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Full Length Research Paper

Effect of differentiated instruction on the academic achievement of Nigerian secondary school biology students

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Abstract

The aim of this study was to investigate the effect of Differentiated Instruction on the academic achievement of Senior Secondary One biology students. One research question and one null hypothesis guided the conduct of the study. The design was quasi experimental that employed a pre-test, post-test non-randomised equivalent groups. A total of 67 biology students found in two intact classes in two randomly selected schools were used for the study. A researcher developed instrument, Biology Achievement Test was validated and used for data collection. The instrument had a reliability coefficient of 0.86. Data were analysed using mean and ANOVA. Results showed that a significant difference exists between the achievement of students taught with differentiated instruction method and those taught with conventional method. The study recommended among other things that Biology teachers should be trained on how to use differentiated instruction method in teaching biology.

Keywords: Differentiated instruction, learning abilities, academic achievement, Biology.

INTRODUCTION

Current educational trends across the globe have reflected significant changes in student population for three or more decades now. The inclusion of students from non-English speaking background (in English speaking countries), students with disabilities, students from diverse cultural background and students with varying interest, learning styles, experiences, strengths and needs compel educators to re-look at their teaching and instructional practices with a view to ascertain a better approach to teaching and learning that will give students multiple options for taking in information and making sense of ideas (Subban, 2006). As a response to this, differentiated instruction was invented to cater for a variety of learning profiles.

Differentiated instruction according to Tomlinson (2001) is the process of ensuring that what a student learns, how he or she learns it and how the students demonstrates what he or she has learned is a match for that students readiness level, interest and preferred mode of learning. Differentiated instruction involves providing students with different avenues for acquiring content, processing, constructing or making sense of ideas and for developing teaching products so that all students within a class can learn effectively regardless of differences in ability. Coleman (2001) believes that engaging students actively in the learning process and in the contest allows them to see patterns developing, the overlap between disciplines, and learning as a cumulative whole.

It is common knowledge that no two students enter a classroom with identical abilities, experiences and needs. Learning disability varies from one person to another. In other words, one person with learning disability may not have the same kind of learning problem as another person with learning disability. For instance, one person may have trouble with reading and writing, another with understanding mathematics, yet another may have trouble in each of these areas as well as with understanding what people are saying. Learning styles, language proficiency, background knowledge, readiness to learn and other factors can vary widely within a single class group. However, regardless of their individual differences, students are expected to master the same concepts, principles and skills. The idea of differentiated instruction was employed to carry all students along by providing them multiple parts for maximising their learning potentials.

According to Tomlinson and Strickland (2005), diffe-

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rentiated instruction is a systematic approach to planning curriculum and instruction for academically diverse learners. It is a way of thinking about the classroom with dual goals of honouring each student's learning needs and maximising each student's learning capacity. It is a philosophy of teaching premised on the fact that students learn best when their teachers accommodate the differences in their readiness levels, interest and learning profiles (Tomlinson, 2001). It is a way of teaching that compels a teacher to pro-actively respond to a range of diverse learner characteristics (Kromberge, Walker & Zimmerman, 2009). Nunley (2006) defines differentiated instruction simply as providing instruction in a variety of ways to meet the needs of a variety of learners. Differentiated instruction therefore simply means creating multiple parts so that students of different abilities, interests or learning needs experience equally appropriate ways to absorb, use, develop and present concepts as a part of the daily learning process. It allows students to take greater responsibility and ownership for their own learning and provides opportunities for peer teaching and cooperative learning.

The theory of differentiated instruction is based mainly on the theory of social constructivism (Vygotsky, 1978) and emphasises the active participation of students in the learning process where the construction of knowledge emerges due to the interaction of students with their environment (other students, teachers, knowledge, educational material etc). The teacher, who entails the key to a successful differentiated instruction, is challenged to facilitate learning for students of different readiness level, interest, learning profile, socio economic, cultural and psycho emotional characteristics and all features that can affect the construction procedure of new knowledge (Tomlinson, 2003). Differentiated instruction therefore, may be an ideal method for teaching science subjects especially biology that requires a lot of 'doing' (activity-oriented).

Biology occupies a unique position in the school curriculum. Biology is central to many science-related courses such as medicine, pharmacy, nursing, agriculture, biochemistry, microbiology and so on. It is obvious that no student intending to study these disciplines can do without biology. These factors among others have drawn attention of researchers and curriculum planners towards biology as a subject in the school curriculum (Kareen, 2003). Inspite of the importance and popularity of biology among Nigerian students, performance at Senior Secondary School level remains poor (Nwagbo, 2006; Armed, 2008; WAEC, 2008; Egbunonu and Ugbaja, 2011).

The desire to know the causes of poor performance in biology has been the focus of researchers for some time now. It has been observed that poor performance in the sciences in general and biology in particular is caused by poor quality of science teachers, overcrowded classrooms, lack of suitable and adequate science equipment, large class size (Salau, 1996; Onwirhiren, 2005), heterogeneous classroom in terms of ability level, ill equipped laboratories, overloaded biology syllabus and poor teaching methods (Salau, 1996; Kareem, 2003; Onwirhiren, 2005; Armed, 2008). These factors encourage biology teachers to resort to only lecture method most of the time. It is a well known fact that the quality of education depends on the teachers and so the method they use in teaching matters a lot.

The issue for poor academic achievement of students has been of more concern to all and sundry. Teachers have been shown to have an important influence on students' academic achievement and they also play a crucial role in educational attainment because the teacher is ultimately responsible for translating educational policy into action (Afe, 2001). This could be why for a long time, pupils' academic performance in both internal and external examinations was used to determine excellence in teachers and teaching (Ajao, 2001). Both teaching and learning depend on the teachers and their teaching methods.

Consequent upon the observed deterioration in the academic achievement, attitude and values of secondary school biology students in public secondary schools, one wonders if the high failure rate and the poor quality of the students is not a reflection of the instructional quality in the schools. In other words, the ineffectiveness of the teacher as regards to the method of teaching employed in the classroom interaction with the students could be responsible for the observed poor performance of biology students and the widely acclaimed fallen standard of education in Nigeria. For example, Usman (2009), Duze (2011) and Yahaya (2012) strongly believe that the standard of education in Nigeria is falling.

Teachers are familiar with the use of a number of teaching methods but more especially the conventional methods like lecture, discussion and demonstration methods. The use of these methods has still not produced the expected results as regards students' academic achievement. Differentiated instruction is one of the novel instructional strategies whose benefits have not been harnessed by teachers in Nigeria. Most studies on it for example Hodge (1997), McAdmins (2001) were done abroad and so it's efficacy for Nigerian students has not been established. The question now is, will differentiated instruction help to improve Nigerian students' understanding and learning of, and enhance achievement in biology if employed by biology teachers in the classrooms? This provides the impetus for this study. The study therefore was designed to determine the effect of differentiated instruction on the academic achievement of secondary school biology students in Anambra state, Nigeria.

This study hopefully will be significant in a number of ways. The use of one-size-fits-all curriculum no longer meets the needs of the majority of learners. The use of a single-paced lesson delivered through a singular

instructional approach disregards the different learning styles and interest present in all classrooms. In addition, addressing students' differences and interests appears to enhance their motivation and enhance learning in classrooms. It is prudent to point out that every learner benefits from an engaging learning experience, every learner deserves to be treated with respect and every learner should have an opportunity to reach his or her potential. The current educational system does not adequately address these needs. Thus, the knowledge from this study will help the school administrators to encourage their teachers to use the methods of teaching that can effectively address the issue of diversity in learning abilities. Differentiated instruction is one of such methods.

The Ministry of Education will also see the need to provide in-service opportunities for teachers who decide to expand their knowledge on the use of differentiated instruction as an instructional strategy. All these will go a long way to improve the quality of teaching and learning in various secondary schools in the country thereby improving the quality of secondary school leavers being produced every year.

Research question

The following research question was raised to guide the conduct of the study:
What is the difference between the mean achievement score of students taught biology using differentiated instruction and that of those taught using lecture method?

Research Hypothesis

There is no significant difference between the mean achievement scores of the students taught biology using differentiated instruction and the scores of those taught using lecture method.

MATERIALS AND METHODS

The study adopted a quasi experimental research design in which intact classes were used. Specifically, the study adopted a pre-test, post-test non randomised equivalent group design.

The study was carried out in Awka education zone of Anambra state, Nigeria. The population of the study consist of all biology students in all the 18 secondary schools in Awka South Local Government Area of Awka Education Zone totalling 4,300 students.

A sample of 67 Senior Secondary One (SS1) biology students from two randomly selected secondary schools was used for the study. From the two sampled schools, one intact class each was randomly selected and used. One class was randomly assigned to experimental group while the other was assigned to control group.

The instrument used for was Biology Achievement Test (BAT) designed by the researchers. BAT was validated by two science educators. Kuder-Richardson (K-R 21) was used to establish the Internal Consistency of BAT which was found to be 0.86. This value was considered high enough for the study.

Before the commencement of the treatment, the researchers administered a pre-test on both the experimental and control groups using BAT. This was followed by the treatment which lasted for 4 weeks. The students were taught parts of a flower and their functions. The experimental group was taught using differentiated instruction method while the control group was taught using expository (lecture) method. The differentiated instruction method used was adapted from Sternberg (www.nwaea.k12.ia.us/documents/filelibrary/.../DI-lesson-sternberg.doc) and modified to suit the content of the lesson (see the Appendix on p. 15). At the end of the treatment, post-test was administered to both the experimental and control groups using the same instrument BAT but with the questions reshuffled.
Data collected was analyzed using mean and ANCOVA.

RESULTS

Research Question

What is the difference between the mean achievement score of students taught biology using differentiated instruction and that of those taught using lecture method?

Table 1 showed that for the post-test, the students taught with differentiated instruction had a higher mean score than the control group. Also, the experimental group had a higher mean gain than the control group.

HYPOTHESIS

There is no significant difference between the achievement scores of the students taught biology using differentiated instruction and that of those taught using lecture method.

Table 2 showed that there is a significant difference between the achievement scores of students taught biology using differentiated instruction and those of students taught using lecture method. Therefore, the null hypothesis was rejected.

DISCUSSION

The result of this study reveals that Biology students taught using differentiated instruction performed significantly higher than their counterparts taught with

Table 1. Mean biology achievement scores of experimental and control groups

Groups	Pre-test Mean	Post-test Mean	Mean Gain
Experimental	6.26	11.54	5.28
(N = 35)	(df = 3.34)	(df = 4.98)	
Expository	6.44	9.19	2.75
(N = 32)	(df = 2.82	(df = 3.84)	
Mean difference	0.18	2.35	2.53

Table 2. ANCOVA statistics for testing Ho:

Source of Variance	Df	SSx	SSy	SSxy	SSyx	MSSyx	Sdyx	Fyx
Between groups	1	2.52	180.60	21.35	143.42	143.42	3.45	12.07
Within groups	65	642.58	1249.70	582.04	772.50	11.88		
Total	66	645.1	1430.3					
					f-cal = 12.07			
					f-crit = 3.99			
					f-crit (3.99) < f-cal (12.07)			

lecture method. This gave support to the study by McAdmins (2001) who reported significant improvement in the test scores of low- scoring students in the Rockwood School District (Missouri), following the use of differentiated instruction. The result is also in support of an earlier study by Hodge (1997). Hodge investigated the use of differentiated instruction on students' scores on standardized test, teachers' perceptions of their ability to meet the needs of diverse students and parents expectation of students' performance and found out that students who were prepared for test using differentiated techniques showed a gain in their biology scores. The similarity of the findings of these studies point to the fact that differentiated instruction is effective in promoting students learning irrespective of where it is used and should therefore be used by teachers in Nigeria to teach Biology.

RECOMMENDATIONS

1. Since differentiated instruction in a teaching technique that takes care of individual differences in the classroom and provides every learner the opportunity to acquire knowledge in diverse ways, it is highly recommended that Nigerian teachers in general and biology teachers in particular should adopt it in their classroom interaction.
2. Since most teachers may not be conversant with the use of differentiated instruction as a teaching method, seminars and workshops should be organized for them to get them acquainted with the use of the method.

REFERENCES

Afe JO (2001). Reflections of becoming a teacher and the challenges of teaching education. *Inaugural Lecture Series 64.* Benin City. University of Benin, Nigeria.

Ahmed MA (2008). Influence of personality factors on Biology lectures assessment of difficulty levels of genetics concepts in Nigerian Colleges of Education. *Unpublished PhD. Thesis.* University of Ilorin.

Ajao W (2001). Cadbury is determined to move education forward. *Vanguard.* December, 27, pp.16.

Coleman MR (2001). Curriculum differentiation: Sophistication. *Gifted child Today, 24 (2).* 24-26.

Duze C (2011). Falling standard in Nigeria education: Traceable to proper skills acquisition in school? Retrieved on 26/8/12 from http://interesjournals.org/ER/pdf/2011/January/Duze.pdf

Egbunonu R, Ugbaja J (2011). An analysis of students performance in Biology, 2000-2005. *Proceedings of the 52nd Annual Conference of Science Teachers Association of Nigeria (STAN).* 235-241.

Hodge PH (1997). An analysis of the impact of a prescribed staff development programme in differentiated instruction on students' achievement and attitudes of teachers and parents towards that instruction. *Unpublished PhD. Thesis*. University of Alabama.

Kareem LO (2003). Effects of audio-graphic self-instructional packages on senior secondary school students' performance in biology in Ilorin, Nigeria. *Unpublished PhD thesis.* University of Ilorin.

Kromberg R, Walker D, Zimmerman J (2009). Teaching to diversity in an age of standards. *The College of Education and Human Development*. University of Minnesota.

McAdmins S (2001). Teachers tailor their instruction to meet a variety of students' needs. *Journal of Staff Development, 22(2).* 1-5.

Nunley KF (2006). Differentiating the high school classroom: Solution strategies for 18 common obstacles. *Thousand Oaks.* CA, Corwin Press.

Nwagbo CR (2006). Effects of two teaching methods on the achievement in and attitude to biology students of different levels of scientific literacy. *International Journal of Education Research.* 45, 216-229.

Onwirhiren EM (2005).The effects of class size and gender on academic performance in chemistry at post-secondary levels. *Nigeria J. Professional Teachers,* 1(1), 146-150.

Salau MO (1996). The effect of class size on the achievement of

different ability groups in mathematics. *Journal of Science Teachers* Association *of Nigeria (JSTAN).* 31 (1&2), 57-63.
Subban P (2006). Differentiated instruction: A research basis. *International Education Journal,* 7(7), 935-947.
Tomlinson CA (2001). *How to differentiate instruction in mixed ability classrooms* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.
Tomlinson CA (2003). Deciding to teach them all. *Educational Leadership.* 61(2), 6-11.
Tomlinson CA, Strickland CA (2005). Differentiation in practice: A resource Guide for differentiating curriculum, Grades 9-12. *Association for Supervision and Curriculum Development.*
Usman AM (2009). Vision 20:2020 and the falling standard of education in Nigeria. Retrieved on 26/8/12 from http://sundaytrust.com.ng/index.php? option=com content&view=article&id=495:vision-202020-and-the-falling-standard-of-education-in-nigeria&catid=7:comment-a-debate&Itemid=113
Vygotsky LS (1978). *Mind and society: The development of higher mental processes.* Cambridge, MA, Harvard University Press.
Yahaya H (2012). Nigeria: Cleric decries low standard of education in Nigeria. Retrieved on 26/8/12 from http://allafrica.com/stories/201208060693

Appendix

The Differentiated Instruction on Parts and Functions of a Flower
Subject: Biology
Topic: Parts and Functions of a Flower
Teaching and Learning Materials: Freshly plucked flowers, drawing of a generalised flower, drawing of male and female parts of a flower.
Know: Names of flower parts, functions of the parts, colours of the non-essential parts.
Understand: A flower is a plant organ with different parts.
Do: 1. Students to draw a named flower and label all the parts (teacher presents a chart showing an annotated diagram of a named flower and guides the students to draw the flower and label it).
2. Students to analyse and relate each part with its function. This involves discussion method.
Activities: 1. Use concept maps to relate structure with function of the parts
2. List parts and functions and use directional markers to match the two
3. Give numbers or labels to each part and its corresponding function
Practical: Give other examples of plants or animals or any object in your environment that could serve as analogies for the flower for example the cell, the motor car. Discuss with your peers how the different parts relate with their functions and how one part relates with others in such a way that one may suffer handicap without the other part/parts. This is to show the interrelatedness of all the parts and their functions.
Creative: Divide the class into 3 groups. Let each group create and tell a story that will help the understanding of flower as an organ with many parts and the interrelatedness of these parts.
Conclusion: Teacher leads a discussion of a flower as a plant organ using more examples.
Evaluation: Teacher evaluates the students' understanding of the lesson by asking them questions like:
- Name 5 parts of a flower.
- Name 2 parts of a flower and mention their functions

Draw and label the structure of a generalised flower.