to various causes such as, uneven distribution of learning resources by Government which supports Ofodu (2011) who confirmed a wide disparity in the distribution of resources and social amenities by the Government. Also a significant relationship between availability of basic science instructional materials and pupil's attitude towards science learning was recorded. Primary teachers cannot perform science practical lessons in abstract; the use of equipment is subject to its availability in schools.

Also recorded was a significant influence of teacher's availability on primary pupil's attitude towards science learning. Of note is the problem of teachers refusing postings or not willing to perform well in isolated villages. This is in agreement with the study of Ogili (2009) who believed that rural located schools are placed at a disadvantage compares to their urban counterparts, reason being that rural location is characterized by a lesser social motivation for both teachers and primary school pupils.

A significant relationship between urban location and Primary school pupils' attitude towards science learning and a corresponding significant relationship between rural location and Primary school pupils' attitude towards science learning was recorded. However, a significant difference in the influence of teachers in rural and urban areas on primary pupil's attitude towards science learning was recorded. The finding in this study reveals apparent influence of school location on the attitude of primary school pupils. The findings can be linked with that of Owoeye and Yara (2011) who believed that students in urban locations have better advantage by learning in an urban environment, which apparently enriches their academic knowledge, despite the disadvantage of having to learn in large classes. A significant influence of rural school location on primary pupils attitude towards science learning was recorded. Generally, rural school locations are deficit in social amenities, teachers are compelled to stay there. Science equipment are mostly improvised and pupils are not socially exposed.

Conclusion

It was concluded from the study that primary school pupils' attitudes towards science learning can be influenced by their school location. What a student hears, sees and come in contact with

during schooling can influence his/her attitude towards learning science subject.

It was discovered that school location often affects distribution of science equipment among schools and that schools location may affect teachers availability in schools will influence the pupils attitude to science learning. Many teachers prefer working in urban schools and this can influence pupils attitude towards science learning.

Recommendations

The following are thus recommended

1. Government should be just on the distribution of science equipment and learning facilities among rural and urban schools

2. There should be fairness in the distribution and posting of teachers' to school locations.

3. Teachers should willingly accept their postings as part of their obligation to their profession

4. Interaction between rural and urban schools should be encouraged via science quiz exhibitions participation and competition

5. Government and stakeholders should avoid being partial when attending to primary schools issues.

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TOWARDS A SUSTAINABLE NATION'S BUILDING: CHALLENGES OF PHYSICS TEACHERS IN THE CHANGING WORLD

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Abstract

The paper was a discourse on the relevance of Physics teachers on sustainability of nation's building especially in this 21st century of global technological growth. It highlighted the objectives of teaching Physics in the Secondary Schools in Nigeria. The teachers' attitude towards the subject was discussed and its implication on students' enrolment into science and science related courses in higher institutions of learning. The challenges of the teachers towards enhancing effective teaching and learning of Physics at the Secondary Schools were unveiled while possible solutions that could bring about positive changes in the teachers' activities for effective teaching and learning of Physics at the Secondary Schools capable of enhancing a sustainable nation's building were proffered.

Key words: Nation's building, Physics teacher, challenges, sustainable, changing world.

Introduction

The sustainability of any nation is majorly anchored on the degree of availability of her manpower. A nation that is well equipped with professional manpower is obliged to grow and be able to maintain a continuous development, otherwise referred to as sustainability of the nation's growth. Evidently, professionalism is a function of knowledge acquired in a specified field. From time to time, there is always a continuous global change in all spheres of human endeavours. Suffice to say however that it is the inputs of man that often effect the change. Of recent, the generic world focus is towards the technological growth of any nation. Every nation of the world is aspiring to develop their manpower in the field of technology. This is evident in the innovations of technology based outputs around such as in areas of communication, transportation, security, business and commerce, administration, among others.

The growth in technology is a function of the scientific knowledge of the nation. In other words, technology is the application of scientific skills into solving practical problems. Major among the science subjects that form the nucleus of technology is Physics. From the discourse, the teaching and learning of Physics is germane to the growth and sustainability of a nation's building.

Objectives of Secondary School Physics

Physics is a science subject whose concepts, theories, experiments and observations are related as a means of exploring ideas. Thus, Physics involves formal definitions, concepts and laws (Adedayo, 2008). The National Policy on Education in Nigeria (NPE, 2007) stipulates that the overall philosophy of her education is geared towards self-realization, better human relationship, individual and national efficiency, effective citizenship, social, cultural, economic, political, scientific and technical progress for proper harmonization between the philosophy and the national objectives. The national education aims and objectives to which the philosophy is linked, among others, is the acquisition of appropriate skills, abilities and competences both mental and physical as equipment for the individual to live in and contribute to the development of his/her society.

In the overall national objectives are embedded two broad aims of secondary education. Being a function of education received between primary and tertiary levels, secondary school education is meant to:

(a) prepare students for useful living within the society; and

(b) prepare students to cope with higher institution.

To fulfill these aims, the aspect of Physics as a major science subject is documented in the national scheme designed for studying Physics at the secondary school level. These are to:

(i) provide basic literacy in Physics for functional living in the society;

(ii) acquire basic concepts and principles of physics as a preparation for further studies;

(iii) acquire essential scientific skills and attitudes as a preparation for the technological application of physics; and

(iv) stimulate enhanced creativity.

On this basis, the researcher aligns with Ogunleye (1998) who highlighted some objectives of teaching physics in secondary schools to include:

- development in students certain cognitive skills such as developing critical thinking, manipulating ability, communicating ability and organization ability;
- making students use scientific tools, equipment's, terms and expressions with accuracy and understanding;
- giving students a place and role through physics applications and inter-relationship in science, engineering, medicine, social science and other fields of human endeavour;
- giving students understanding of the principles, theories and laws of physics and its applications to problem-solving situations within and outside the academic sphere.

Thus, for any nation to grow and sustain her technological growth, the acquisition of basic concepts and principles of physics is indispensable.

Teachers' attitude to Physics Pedagogy

The attitude of teachers to the teaching of physics seems not favourable. Majority of physics teachers felt unfulfilled finding themselves in the classroom with all the tasks involved in the study of physics. This is noticeable in the following aspects of the teachers' impressions:

1. Attitude to teaching profession: The issues surrounding teaching generally as a profession are not encouraging to the teachers, including those teaching physics. They handle the job with levity since they are not motivated on the job. On these bases, many periods are skipped while the classes attended are not adequately prepared for. The resultant effect is that the teaching learning encounters in such situations are not effective. No much learning would take place.

2. Threat of mathematical skills involved: Physics is a science subject which by nature involves lots of mathematical drills and skills. There is rarely a topic in physics without its accompanied aspect of calculation. It is unfortunate however that this very much needed skill is a threat not to students alone, but to the teachers alike (Lassa, 1984, Adedayo, 2008). It was opined by Owolabi (2003) that the negative attitude to mathematical activities could be as a result of such factors as sex dichotomy, hereditary, environmental, orientation, subject teacher and the pedagogical method of the teacher. Experience of the researcher of this study on interaction with other colleagues while teaching in the secondary school showed that some Physics teachers often brush over the calculation aspect of any topic that seemed to prove difficult. As a result of this, teachers who are mathematical phobia may not be favourably disposed to teach physics.

3. Inappropriate teaching methods: Physics is a science subject that is primarily concerned with the qualitative and quantitative description of the properties of the properties and behaviour of matters (Akinwumi, 1986, Adedayo, 2014). The instructional method adopted by the teacher therefore needed to be appropriate if students would comprehend the concepts being passed to them in the classroom. It is imperative of physics teacher to adopt a systematic approach in teaching, such that would enable students to progress from concrete operations to

generalization and use of symbols. The desire of the teacher to present the best to the students is desirable. The common practice in the secondary schools is that the teachers' methods of instruction are more of teaching and lecturing. This rubs the students of active participation in the teaching and learning process. The teachers' mode of explanation often makes the concepts difficult for the students to comprehend. The resultant effect is that the learners summarily conclude that the subject is too tough for them and eventually cultivate negative impression about the subject.

4. Practical aspect difficulty: It is pathetic to discover that majority of physics teachers are threatened when it comes to practical aspect of physics. This is due to the fact that they are not competent in practical physics. As a result, the practical classes are avoided and deferred till very close time to the students' certificate examination. Consequently, the students performed poorly in their external examinations.

5. Teacher – Students relationship: The attitudes of most secondary school physics teachers scare students and often peels them off from the subject. Instead of being friendly with the students to create their interest in the subject they teach, they are rather hostile and unapproachable for the students. This discourages the students to interact with such teachers and consequently loose interest in both the teachers and the subject. The students invariably become frustrated, discouraged and imbibe wrong perception about physics. It is disheartening to note that some of the teachers who interact with the students are not doing so honestly but due to some hidden agenda. For instance, a male teacher may be dating the female students and thereby having illicit affairs with them. Other reason for closer interaction with the students may be due to an obligation that may be required from the students. In such cases, the relationship is not healthy and unprofessional. The students could not link such interaction to teaching-learning process but merely a social interaction.

Challenges of Physics Teachers for Efficiency

i. ***Job satisfaction:*** The efficiency of any staff on a job anchored majorly on the satisfaction such staff has on the job. The experience of the physics teachers on the job seems not commensurate with the hard time and energy expended by the teachers while studying the subject in school. While many of their friends and colleagues did not offer physics because of the tasks involved in it, they resolutely decided to pursue it with high expectation that they would reap the fruits of their labour. The teaching terrain they find themselves seems not yielding their expected dividends; so they are discouraged and not satisfied with teaching physics. No wonder most of the physics teachers in the secondary schools are job seekers for better pasture. A research report on whether or not professionalization of teaching has increased the teachers' status and morale by Emoruwa & Olugbeko (2011) revealed a negative result. In their outcomes, 61% of the teachers agreed that government does not give them much listening ears and 74% complained that the benefits given to civil servants are not extended to them. Undoubtedly, this would cause inferiority complex on the part of the teachers since they are treated as second class citizens even though they are holding the same certificates with their counterparts in the civil service. It is highly demoralizing.

ii. ***Teachers' Education programme:*** Much as there are many institutions for training would be teachers, the adequacy of their programme to the meet the current educational challenges seems doubting. Most of the institution still embark on their old curriculum for training their students, not being cognizance of the fact that the present generation educational demands are technological driven, and more importantly, the 21st century pedagogical approaches.

iii. ***Government inconsistent policies:*** The incessant change in educational policies as designed by the government has been a challenge to effective teaching and learning physics. In a situation whereby a programme is being run and the government just come up with a new policies, which by implication, biding on everyone in the system, truncates the existing programme.

iv. ***Students' unreadiness for physics****:* pg 21Indication from the students' attitudes towards the study of physics showed that the

level of students' preparedness is low. Most of the students perceived their physics teachers as being too tough and unapproachable because of the nature of the concepts in physics. This view is at variance to the outcome of Ofodu's (2008) study that students perceived their English Language teachers as experts and have firm grip of the subject. However, the mathematical skills involved in physics made its teaching tough in the view of the students and therefore are not voluntarily willing to attend physics classes.

v. ***Lack of appropriate facilities:*** The importance of instructional facilities at enhancing effective learning cannot overemphasize. Perhaps, this is in line with Ogunleye (1999) and Ayodele's (2009) assertion that poor performance of students in science related subjects, physics inclusive, was due to bad school environment among others.

vi. ***Curriculum problem:*** The current physics curriculum in the secondary schools in Nigeria is overloaded with contents such that may not be covered within the stipulated period. This poses a high demand on the teachers making them to work tirelessly at ensuring that at least a high percentage of the contents are taught before the time laps.

vii. ***Lack of Motivation by the Government:*** The response of the government to educational demands has not been encouraging, which by extension, the materials required for physics teaching and learning process. It is shameful to report the meager amount assigned as science allowance as being paid by the government. Even, if there is an accident in the laboratory, such amount cannot convey the teacher to the closest clinic, talk less of treatment.

viii. ***Inadequate Infrastructure in Schools:*** Most of the schools are faced with shortage of needed infrastructure capable of engendering effective teaching and learning. In many schools, a classroom is converted to the laboratory which is used for all the science subjects. In such a case, the basic physics laboratory apparatus and equipment could not be available for the teacher and students' use.

ix. ***Lack of pedagogical Skills:*** The skill to be displayed by any teacher is a function of the teacher's academic qualification and years of teaching experience. Fuller & Alexander (2004) and Ayodele (2009) reported that students taught by more qualified teachers in terms of academic credentials performed significantly better than students of less qualified teachers. Also, Ayodele (2011) submitted that there is positive correlation between years of teaching experience and overall performance of students. Thus, students of experienced teachers would attain significantly higher levels of academic achievement than students of inexperienced teachers.

x. ***Overcrowded Classroom:*** Research reports on the influence of class size on the academic performance of students have consistently revealed that smaller class size is more beneficial for academic achievement of students (Fabunmi, Brai-Abu & Adeniji, 2007; Ayodele, 2011).

xi. ***Overloaded Examinations Syllabi:*** The desire to meet the required technological demands of the present age has led to incorporating more needed concepts into the curriculum, thereby swelling up the syllabus of all the examination bodies (Adedayo, 2014). The resultant effect is expansion of coverage area for the teachers. This requires more efforts and extra activities on the part of the teacher.

xii. ***Heavy teaching load due to insufficient qualified teachers:*** As a result of insufficient qualified physics teachers, the few available teachers are overloaded with work. In such a situation, they are not able to cover the already overloaded syllabus in their hands, talkless of marking students' assignments, giving them feedback and making corrections.

xiii. ***Lack of provision for educational needs of Students by parents:*** Poor economy of the parents could hinder such from procuring the needed textbooks, graph book and such other materials that their ward may require

for effective learning. In such a case, whatever effort put in by the teacher may not be productive, hence, renders his efforts futile.

xiv. ***Non-responsive of the teachers to Curriculum Innovation:*** Much as curriculum change and innovation is desirable for up-to-date and useful curriculum, the response of teachers has always been cold towards it. Generally, change is one of the phenomena that man do not desire, even though it is imperative in most cases, curriculum inclusive. The success of curriculum reform depends majorly on one part, whether teachers are valued and acknowledged in the process and whether the teachers understand the innovation put in place (Amadi & Nnodim, 2011).

xv. ***Quest for wealth:*** The desire to be wealthy by everybody nowadays has decimated the zeal and diligence of teachers, who are not compensated in commensurate to their job performance. On this basis, many physics teachers are weary in discharging their statutory teaching in full.

Suggested Way Forward

Realising the significance of physics concepts to the technological growth of our world, it is imperative of all the stakeholders of physics teaching-learning enterprise to articulate their potentials and resources towards improving the teaching and learning of physics, especially at the secondary school level which equip the students with the fundamental principles embedded in the subject. In order to achieve this herculean task, the following steps are suggested:

a. The physics teachers should put up an attitude that would enhance improved teaching and learning of the subject. They should endeavour to attend their classes without being weary for whatever reason.

b. Appropriate method should be employed by the teacher in teaching physics, capable of enhancing effective learning.

c. Collaborative teaching is encouraged among physics teachers to tackle any topic that may prove naughty to any teacher, be it calculation or practical aspect.

d. The teacher should create a healthy relationship with the students, aimed at developing the interest to study physics in them, and not based on unprofessional vices.

e. Government should maintain a consistent curriculum, and if need be for any innovation, the teachers who are the implementers of the curriculum should be carried along.

f. Government should adequately provide the necessary materials for teaching physics, being infrastructure, human and material resources.

g. The allowances accruing to the physics teachers should be jacked up to encourage the teachers. In fact, the allowance should be a certain percentage of the basic salary of the teachers.

h. The curriculum for training potential physics teachers should be reviewed to meet up with the 21st century world of digitalization.

i. Parents should be alert to their responsibility of providing the needed materials for their children and wards.

j. The teacher should consider their job as a calling, a profession to be protected through diligence and integrity.

Conclusion

Physics as a subject is central to societal growth and development. This would be achieved when it is effectively taught by the teachers and learnt by the students. However, attitudes of the teachers seem not encouraging and worst still, they are being faced with avalanche of challenges which incapacitate their dedication and output in their statutory roles of impacting on the learners. Teachers' attitude should be such that could engender effective teaching and learning of the subject. The suggested actions should be taken into consideration so that the building of nation technological development can be sustained.

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