STUDENTS' UNDERSTANDING OF CONCEPTS AND THEIR ACHIEVEMENT IN SCIENCE: IMPLICATION FOR AN INNOVATIVE INSTRUCTIONAL STRATEGY

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Abstract
The paper observed the pattern of enrolment and achievement in sciences particularly in physics, chemistry and biology over some years particularly between 2000 and 2004.It went further to observe that the level of achievement in science is due to difficulty in understanding scientific concepts. Thus the paper opined that an innovative strategy such as creating an attractive learning environment outside the conventional science laboratory and use of computer-assisted- instruction could optimally enhance understanding of scientific concepts to fruition.

Introduction
Science according to Otuka and Uzoechi (2009) is a human activity that has had profound influence on our social, economic and cultural lives. This is why the issues of enrolment and achievement in the three basic science at the senior secondary school cannot be relegated to the background. science is not merely a technique or a body of systematic knowledge; it is rather an attitude of inquiry of observation and reasoning with respect to the world (Eniayeju, (2001).

Eniayeju (2001) pointed out that the low performance of students in public examination has been a matter of utmost concern to many people that have vested interest in science education. This is why this study looked into the issues relating to students understanding of concepts and their corresponding achievements in public examinations.

Generally, physics, chemistry and Biology have many theoretical concepts that are difficult to understand by students (Gohen & Kocakeya, 2005). Hencer and Tuzeman (2008) in about 3500(three hundred and fifty)studies related to Science education in the last twenty years observed that students were unsuccessful in the understanding of some scientific concepts so that learning such concepts is frightening to them.

Ajewole (1990) in Suleiman (2006) observed that the teacher centred methods of teaching have failed to produce science students that are committed and who can reason critically and able to transfer what is learnt to a new situation. It is in this line that Suleiman (2006) opined that a more interactive methodology should be employed in teaching science instead of the rote learning of scientific facts.

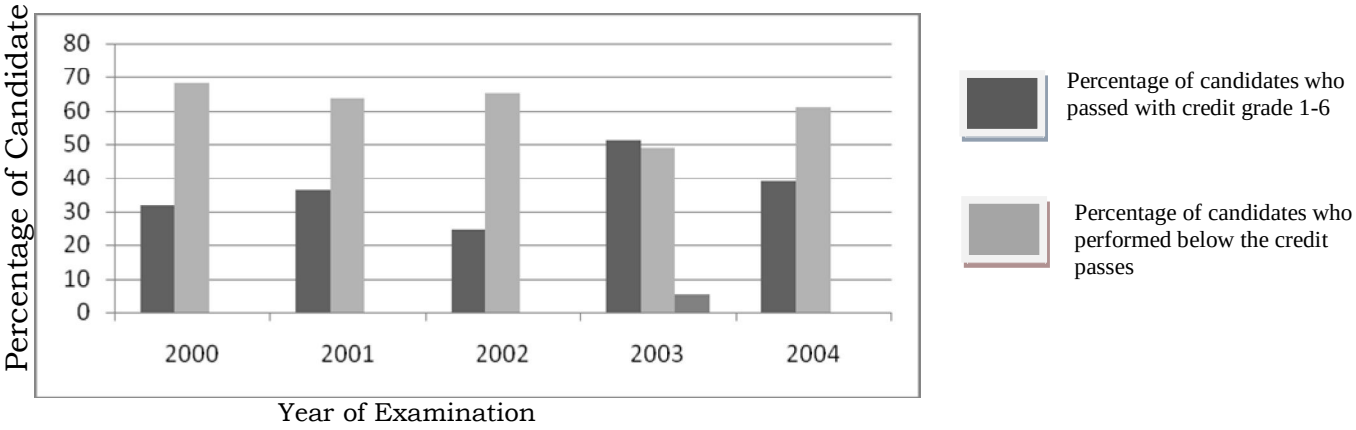
Enrolment and Achievement Pattern in Science
Ezeife (1996) in Nkwo, Akinbola and Ikitde (2008) points to the fact that there are increasing conditions for underachievement and slow learning in physics (one of the basic sciences) portraying possible failures of previous efforts of science education in improving learning conditions. Bamidele (2004) also observed that lack of interest in physics (science) by students due to preconceived idea that it is a difficult subject has affected the enrolment of students in it

Table 1: Showing students' enrolment and performance pattern in the senior secondary school certificate (SSCE) in chemistry (2000-2004 May/June)

Year of Enrollment	No of Candidate Enrolled	Percentage of Candidates who Passed with Credit Grade (1-6)	Percentage of Candidate who Performed Below the Credit Grade (1-6)
2000	195,810	31.88	68.12
2001	301,740	36.25	63.75
2002	309,112	24.89	65.11
2003	288,324	50.98	49.02
2004	275,078	38.97	61.03

Source: The West African Examination Council (Test Development Division Centre) in Onifade (2006)

Table 1 shows the number of candidates enrolled in chemistry and the percentage of those who passed at credit level as well as below the credit level. The percentage of students that passed at credit level were lower than those who performed below the credit level except for 2003. This is further shown in the bar chart below.



From fig 1, percentage of students who performed below credit passes in Chemistry was higher except for the year 2003.

Table 2: Showing Students enrollment and performance pattern in the senior secondary school certificate (SSCE) biology (2000-2004 MAY/JUNE)

Year of Enrollment	No of Candidate Enrolled	Percentage Candidates who Passed with Credit Grade (1-6)	Percentage who Performed below the Credit Grade
2000	620,291	19.30	80.70
2001	995,345	23.25	76.75
2002	1,047,235	31.39	68.61
2003	931,219	43.14	56.86
2004	838,945	30.83	69.17

Source: The West African Examination Council (Test Development Division Centre) in Onifade (2006)

Table 2 above shows the number of candidates enrolled in Biology and the percentage of those who passed at credit level of well as below the credit level. In all years the percentage of those who

performed below the credit level was much higher than those who passed credit level. This information is represented in the bar chart below:

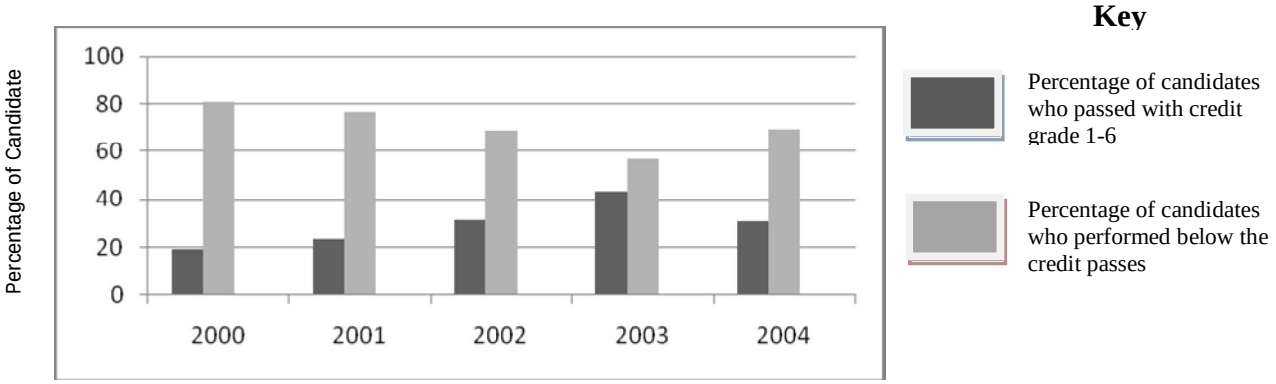


Fig. 2.

In all cases from the bar chart in fig 2, percentage of students' with credit passes in Biology is lower than those who performed below the credit mark.

Table 3: Showing students' enrolment and performance perform in the Senior Secondary School Certificate (SSCE) in physics (2000-2004 MAY/JUNE)

Year of Enrollment	No of Candidate Enrolled	Percentage of Candidates who Passed with Credit Level	Percentage who Performed below the Credit Level
2000	188,312	30.05	69.95
2001	287,993	34.46	65.40
2002	298,059	47.66	52.34
2003	280,818	47.56	52.44
2004	270,026	51.02	48.98

Source: The West African Examination Council (Test Development Division Centre) in Onifade (2006)

From table 3 from year 2000 to 2003, percentage of candidates with performance below the credit level were much higher than those with performance at credit level with exception of the performance in 2004. The information is represented in a bar chart:

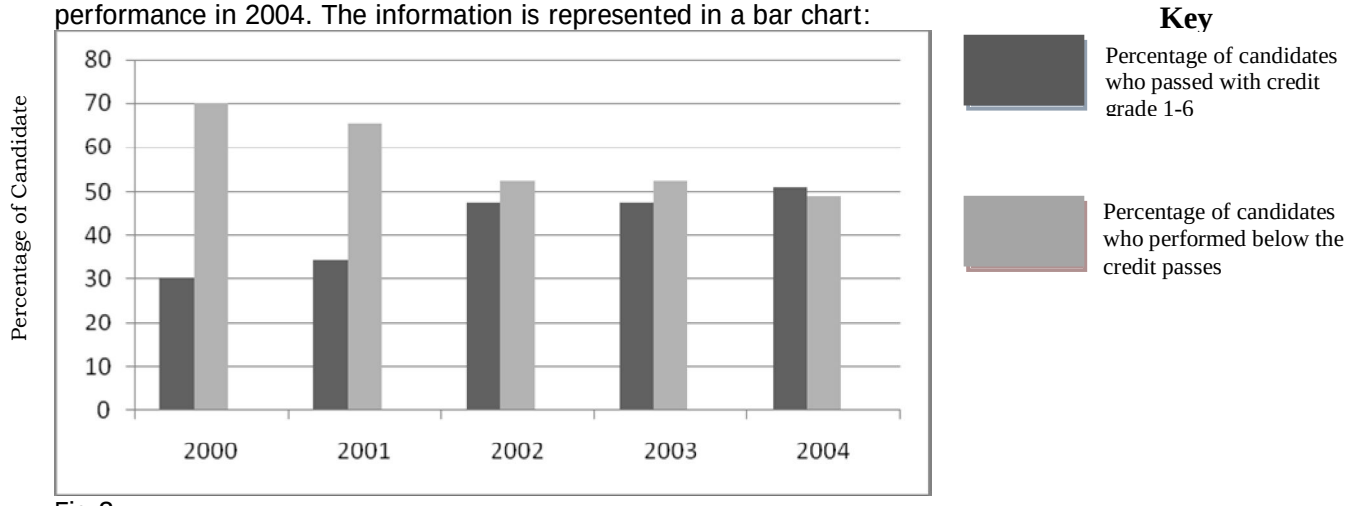


Fig 3

Key

In all cases as shown in fig 3, the number of candidate who performed below the credit level in physics is higher than those who passed with credit except in the case of 2004 with 51.02% as against 48.98%

Understanding Scientific Concepts: A Determinant for achievement in Science

Students are unsuccessful in the understanding of some scientific concepts so that learning such concepts is frightening to them and consequently low achievement in science (Hencer & Tuzeman, 2008). Also the enveloping problems of underachievement and slow learning that attend Physics (one of the basic science) as observed by Ikwa (1997) in Nkwo et al (2008) are attributed to students and teachers' ineffective grasp of concepts due to difficulty in constructing and understanding of these concepts Besides, Otuka and Uzoechi (2009) also observed that concepts are important in communicating science. This implies that no appreciable achievement can be observed if scientific concepts are not well understood and communicated.

According to Otuka and uzoechi (2009), the term concept has various explanations by various people. To some, concept are terms, symbols, ideas or names, while to others concept are summaries of related facts, composite knowledge, exclusive in relational terms or mental picture. Ogunniyi (1986) in Otuka and Uzoechi (2009) asserts that concepts are important in communication in science. Success in communication according to him depends on the way and manner science data are selected and organized into manageable key of concepts. Scientific concepts are often organized into two classes: empirical and theoretical.

Gonen, Kocakaya and Inan (2006) established that physics, chemistry and Biology have many theoretical concept that are difficult to understand by students. In physics, concepts like field, equilibrium. energy ,and motion; in biology, concept like genetics, respiration, metabolism and ecology are regarded as difficult concepts. In order to raise the level of understanding of concept for optimal performance in this basic science namely physics, chemistry and Biology illustration by models must be taken beyond their physical limitation. They must serve a basis for venturing into the realm of abstracts or as supplement to the intuition of the students hence a need for an innovative teaching strategy for optimal students' performance. In fact, Mayer (2003) in Kara & Kahraman (2006) reported that experimental evidences had found that verbal – only method is not working so well and that increasing visual content makes instruction lasting and effective when principles of how people learn are taking into account. It is on this note that this paper advocates for an innovative strategy in teaching science concepts for optimal achievement.

Necessary Innovative Strategy in Science Teaching for Optimal achievement

Knowledge needed in contemporary science education is functional science literacy (Onifade, 2006). According to him, traditional knowledge is now obsolete. Science education has gone through some strain and stress in Nigeria and that some innovation introduced in schools were centred on the integration of theory and practical in the student based science curricula for schools. The first innovations introduced in schools were centered on the integration of theory and practical in the student based science curricular for schools. The first innovations were in the following areas:

(i) Massive-in-service training of science training of science teachers through the annual long vacation science courses and the master-trainers organized at different centres in the country.

(ii) Development of a standard list of science equipment as the minimum required for the teaching and learning of science in school.

But today, science education is facing a lot of challenges so that science teachers and students are not yet at level from where they are able to acquire the necessary contemporary knowledge, skills

and attitude for optimal science performance. In the light of this, the following innovations for improved achievement in physics, chemistry and Biology is necessary:

(i) Reducing attrition in enrollment by stimulating enrollment interest through curriculum innovations in the area of computer-assisted-instruction (CAI) packages for regular instruction in the basic sciences. This is could cover both theoretical and practical lessons rather than the chalk-talk method. This is confirmed by Kara and Kahraman (2008) who asserts that the ongoing CAI package could make lesson more interesting and encouraging so that more complex science concept can be learnt permanently in an effective way. Besides, Dirmirci (2005) also observed that the ongoing revolution in information technology has led to new jobs for creating innovative educational environment such innovative learning environment could shoot up enrollment in basic sciences (physics, chemistry and biology) and also discourage drop out (attrition) from science classes.

(ii) Making abstract science concept real through CAI for optima/performance. In the view of Otuka and Sander (2004) that modeling and interactive physics with computer is a tool that improves physics instruction by making abstract concepts real rather than talk and chalk method. In fact, Ajileye (2008) also observed that the most recent curricular innovation should be towards globalization and information technology via the use of computer and internet therefore computer-aided-instruction can be used in introduced in the curriculum to enhance an optimal performance- in the basic sciences.

(iii) Creating an innovative educational environment for learning science beyond the conventional laboratory. The learning and teaching of science should be taking to beyond the laboratory walls to the outside to remove the phobia associated with the learning of science well as create a friendly and tantalizing environment for science learning. This is accordance with the observation made by Bajah (1997) in Onifade (2006) that the walls of the conventional laboratory should be broken and the entire physical environment should now be our environment for learning science.

(iv) Creating an environment for mobile learning. Mobile-learning offers modern ways to support leaning progress through process mobile devices such as hand held and tablet computer, MP3player, smart phones and mobile phones. It presents a unique attributes compared to conventional ,mobile learning emerging as one of the solutions to the challenges faced by education UNESCO programme of activities of geared toward exploring how mobile technology can enable the achievement of education for all.

(v) Creating virtual laboratory. Practical in schools are mainly focused on getting good marks in internal and external examinations. Students have become merit oriented and hence inattentive to the importance of practical science. Virtual lab is such that orchestrates the full proof of teaching practical physics in an exciting way technologically.

Conclusion

The paper identified that difficulty of learning scientific concept could be responsible for low performance in science subjects and that innovative approach of teaching and learning science such as introduction of all encompassing computer-aided-instruction to stimulate interest, motivate understanding of concepts for optimal performance and also reduce enrolment attrition is a necessity.

Recommendations

(i) Curriculum innovative strategy in areas of computer assisted-instruction should be introduced very quickly into schools to make understanding of science concepts, friendly and understandable.

(ii) Government should fund schools with computer aided in structural packages and systems for teaching and learning science for optimal performance in science at the Senior Secondary School

References

Ajileye, M. A. (2008). Secondary schoolteacher and the challenge of information and communication technology. *Zuba Journal of Science Education,* 2(1) 53-58.

Bamidele, L. (2004). Students' poor performance in Physics: A bane to our nation's technological development. *Nigeria Journal of Science Education and Practice, 2(1)174.*

Dermici, N. (2005). A study about student's misconceptions in force and motion concepts by incorporating a web-assisted physics program. *The Turkish Online Journal of Educational Technology, 4(3),* 7.

Eniayeju, P. A. (2001). Competences required of science education teachers. A paper presented at the NCCE/UNESCO train-the-trainers workshop for revitalization of science education in Nigeria 7th Oct. 8th Dec.

Gonen, S. Kocakaya, S. & Inan, C. (2006). The effect of computer-assisted teaching and 7E model of the constructivist learning method on the achievements and attitudes of High school students. *The Turkish online Journal of Educational Technology, 5(4), 11, 82-83.*

Hencer, A. H. & Tuzeman, A. T. (2005). A research on the effect of computer-assisted science teaching*. World Applied Science Journal, 4(2),199-205.*

Kara, I. & Kahraman, O. (2008). The Effect of Computer-Assisted Instruction on Achievement of students on the instruction of physics topics of the 7th grade science course at a primary school. *Journal of Applied Sciences, 8(6), 1067-1072.*

Nkwo, K. I., Akinbola, A. O. & Ikitde, G. A. (2008). Effect of prior knowledge of instructional objectives on students' achievement in selected difficult concepts in Nigerian secondary school physics. *International Multidisciplinary Journal*, 2(1).

Onifade, A. (2006). *Challenges of science and science education in colleges of education.* Lead Paper Presented at the Conference of School of Science, Oyo State College of Education, Oyo 13th June.

Otuka, J. O. E. & Sander, F. (2004). *Workshop on modeling, interactive physics and analysis of learning Processes.* Proceedings of the 45th Annual Conference of STAN 254.

Otuka, J. O. E. & Uzoechi, Z. C. (2009). *History and philosophy of science.* Keffi: Onavi Printing and Publishing Co. Ltd

Suleiman, F. B. (2006). *Cognition preference of chemistry students. A case study of federal college of education, Katisina.* A Conference Paper Presented at the Annual Conference of the School of Science F. C. E. Zaria 6th April.