Journal of Education and Practice www.iiste.org
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.7, No.7, 2016

The Implementation of Action Research for the Improvement of Biology Teaching and Learning in Senior Secondary Schools in Nigeria

Udeani, U.N.[1] Atagana, H.I.[2] Esiobu, G.O.[1]
1. Department of Science and Technology Education, University of Lagos, Nigeria
2. Institute of Science and Technology Education, University of South Africa, Pretoria, South Africa

Abstract
The main objective of the study was to implement an action research strategy to improve the teaching and learning of biology in senior secondary schools in Nigeria. Specifically the following research questions were raised:-

- What are the levels of intellectual challenge included in the activities used for classroom and laboratory instructions?
- What are the levels of intellectual challenge included in the redesigned course materials for classroom and laboratory instructions.
- Will there be an increase in learning when a revised course material is used for classroom / laboratory instruction.
- Is there any relationship between activities enjoyed by students and those that enhance their learning?
- Is there any relationship between effective learning and perceived students enjoyment of an activity?

Purposive sampling was used to select four senior secondary schools from urban and rural location of Lagos State. In each of the participating school two intact classes were used to act as experimental and control group. Altogether 267 students and their four biology teachers participated in the study. The redesigned course material was used to teach biology to the experimental class and the traditional course material was used for the control group for the second term of the 2014/2015 academic year.
The major findings were:

- The result of the analysis of the review of the activities and exercises in the recommended Biology textbook in use in Lagos State schools showed that all the exercises and activities were predominantly at the lower cognitive levels of Blooms Taxonomy of educational objectives.

- The result also showed that the mean achievement score of the students taught with the redesigned course materials was significantly higher than the mean achievement score of those taught using the traditional course materials.
- There was no significant correlation between activities enjoyed by students and those that enhanced their learning.

Educational implications of the findings for the improvement of instructional practices were discussed.
Keywords: Biology Teaching, Biology Learning, Action Research Secondary School.

Background to the study

Our world is profoundly shaped by science and technology. Preserving the environment, reducing poverty and improving health; each of these challenges and many more require scientists capable of developing effective and feasible responses and citizens who can engage in active debate on them.

In order to achieve this, the **1999** Budapest declaration underscored the importance of science education for all. Science education is a field of study concerned with producing a scientifically literate society. It also lays the foundation for future work in science and science related fields by acquainting the students with certain basic knowledge, skills and attitudes. Science education is the bedrock upon which scientific and technological development depends. Indeed, science and mathematics education that is relevant and of sound quality can develop critical and creative thinking, help learners to understand and participate in public policy discussions, encourage behavioural changes that put the world on a more sustainable path and stimulate socio-economic development. Science and mathematics education can therefore make a critical contribution to the Millennium Development Goals (MDGs) adopted by the world's leaders in **2000** and Sustainable Development Goals (SDGs) in **2015.**

Over the last two decades science education has received an exceptional attention from both education and politics stakeholders as a field of significant potential impact on a nation's success. Many efforts have been made to improve science teaching and learning in non-customary ways. Science education reform initiatives in the USA have targeted scientific literacy through inquiry experiences and skills "for all" **(AAAS, 1990, 2005; NRC, 1996)**. Many other countries around the globe directly or indirectly have shared the notion of educating all of their citizens and teaching science as inquiring as a major part of their educational reforms **(Abd – EL – Khalick et al 2004)**. Likewise in Nigeria, main objectives of the most recent curriculum reform initiatives involved infusing constructivist principles to the teaching and learning of the sciences. **(Obioma 2009).**

An inquiry approach to teaching and learning is considered to best reflect a quality science education, and thus is largely promoted in various reform documents. Inquiry teaching and constructivism are approaches that share a philosophical base structured around students' construction of knowledge and their active and responsible participation in learning. With this said, as the US National Science Education Standards **(NSES)** authors preferred the word inquiry over constructivism, inquiry has become the most ubiquitously used term **(Anderson, 2002).**

In an attempt to find an operational definition for inquiry based science teaching **Kahveci (2010)** contrasted it with textbook – based approaches to teaching science. A textbook – based approach means teaching by largely depending on and following textbook content in contrast with an inquiring approach. **Settlage (2007)** highlights that inquiry "has long been promoted as the antidote for teaching science directly from a textbook" and **Von Secker (2002)** indicates that the science education reform calls for pedagogical shift from a teacher – centered, textbook – based instructional paradigm to a student – centered, inquiry – based model. While textbook – based teaching has been associated with direct instruction, inquiry – based teaching has been suggested to depend largely on students' hands – on investigations with various curriculum materials used as guides **(Pine et al, 2006).**

Although these distinctions have often been made on an 'either/or' basis, textbooks are still being widely used in classrooms and continue to be an essential part of the curriculum **(Kahveci, 2010)**. As various scholars indicate, science textbooks have played a dominant role in the teaching of science and have been mostly the science curriculum **(Chiappetta & Fillaman 2007; Pizzim, Shepardson & Abell 1992).** Confirming this to be true in Nigerian classrooms, **Udeani (2013)** draw attention to the power textbook might have in supporting effective teaching and that textbooks are used as the primary organizer of subject matter at all levels of schooling and given that they are a prominent component of curriculum should reflect inquiry oriented teaching in both its subject matter and activities.

With this study we want to focus on the instructional activities used in daily classroom practice and also on the questions inherent in the textbook prescribed for instruction in biology at the senior secondary school level. We argue that student learning is especially directed by questions included in textbooks which students and teachers work with daily. In concurrence with **Kahveci (2010)** we believe that textbook questions are primary activators for students to focus on the content offered in textbooks and to engage in learning in a particular way. To gain insight into the level of intellectual challenge in the learning activities and questions offered to students in the textbook we analysed the textbooks using Bloom Taxonomy of educational objectives.

Some students are more successful than others in learning science. This may be due to differences in the way students learn – whether it is meaningful or rote learning **(Ausubel 1968).** Meaningful learning requires relevant prior knowledge, meaningful learning tasks, and a meaningful learning set. **(Novak 1988)** In contrast, rote learning is arbitrary, verbatim, and not related to experience with events or objects, and lacks affective commitment on the part of the learner to relate new and prior knowledge. The nature of students' learning – that is, meaningful or rote – is related to the construct "approaches to learning" **(Chin & Brown 2000)**.

Approaches to learning or learning approaches refer to the "ways in which students go about their academic tasks, thereby affecting the nature of the learning outcome" (**Biggs 1994).** Research on approaches to learning derives much from the seminal work of **Marton and Saljo (1976)** on reading from test using phenomenographic methods, were learning is studied from the perspective of the learner. These authors distinguished between deep and surface approaches to learning and this distinction "appears to be a powerful form of categorization for differences in learning strategies" **(Entwistle & Ramsden, 1983).** The general framework and defining features of the deep and surface approaches were described by **Biggs (1987)** and **Marton (1983).**

In essence, the deep approach is associated with intrinsic motivation and interest in the content of the task, a focus on understanding the meaning of the learning material, an attempt to relate parts to each other, new ideas to previous knowledge, and concepts to everyday experiences. There is an internal emphasis where the learner personalizes that task, making it meaningful to his or her own experience and to the real world. In contrast, the surface approach is based on extrinsic or instrumental motivation. The learner who uses a surface approach perceives the task as a demand to be met, tends to memorize discrete facts, reproduces terms and procedures through rote learning, and views a particular task in isolation from other tasks and from real life as a whole.

Teaching which is assisting students to cultivate a deep understanding of what is being taught can be achieved through a number of thought provoking exercises **(Levin & Nolan, 2000)** such as making students explain concepts in their own words, making predictions, drawings, finding exemplars in new contexts and applying concepts to new situations **(Bandt 1992)**. Increasing the intellectual challenges of the tasks requested in student assignments and activities encourages students to achieve a deeper understanding of course materials. This deep approach correlates to Bloom's taxonomy in that moving task beyond a knowledge level to application, comprehension, analysis and synthesis will encourage learners to move beyond the surface approach. Teaching strategies correlates with student learning, with students adopting deep approaches in classrooms that are more student – centered **(Prosser & Trigwell 1999)**.

To achieve these effects, teachers must move away from lecture – based teaching to more participative approaches that include real – life applications of learning, such as the increased involvement of students in experimental designs and activities. Hence, the focus of this research was to look into issues relating to students effective learning and understanding in biology classes by applying the action research approach to teaching.

The study attempted to address issues relating to shortage of students who are available to enroll for courses in the sciences at the university and take up careers in science and technology. The lack of understanding of students in a number of concepts in the sciences have deprived students from taking up careers in fields such as engineering, medicine, pharmacy, agriculture, biotechnology etc. Nigeria in a bid to tune into the global technology drive has set up some innovative hubs in science and technology. The scarcity of well trained personnel has continued to plague these initiatives. To ameliorate these problem proper and effective strategies for the delivery of course materials in classroom and laboratory sessions would have to be developed at both the school, state and national levels. Although the New National Curriculum in the sciences packaged sufficient information to achieve the national goal in science education, inadequate preparation and delivery of the course materials will continue to be the bane of the implementation of the curriculum to achieve meaningful learning on the part of the students.

Problem identification

The development of course materials and the method of delivery in the classrooms and laboratories, as observed with the current syllabuses in the sciences in Nigeria, are not sufficient to enhance the students learning and prepare them adequately for the challenges of higher education. Although, the syllabuses in the sciences provides for adequate learning to prepare the student for taking up careers in science and engineering, the development of course materials and the type of activities required to achieve the desired outcome would have to be addressed early and adequately.

Activities in the teaching of biology include lectures, laboratory practical and demonstrations, observations of preserved specimens, and dissections of plants and preserved animals. These activities do not consistently include higher levels of intellectual challenge.

Assessment of learning is typically by performance on written examinations and reports of practical laboratory exercises, usually at the end of the term or year, during which students normally reproduce memorized materials rather than applying, analyzing and synthesizing the materials learned.

For cognitive ability to be developed by the students, a progressive learning pattern has to be followed in a hierarchical manner according to Bloom's taxonomy, from simple understanding to application and synthesis of the knowledge, and performance tasks undertaken by students should reflect the range of cognitive skills **(Reed & Bergemann, 2011).**

Activities of higher order intellectual levels thus need to be consistently included in the course material to facilitate such higher goals. The lack of intellectual challenges in the course materials and the method of delivery in both classroom lessons and the laboratory practical sessions constitute the basis for this research project.

Purpose of the Study

The purpose of the study was to examine the effectiveness of teaching and learning biology concepts by applying the action research approach. This was be done by

1. Review study materials (recommended textbook, lesson notes and laboratory guides) in secondary school biology with a view to identifying the levels of intellectual challenges included in the activities used for classroom / laboratory instructions.
2. Revise the course materials by including adequate higher intellectual challenge activities using Bloom's taxonomy.
3. Use action research procedures to apply the revised course materials in classroom and laboratory sessions to determine whether more learning will take place.
4. Determine whether activities enjoyed by students also constitute those that enhance their learning.
5. Determine whether there is any correlation between effective learning and perceived students enjoyment of an activity.

Research Questions

1. What are the levels of intellectual challenge included in the activities used for classroom and laboratory instructions?
2. What are the levels of intellectual challenge included in the redesigned course materials for classroom and laboratory instructions.
3. Will there be an increase in learning when a revised course material is used for classroom / laboratory instruction.
4. Is there any relationship between activities enjoyed by students and those that enhance their learning?
5. Is there any relationship between effective learning and perceived students enjoyment of an activity?

Research Hypotheses

1. There will be no significant difference in the mean achievement scores of students taught with the redesigned course materials and those taught with the traditional course materials.
2. There will be no significant correlation between activities enjoyed by the students and those that enhance their learning.
3. There will be no significant correlation between effective learning and perceived student enjoyment of an activity.

Scope of the Study

The study was carried out in four co-educational schools in an urban and rural environment in Lagos State. The study analyzed the recommended biology textbook – **Ramalingam, S.T. (2012)** Modern Biology for Senior Secondary Schools. Onitsha: Africana First Publishers Ltd. The study used action research methodology to teach a redesigned course material to see its effect on improving learning at the higher cognitive levels.

Methods

The Design of the Study

The basic design of the study used action research to explore the effects of specific changes in the design of activities in the course material used in senior secondary school biology.

Comparison was made between students who participated in the traditional activities and those who participated in the redesigned course materials for the term. **Gerald Susman (1983)** made a significant contribution to understanding and implementing action research. His model distinguishes five phases to be conducted within each research cycle as presented in **Figure I**

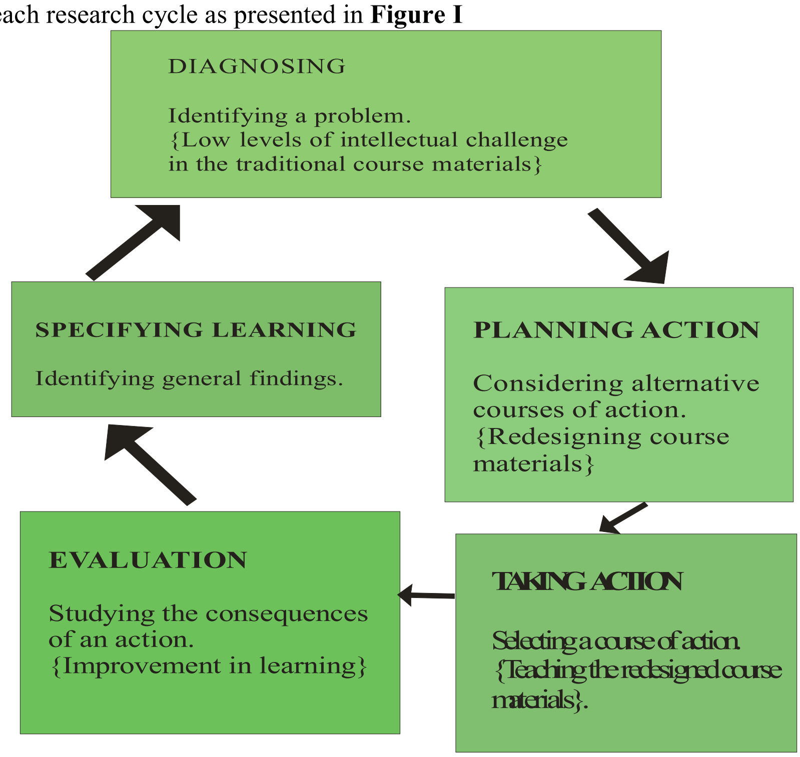

Fig 1: Action Research Cycle.

A problem is identified and data is collected for a more detailed diagnosis. This is then followed by a collective postulation of several possible solutions, from which a single plan of action emerges and is implemented. Data on the results of the intervention are collected and analyzed and the findings are interpreted in light of how successful the action has been.

The Action Research Process
Step I: Diagnosing (Identifying the Problem)
The review of the activities and exercises in the prescribed text book – Modern Biology for Senior Secondary Schools to identify the levels of intellectual challenge in the activities used for classroom and laboratory instruction and exercises at the end of each chapter. The review was done by the researchers assisted by the four biology teachers.
Step II: Planning Action
Revision of Course Materials

a) The scheme of work for **2014/2015** SS II second term was revised by including adequate higher intellectual challenge activities using Bloom's Taxonomy of Educational Objectives in the cognitive domain.

THE SCHEME OF WORK FOR SS II 2ND TERM
BIOLOGY
TOPIC / CONTENT

1. **EXCRETION**
   i. Definition of Excretion
   ii. Structures of Excretion in living organisms
   iii. Waste products of metabolism
   iv. Forms in which waste products are excreted.
2. **TISSUES AND SUPPORTING SYSTEMS**
   SKELETON AND SUPPORTING SYSTEMS
   i. Definition of skeleton
   ii. Biological significance of skeleton
   iii. Forms of skeleton (Chitin, Cartilage, Bone)
   iv. Types of skeleton (Exo-skeleton, Endo-skeleton, Hydrostatic)
3. **COMPONENTS OF THE MAMMALIAN SKELETON**
   i. AXIAL SKELETON
   a) The Skull
   b) The Vertebral Column
   c) Ribs
   ii. APPENDICULAR SKELETON
   a) Pectoral girdle
   b) Pelvic girdle
   c) Pentadactyl limbs
4 **i) JOINTS**
   a) Types of joints
   b) Structure of joints
   c) Functions of joints
   d) Mechanism of joint movement
   e) Functions of skeleton
   ii) SUPPORTING TISSUES IN PLANTS
   a) Types of plant supporting tissues
   b) Structure / Features of plant supporting tissues.
   c) Functions of plant supporting tissues.
5. **ALIMENTARY CANAL / DIGESTIVE SYSTEM**
   ALIMENTARY TRACT OF ANIMALS
   i) INVERTEBRATE
   a) Planeria
   b) Earthworm
   c) Grasshopper
   ii) **VERTEBRATES**
   a) Birds
   b) Rabbits
   c) Similarities and differences in the alimentary canals of different animals.

d) Digestive system and digestion in man.

6. **PRACTICALS on Digestion and Skeletal System.**
Dissection of Rabbits / Rat / Fowl

7. **FEEDING HABITS**
   a) Categories and mechanisms
   (Filter and fluid Feeding)
   (Piercing and Sucking)
   b) Modification in organisms to reflect feeding habits.

8. c) Feeding in Amoeba, Hydra & Man
   d) Teeth – types, structure and functions
   e) Dentition in Herbivores, Carnivores and Omnivores.

9. **TRANSPORT SYSTEM**
   a. Need for Transportation
   b. Materials for Transportation e.g. food, oxygen, wastes.
   c. Media of transportation e.g. Cytoplasm, lymph, blood.
   d. Composition and Functions of Blood and lymph

10. **CIRCULATORY SYSTEM**
   a. Structure of the Mammalian heart, arteries, veins, and capillaries.
   b. Types and mechanism of circulation
   c. Open and closed circulatory
   d. Single and double circulatory.

11. **MECHANISM OF TRANSPORT IN HIGHER PLANTS**
   a. Absorption and Transport of water and mineral salts
   b. Transportation
   c. Translocation

12. **REVISION AND EXAMINATION**

13. **REVISION AND EXAMINATION**

The revised course material for the term is included in the appendices. Table I presents the level of intellectual challenge in the traditional and revised course materials. This exercise was also carried out by the researchers assisted by the four teachers.

Table 1: Activities in the SSII 2nd Term Scheme of Work

Concept	Material	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total
Excretory System	Traditional	3	-	-	-	-	-	**3**
	Revised	2	1	1	3	-	1	**8**
Skeletal System	Traditional	1	2	-	-	-	-	**3**
	Revised	1	3	1	4	1	-	**10**
Digestive System	Traditional	-	-	-	4	-	-	**4**
	Revised	1	2	-	7	-	1	**11**
Transport System (Animals)	Traditional	1	2	1	-	-	-	**4**
	Revised	1	2	2	2	2	1	**10**
Transport System (Plants)	Traditional	-	-	-	5	-	-	**5**
	Revised	-	2	1	6	2	-	**11**

a) Training the Teachers

The four biology teachers were trained on how to use the revised course materials during the instructional process. Altogether 12 training sessions of two hours was held for the teachers in the Biology Lab of the Department of Science and Technology Education. The research team members demonstrated all the activities with the teachers (experiments, simulations, dissections, construction etc.). Trial sessions were videotaped for discussions and clarifications.

Step III: Taking Action

The revised course materials were used during the instructional process for the whole of 2nd term in the participating schools to teach the experimental groups while the control groups were taught using the traditional materials. Actual teaching lasted for eleven weeks. The participating teacher would give the instruction and the researchers observed the delivery without active participation.

The laboratory exercises and demonstration were carried out using the revised practical guides. Additional models, slides, equipment and consumables where brought to enrich the learning experiences of the students.

In the control class the same content were presented employing the traditional lecture method for instruction.

At the completion of each concept or group of concepts achievement tests, questionnaires were administered to the students. Assignments and laboratory reports were also collected.

Sampling

Purposive sampling was used to select the four senior secondary schools from an urban and a rural location in Lagos State.

The four schools selected are:-

1. Arch Adelaja Senior High School, Bariga
2. Shomolu Senior High School, Shomolu
3. Government Technical College Odumola, Epe
4. Surulere Girls Senior Secondary School, Surulere

The four schools were selected based on the following criteria: schools that are equivalent in performance in the past Lagos State Unified Examination, have graduate biology teachers that have been teaching in the same school and the same level for not less than five years, teachers that are willing to participate in the study.

In each of the participating school two intact classes were used to act as experimental and control group respectively. Altogether two hundred and sixty seven **(267)** students and their four biology teachers participated in the study. Average age of the students was 16^{+}.

Research Instrument

Various research instruments were used for the study. These included:-

1. **3 Biology Achievements Tests**
   a. **Biology Achievement Test 1**
   This test contained 30 items and covered the following concepts – Tissues and Supporting Systems; Components of the Mammalian Skeleton, Axial and Appendicular Skeleton, Joints, and supporting Tissues in Plants.
   b. **Biology Achievement Test 2**
   This test contained 37 items and covered Excretory and Transport Systems in Plants and Animals.
   c. **Biology Achievement Test 3**
   This test contained **27** items and covered the following concepts – Alimentary canal, Digestive Systems, Feeding Habits in both Invertebrates and Vertebrates.
   The table of specification for the three Achievement Tests is included in the Appendix. The reliability indices for the test are as follows: - Achievement test 1 **(0.81)**; Test 2 **(0.79)**; Test 3 **(0.83)**. The split half reliability coefficient was calculated using the Pearson Product moment correlation coefficient.
2. **Student Enjoyment of Activity Questionnaire**
   Four questionnaires were developed on a 5 – point Likert Scale to assess students' enjoyment of the activities they carried out during the class periods. The questionnaires covered Skeletal Systems, Transportation in Living organisms, Excretory System and the Digestive System.

Table 2: The Reliability Test of Questionnaire on Students Enjoyment of Learning Activities

Instrument	Scale Statistics					Reliability Statistics
Source	N of Items	**N of Samples**	**Mean**	**STD**	**CV**	**Cronbach's Alpha**
Digestion	10	140	42.73	5.518	0.13	0.776
Excretion	8	152	25.70	6.225	0.24	0.781
Skeletal System	13	132	56.29	5.542	0.10	0.769
Transportation in Living Organisms	14	136	55.65	0.849	0.15	0.849
Pooled Data	45	560	188.74	14.370	0.08	0.828

The test of reliability result of the responses of Students' Enjoyment of Learning Activities, using standardized Cronbach's Alpha indicates that the instruments are reliable, since the Cronbach's Alpha Statistics obtained in each section and overall is **70%** threshold value. The validation of reliability results of instrument is carried out using the coefficient of variable (CV) result which are **< 0.50** threshold value, implying strong homogeneity on how the respondents rated the items. Hence, there is an internal consistency of the answers provided by the students, and therefore the data do not violate the assumption of reliability.

3. **End of Concept Essay Questions**
Two essay questions were given to students to answer and submit at the end of each concept taught. The essay questions test the higher cognitive domain – i.e. Analysis, Synthesis and Evaluation of Blooms Taxonomy of Educational Objectives.

Results
The result of the analysis of the review of the activities and exercises in the recommended Biology textbook for use in Lagos State Schools is as presented.

Analysis of Activities and Exercises

Table 3: Exercises in Modern Biology Text

EXERCISES IN MODERN BIOLOGY		
BEHAVIOUR	FREQUENCY	%
KNOWLEDGE	136	55
COMPREHENSION	99	40
APPLICATION	5	2
ANALYSIS	7	3
SYNTHESIS	2	1
EVALUATION	0	0
TOTAL	249	100

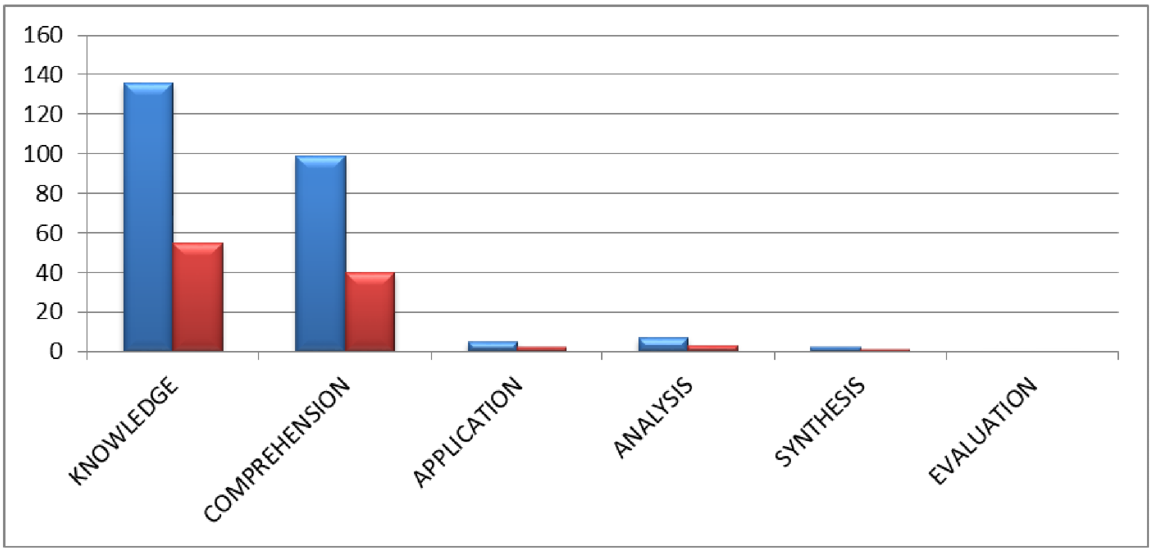

Fig 2: Bar Chart of Exercises in Modern Biology Text

Table 4: Activities in Modern Biology Text

ACTIVITIES IN MODERN BIOLOGY		
BEHAVIOUR	FREQUENCY	%
KNOWLEDGE	41	26
COMPREHENSION	44	28
APPLICATION	26	17
ANALYSIS	37	24
SYNTHESIS	7	5
EVALUATION	0	0
TOTAL	155	100

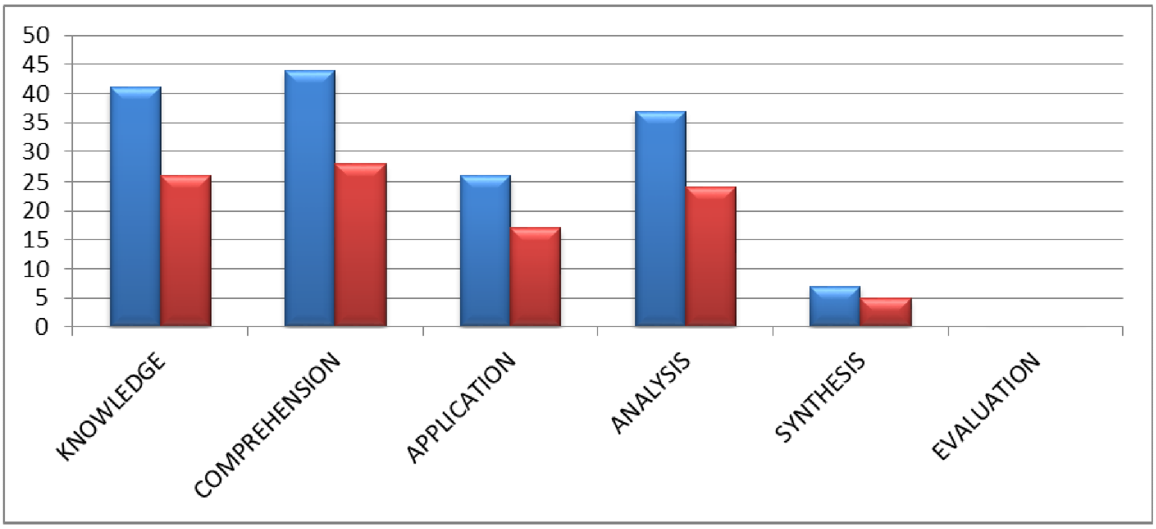

Fig 3: Bar Chart of Activities in Modern Biology Text

As could be seen from the Table **3 & 4** and Figure **2 & 3** most of the activities and exercises are at the lower cognitive level of Blooms Taxonomy of Educational Objectives. Specifically **71%** of the activities and **95%** of the exercises are at the lower cognitive levels of Blooms Taxonomy of Educational Objectives.

Student Achievement Results

Hypothesis 1: There will be no significant difference in the mean achievement scores of students taught with the redesigned course materials and those taught with the traditional course materials.

Table 5: Descriptive Statistics of Mean Achievement Scores of Students

Methods	N	Mean Achievement scores	Std. Deviation	Std. Error Mean
Redesigned Course Materials	128	10.6144	1.85768	.16420
Traditional Course Materials	137	8.3601	2.31232	.19755

The descriptive statistics indicates that the mean achievement scores of students taught with the redesigned course materials is **10.61** while those taught with the traditional course materials is **8.36**. The results are obtained with minimum error of **0.164** and **0.197** respectively. The test for significance difference is carried out using independent samples t-test.

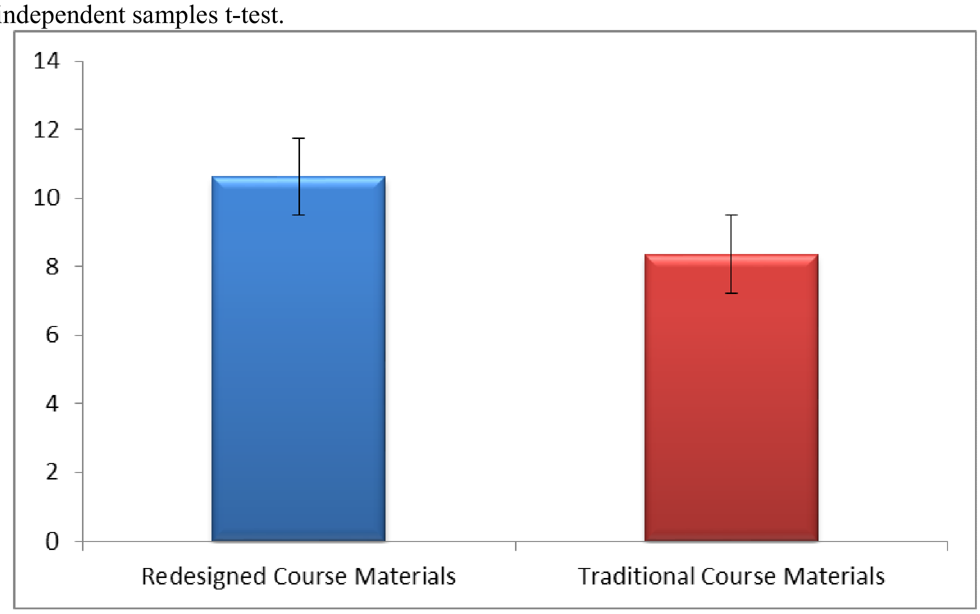

Figure 4: Bar Chart of Mean Achievement Scores of the Students

The bar chart results show that the mean achievement score from redesigned course materials method is higher than the mean achievement score from traditional course materials. In addition, the error bar indicates that equal treatments are administered in each method of teaching.

Table 6: Independent Samples Test to Test Hypothesis 1

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	5.913	.016	8.711	263	.000	2.25423	.25878	1.74469	2.76377
Equal variances not assumed			8.775	257.308	.000	2.25423	.25688	1.74837	2.76009

The independent samples t-test result indicates that, when equal variances are assumed, there is a significant difference in the mean achievement scores of students taught with the redesigned course materials and those taught with the traditional course materials at **t = 8.710, p = 0.000 < 0.05** significance level. The result implied that students taught with the redesigned course materials performed better than those taught with the traditional course materials.**Student Enjoyment of Activities.**

Table 7: Descriptive Statistics of Students' Enjoyment of Learning Activities.

Learning Activity	N	Mean	STD	Category	Extent	Remark
Digestion	10	4.27	0.552	4	1.07	High
Excretion	8	3.21	0.778	3	0.80	Low
Skeletal System	13	4.33	0.426	4	1.08	High
Transportation in Living Organisms	14	3.98	0.601	4	0.99	Low
Achievement Score	45	4.19	0.319	4	1.05	High
Mean Reference Index		**4.00**		**4**	**1**	

The descriptive statistics in **Table 7** indicates that the extent of students' enjoyment of learning of biological activities is high in digestive system and skeletal system while it is low in excretory system and transportation in living organisms. Students' enjoyment of learning biological activities is most in skeletal system with a mean score of **4.33** and least in excretory system with a mean score of **3.21**. The results are depicted in the **figure 5**.

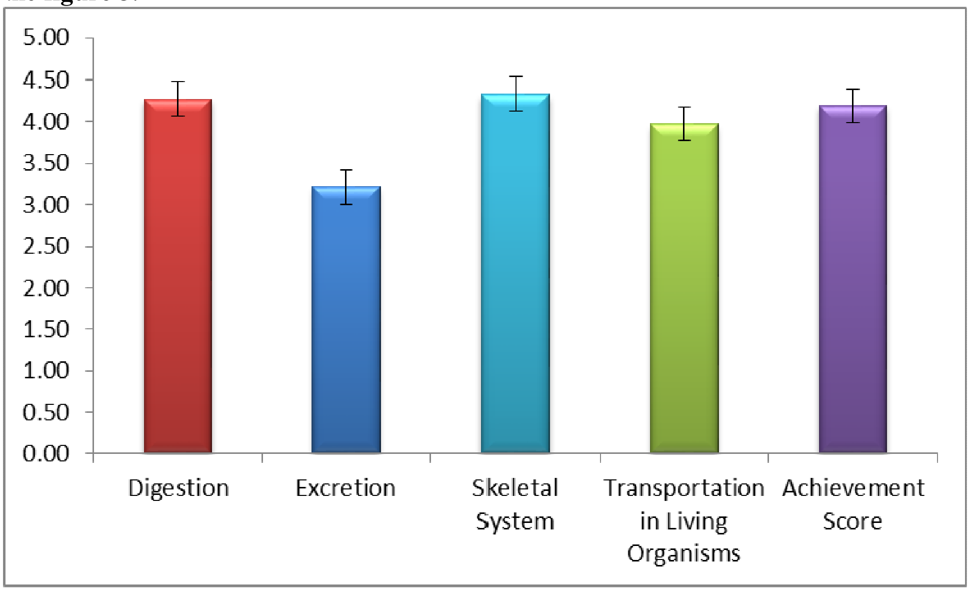

Figure 5: Bar chart of the Mean score of Students' Enjoyment of Learning Activities

The bar chart shows the mean score of students' enjoyment of learning biological activities with the achievement score. It shows that enjoyment of learning activities by students is most in skeletal system, followed by digestive system, and it is least in excretory system. The error bar indicates that equal treatment was administered in each section of the learning activity and among the participating students for optimum response.

Hypothesis 2: There will be no significant correlation between activities enjoyed by the student and those that enhance their learning.

Table 8: Pearson Correlation Analysis on Activities Enjoyed by Students and those that enhance their Learning.

Variables	Mean	Std. Deviation	N	r
Activities Enjoyed by the Students	3.8883	0.51761	173	.020
Activities that enhance students learning	9.4490	2.38501	265	

r = correlation estimate

The Pearson correlation result suggests that there is no significant correlation between activities enjoyed by the student and those that enhance their learning at **r = 0.020 (0.05** significant level). This result implied that students' performance in examination and students' enjoyment of an activity do not correlate.

Hypothesis 3: There will be no significant correlation between effective learning and perceived student enjoyment of an activity.

Table 9: Pearson Correlation Analysis on Effective Learning and Students Enjoyment of Activity

Variables	Mean	Std. Deviation	N	r
Effective Learning	3.8139	.26282	155	.247**
Perceived student enjoyment of an activity	3.8883	.51761	173	

*.Correlation (r) is significant at the 0.01 level

The Pearson correlation result suggests that there is a significant correlation between effective learning and perceived student enjoyment of an activity at **r = 0.247 (p < 0.05).** This result implied that effective learning and perceived student enjoyment of an activity depends on each other.

Discussion of Results

The result of the analysis of the activities and end of chapter questions in the recommended biology text used for senior secondary schools in Nigeria broken down by cognitive level is reported in Tables **3 & 4** and Figure **2 & 3**. The analysis showed the preponderance of low cognitive questions (Knowledge **55%**; Comprehension **40%**) and for the activities **54%** are at the lower level; **41%** at the medium level and **5%** at the higher cognitive level.

These results are similar to the results of **Udeani 2013; Kahveci, 2010** and **Pizzini et al 1992** that found out that input level ie low cognitive level questions dominated in the commonly used secondary science textbooks in their respective countries.

The book analyzed in this study showed that the higher cognitive level questions is low – less than **5%**. Low level questions require the students to recall information from memory; higher order questions promote creation and evaluation **(Pizzini et al 1992).** Also, considering Bloom's Taxonomy of educational objectives in the cognitive domain, for higher level skills, higher level questions should be asked. Input level questions would be likely to promote skills in the knowledge and at most comprehension level, processing questions in the application and analysis levels and output questions in the synthesis and evaluation level.

Research into instructional processes have reiterated the importance of students engagement with the learning materials for meaningful learning. A truly inquiry oriented textbook as recommended by the Nigerian Education Research and Development Centre should pose interesting questions leading students to collect and organize data and involve them in the teaching process as active learners. Contrary to an encyclopedic presentation of the material as historically enacted in science textbooks many contemporary texts are intended to initiate inquiry and suggest interesting investigations **(Chiapetta & Collette, 1989).**

In the textbook analyzed the low proportion of higher order level questions and activities is disappointing in these respects.

In this study, the action research method was used to teach the redesigned course materials to students in the experimental group for the second term of the **2014/2015** academic session. The results on Table 6 and Table 7 indicates that when equal variances are assumed, that there is a significant difference in the mean achievement scores of students taught with the redesigned course materials and those taught with the traditional course materials **(t = 8.710; p = 0.05 significant level)**. The inquiry approach used involved spending time with laboratory activities and various equipment, real life specimens and material and watching video clips. These activities require more class time than the traditional approach. This teaching approach could sometimes be seen as limiting the breadth and depth of the content covered.

Nonetheless, according to **Chiappetta and Collete (1989)** within an inquiry – based approach "what is lost in terms of subject matter is gained in terms of understanding the nature of scientific inquiry".

Another result which attract attention is the no or very low relationship between student biology achievement and their perception of enjoyment of biology activities. In other words, students may be successful in science even if they do not enjoy science. This is an unexpected result. However there may be some reasons which we can allude to the Nigerian Education System. In Nigeria, students have several high stake National Examinations like the West African Examination Council (WAEC) and National Examination Council (NECO) which are taken at the end of the senior secondary school level. These examinations are so vital and important for students and parents since it is perceived as a tool for academic and social mobility.

Therefore, Nigerian students are motivated to be high achievers in many concepts in order to be successful in national examinations even if they do not enjoy the topic.

The result is in agreement with the findings of **Ozdemir (2003)**. His study observed that students' enjoyment of science did not seem to have any significant contribution on science achievement. In addition; he also noted that science achievement had a negative relationship with classroom activities that are student centered. Also agreeing with these results **Anwer, Igbal & Harrison (2012)** in their study with urban and rural students in Pakistan found no relationship between attitudes towards scientific inquiry, enjoyment of science lesson and science achievement.

The result of the present study led the authors to conclude with **Kember, et al (1997)** that when students are engaged in integrating theory and practice and in reflecting on learning, they are more likely to develop a deep approach to learning.

Educational Implications of the Study

- Perhaps the most important implication of this study is for the faculties of education in Nigeria. It is common fact that the teachers have some difficulties in performing an effective teaching / learning process which manifested in the present study. Therefore teacher – training Programs of the country should be revised and preferably have more pre-service teaching practice and emphasize the student – centered classroom activities. However even though the textbooks and curricula are designed with respect to student – centered activities, in practice it is always questionable to implement these methods for enhancing students achievement.
- The appears to be disharmony between curricula and real teaching and learning practices. When the biology curricula and textbooks are evaluated closely, they seem to be somehow student – centered on paper because the biology curricula and textbooks include lots of experiments for students albeit at the lower level cognitive domain. However, school and classroom atmosphere seem to be still quite authoritarian and teacher – centered especially in rural areas. In other words, there are some contradictions between science curricula and real teaching / learning process in schools. In such an atmosphere an efficient student – centered teaching / learning process can hardly be performed. Therefore, the education ministries should take more precautions in order to decrease the disharmony between science curricula and real instructional practices.

References

AAAS (American Association for the Advancement of Science) (1990). *Science for all Americans*. New York: Oxford University Press / American Association for the Advancement of Science.

AAAS (2005) *AAAS Project 2061 textbook evaluations*. (Electronic Version) Retrieved July 28, 2013, from http://www.project2062.org/publications/textbook/hsbio/report/analysis.htm.

Abd-El-Khalick, F., Boujaoude, S., Duschl, R., Lederman, N.G., Mamlok – Naaman, R., Hofstein, A., et al (2004) Inquiry in Science Education: International perspectives. *Science Education*, 88, 397 – 419.

Anderson, R.D. (2002). Reforming Science Teaching. What research says about inquiry? *Journal of Science Teacher Education*, 13, 1, 1 – 12.

Ausubel, D.P. (1968) Educational Psychology: *A cognitive view*. New York: Holt, Rinehart & Winston.

Anwer, M., Igbal, H.M., & Harrison, C. (2012) Students attitudes towards science: A case of Pakistan. *Pakistan Journal of Social and Clinical Psychology*, 10, 1, 3 – 9.

Brandt, R. (1992). On teaching for understanding. A conversation with Howard Gardner. *Educational Leadership*, 50, 4 – 7.

Biggs, J. (1987). Student approaches to learning and studying. Melbourne: Australian Council for Educational Research.

Biggs, J. (1988) Approaches to learning and to essay writing. In R.R. Schmeck (Ed), Learning strategies and learning styles (pp. 185 – 228). New York: Plenum.

Biggs, J. (1994) Approaches to learning: Nature and measurement of . In T. Husen and T.N. Postlethwaite (Eds) *The international encyclopedia of education* (2nd ed., Vol. 1) (pp. 319 – 322) Oxford: Pergamon.

Chiappetta, E.L., & Fillman, D.A. (2007) Analysis of five high school biology textbooks used in the United States for inclusion of the nature of science. *International Journal of Science Education,* 29, 15, 1847 – 1868.

Chin, C., & Brown, D.E. (2000) Learning in science: A comparison of deep and surface approach. *Journal of research in Science Teaching*, 37, 2, 109 – 138.

Entwistle, N.J., & Ramsden, P. (1983) *Understanding student learning.* London: Croom Helm.

Kahveci, A., (2010) Quantitative Analysis of Science and Chemistry Textbooks for Indicators of Reform: A complementary perspective. *International Journal of Science Education*, 32, 11, 1495 – 1519.

Kember, D., Charlesworth, M., Davies, H., Mckay, J, & Stott, V. (1997) Evaluating the effectiveness of educational innovations: Using the study process questionnaire to show that meaningful learning occurs. *Studies in Educational Evaluation,* 23, 141 – 157.

Levin, J. & Nolan, J.F. (2000). Principles of classroom management: A professional decision – making model. Needham Heights: Allyn & Bacon.

Marton, F. (1983) Beyond individual differences. *Educational Psychology,* 3, 289 – 303.

Marton, F., & Saljo, R. (1976) On qualitative differences in learning. I : Outcome and process. *British Journal of Educational Psychology,* 46, 4 – 11.

Novak, J.D. (1988) Learning science and the science of learning. Studies in Science Education, 15, 77 – 101.

NRC (National Research Council). (1996) *National Science Education Standards*. Washington, DC: National Academy Press.

Obioma, G.O. (2009) *Biology for Senior Secondary School*: Nigerian Educational Research and Development Council. Abuja: Federal Government Press.

Ozdemir, E., (2003) Modeling of Factors Affecting Science Achievement of Eight Grade Turkish Students Based on the Third International Mathematics and Science. Unpublished M.Sc. thesis, The Middile East Technical University.

Pine, J., Aschbacher, P., Ruth, E., Jones, M., Mcphee, C., Martin, C., et al (2006) Fifth graders' science inquiry ability: A comparative study of textbook curricula. *Journal of Research in Science Teaching*, 43, 5, 467 – 488.

Pizzini, E.L., Shepardson, D.P., & Abell, S.K. (1992). The questioning level of select middle school science textbooks. *School Science and Mathematics,* 92, 2, 74 – 79.

Prosser, M., & Trigwell, K. (1999) *Understanding and learning in teaching: The experience in higher education.* Philadelphia, PA: Society for Research into Higher Education & Open University Press.

Prosser, M., Trigwell, K., Hazel, E., & Waterhouse, F. (2000) Students' experiences of studying physics concepts: The effect of disintegrated perceptions and approaches. *European Journal of Psychology of Education,* 15, 61 – 74.

Reed, A. J.S., & Bergemenn, V.E. (2001) A *guide to observation, participation and reflection in the classroom,* 4th ed. Boston: McGraw Hill.

Secker, C.E.V., & Lissitz, R.W. (2007) Estimating the impact of instructional practices on student achievement in science. *Journal of Research in Science Teaching*, 36, 1110 – 1126.

Settlage, J. (2007) Demythologizing science teacher education: Conquering the false ideal of open inquiry. *Journal of Science Teacher Education,* 18, 461 – 467 doi: 10 – 1006 / ceps. 1999 – 1020.

Udeani, U.N. (2013) Quantitative Analysis of Secondary Schools Biology Textbooks for Scientific Literacy Themes. *Research Journal in Organizational Psychology & Education Studies,* 2, 1, 39 – 43.

VonSecker. C., (2002) Effects of inquiry – based teacher practices on science excellence and equity. *Journal of Educational Research,* 95, 3, 151 – 160.