PRIOR KNOWLEDGE OF STUDY QUESTIONS AND STUDENTS' BIOLOGY ACADEMIC ACHIEVEMENT AT SENIOR SCHOOL LEVEL

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Abstract

This study investigated the effect of prior knowledge of the study questions on academic achievement of students in Senior School Biology in Delta State Capital Territory (DSCT). Quasi- experimental research design was adopted in carrying out the study. The population was 3,252 Senior School three (SS3) students from 12 Public Secondary Schools. Six secondary schools were randomly assigned to each of experimental or control group. The sample of the study was 813 students (405 students in experimental group and 408 students in control group). Students in experimental group were taught with prior knowledge of study question, while their counterparts in control group were taught without prior knowledge of study question, but with Conventional Lecture Method. Data from the two groups were collected with Biology Achievement Test (BAT). Z-test was used to analyze the data. Students in experimental group had significant higher Mean Academic Achievement (MAA) than students in control group. Implication and recommendation were made to improve teaching and learning in the secondary schools.

Biology was derived from two Greek words, "Bio" and "Logos." 'Bio' means life while 'Logos' means study of (Stone, Cozens, Emina and Ndu, 1980). From this point, biology was defined as the study of living things. Biology as a science subject deals with living and non living things and their existence and relationship with one another (Ogenevwede, 2012). He added that biology forms the basis for medical, biological and environmental sciences. Therefore, to pursue a course in medicine, pharmacy, agriculture, biological science and environmental studies, a pass in biology at credit level and above (A1 –C6) in Senior School Certificate must be obtained (Unified Tertiary Matriculation Examination (UTME), 2012). Biology, one of the natural sciences in the Senior Secondary School Curriculum in Nigeria, is mostly registered by students in the Senior School Certificate Examination (SSCE). This is in line with Aghaduino's (1989) assertion that most students prefer registering biology to other science subjects in the SSCE. He further stated that the students feel that biology is the easiest among other science subjects at the ordinary level. On the contrary, it has been observed that students' performance in biology in SSCE is worse when compared with their performances in other science subjects (Igbojinwaekwu, kpeke and Asuka, 2007). Supporting this observation, Duyilemi (2009) reported the percentage performance of students in SSCE in biology, chemistry and physics from 2000 to 2003.He found that the students had average passes of 64.5%, 66.2% and 90.5% in biology, chemistry and physics, respectively. Ojo (2008), as summarized in table 2 , observed that in 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005 and 2006 biology failure rates were 60.9%, 38.9%, 37.5%, 11.9%, 47%, 37.8%, 27.7%, 35.5%, 32.6% and 23.5%, respectively. In line with the argument that biology is not the easiest science subject at Senior School Certificate level, Ojerinde (2004) in Duyilemi (2009) summarized the poor performance of students in biology, chemistry and physics at ordinary level in tables 1.

Table 1: Percentage Performance in Science Subjects at Credit Level and Abovefrom 2000 To 2003

Subject	2000	2001	2002	2003
Biology	64.48	27.44	34.44	5.81
Chemistry	66.17	56.38	59.92	10.25
Physics	90.54	43.28	57.11	4.49

Source: Ojerinde (2004) in Duyilemi (2009)

Table 2: Entries and Results of Biology candidates from 1997 to 2006

Year	**Num. Enrolled**	**% Grades 1-6**	**%Grades 7-8**	**%Grade F9**
1997	609,026	15.79	23.32	60.88
1998	626,894	34.44	25.33	38.85
1999	41,0831	28.35	34.16	37.47
2000	677,869	10.40	31.61	11.92
2001	995,345	23.25	29.70	47.04
2002	882,119	31.52	30.64	37.82
2003	909,101	43.14	27.80	27.70
2004	821,996	30.83	33.68	35.47
2005	1,055,710	35.77	29.92	32.55
2006	1,129,547	50.22	26.25	23.52

Source: Ojo (2008)

This state of continuous poor performance of students in biology forced some students to look for an alternative subject, which is Health Science (Igbojinwaekwu, in press). Therefore, applying instructional strategy that will enhance a sustainable higher academic achievement in biology is inevitable. The researcher, therefore, opined that the best instructional strategy to apply is to make sure the students have prior knowledge of study questions before teaching commences.

Nzewi (1990), opined that the way material is introduced has a great deal to do with students motivation and learning; carefully designed introductory activities can do a great deal to bridge the gap between what is known and what the students need to know. Following Nzewi's (1990) opinion, it was observed that learning relies on a complex synthesis of biological maturation, prior knowledge and experience, reasoning ability and instruction (Staver, 2003). Therefore, science teachers must discern the roots of students struggles to learn and simultaneously provide instruction that is challenging, but not overwhelming; asking questions during instruction is an effective strategy for

assessing students difficulties (Staver, 1999). Effective science teachers are, therefore, expected to use the following techniques in responses to the complexity of learning:

(i) give a pretest before starting a unit of instruction ;use the result to learn what students know and do not know and to plan appropriate lessons;
(ii) use concrete, manipulative materials and familiar events to help students directly experience scientific phenomena and to encourage their active construction of abstract concepts;
(iii) ask a blend of high-level, low-level, open–ended and close-ended questions to activate students thinking;
(iv) wait for at least three seconds after asking a question before rephrasing it;
(v) wait for at least three seconds following a student's response to a question before continuing;
(vi) delay including abstract science concepts with young children if these concepts cannot be introduced with concrete materials and familiar experiences and ,
(vii) aim the level of instruction slightly beyond the capabilities of individual learners, but within the capabilities of group of learners (Driscoll, 2005, National Research council, 2001, 2005; Rowe 1974a, 1974b; Tobin, 1987,Vygostky, 1978).

Mkpa (1988) confirmed that the use of questions as instructional strategy does not simply provide students with answering skills, but in addition, indicate to students what they are to do and how they are to do it, giving them greater control over their own learning processes. He further stated that when questions are at approximate level of difficulty for students, they are very effective instructional cues for helping them improve their learning and retention of materials. Such instructional strategy is to give the students questions on what they should know in the science concept to be taught. The academic performance of senior school students in Senior Secondary School Certificate Examination in biology has been an issue of concern to parents, teachers and even the government (Ogenevwede, 2012; Ojerinde, 2004; Duyilemi, 2008). For effective teaching to take place, the teacher must stimulate, encourage and maintain active participation of students through the selection of appropriate teaching methods and strategies (Ogenevwede, 2012). He added that successful teaching does not depend only on the teachers' mastery of the subject matter, but also the teaching method employed. In the same vein, Ogbonna (2008) opined that one of the most influential factors in teaching is the teacher's mode of teaching. The statement of problems is therefore, stated thus. What is the effect of prior knowledge of study questions on students' biology academic achievement at senior secondary level in Delta State capital Territory (DSCT)?

Null Hypothesis

One null hypothesis was stated and tested to guide this study.

H_{o1}: There is no significant difference between the Mean Academic Achievement of students exposed to Prior Knowledge of Study Questions Method (PKSQM) and their counterparts exposed to Conventional Lecture Method (CLM) in Senior Secondary Biology.

Methodology

The pretest–posttest control group quasi-experimental research design was adopted in this study. This was because the study used intact classes where complete randomization was not possible.

The population of the study was 3,252 Senior Secondary (SS3) students from twelve secondary schools in DSCT. Six secondary schools were randomly assigned to either experimental group or control group. The population of the experimental and control groups were 1,620 and 1,932 SS3 students, respectively. The samples consisted of 405 and 408 SS3 students in experimental and control groups, respectively. These samples were obtained through simple random sampling techniques.

Biology Achievement Test (BAT) was the instrument used to collect data. The instrument was researcher-made. The BAT comprised two sections, captioned A and B. Section A demanded for personal data of students, while section B consisted of a set of 50 multiple choice biology test items on the concept of the 'structure of the Mammalian Ear and the Mechanism of Hearing', that was taught to the students. The test items were carefully selected from past West African Examinations Council (WAEC) objective question papers from 1999 to 2011. Two experts in Science Education Biology and one expert in Test Development of University of Benin validated the BAT based on relevance and coverage of units of work. The instrument, BAT, was further subjected to traditional item analysis, which consisted of determination of item difficulty coefficient and discriminating power. Kunder-Richardson21(K-R21) formula was used to ascertain the reliability index of BAT as 0.94 and was judged to be highly reliable following Kelinger's (1979) assertion that test instrument with 0.60 to 0.99 is said to be reliable.

The twelve biology teachers who had the same qualification, B.Sc. (Ed), and the same number of years of experience underwent one week training on the structure of the Mammalian Ear and Mechanism of Hearing before they were certified to be competent to teach the students. Also, uniform lesson notes were prepared by the researcher for the teachers based on the concept to be taught. The teachers were instructed to adhere strictly to the lesson notes prepared by the researcher.

BAT was used to pretest students in both experimental and control groups before any treatment was given to the experimental group. The Mean Academic Achievement (MAA) of the pretested students in both experimental and control groups were computed and compared using z-test in a 2-tailed test at 0.05 level of significance, in order, to know their academic standing. After the pretest, the students in the experimental group were given some guiding questions before being exposed to two weeks biology instruction on the concept of the structure of the mammalian ear and the mechanism of hearing, while the Students in control group were simultaneously exposed to Conventional Lecture Method (CLM) of instruction, without guiding questions, for two weeks. At the end of two week's lesson, students in both experimental and control groups were posttested with BAT. The MAA of students' scores in both groups were computed and compared with Z-test in a 2–tailed test at 0.05 level of significance.

Data Analysis and Presentation of Results

The analysis of data and results in this study are summarized in tables 1, 2 and 3.

Table 1: Z-test of Pretested MAA for Experimental and Control Groups

Group	N	Pretested MAA	SD	df	Zcal	Z crit	P
Experimental	405	45.61	5.63	811	1.21	1.96	<0.05
Control	408	45.48	5.59				

` Data in table 1 show that Zcal= 1.21 is less than Z crit = 1.96 at 0.05 level of significance at 811 df in a 2-tailed test. This means that the Zcal is not significant. The implication is that students in both experimental and control groups are homogenous and comparable and therefore, comparable enough to take part in this study.

Hypothesis Testing

The null hypothesis, H_{o1} : there is no significant difference between the Mean Academic Achievement of students with Prior Knowledge of Study Questions and their counterparts exposed to Conventional Lecture Method (CLM) in Senior School Biology, was tested as shown in table 2

Table 2: Z-test of Posttested MAA for Experimental and Control Groups

Group	N	Posttested MAA	SD	df	Zcal	Zcrit	P
Experimental	405	78.15	3.79	811	2.13	1.96	<0.05
Control	408	61.53	4.12				

Data in table 3 show that Zcal (2.13) > Zcrit (1.96) at 0.05 level of significance at 811 df in a 2-tailed test. H_{o1} is therefore, rejected. This implies that there is a significant difference in MAA between the experimental and control groups, in favour of the experimental group.

Table 3: Z-test of Posttested-Pretested MAA Gain for Experimental and Control Groups

Group	N	MAA Gain	SD	df	Z_{cal}	Z_{crit}	P
Experimental	405	32.54	4.71	811	2.17	1.96	<0.05
Control	408	16.05	4.86				

Data in table 3 show that Z-cal (2.17) > $Z\text{-}_{crit}$ (1.96) at 0.05 level of significance at 811 df in a 2-tailed test. This, therefore, authenticates the rejection of H_{o1} as analyzed in table 3.

Discussion

These studies investigate a Prior Knowledge of Study Questions and Academic Achievement of Students in Biology at Senior School Level. The finding in the study showed that prior knowledge of study questions among students resulted in better academic achievement than their counterparts taught without prior knowledge of study questions . This finding agrees with the finding of Akuezuilo and Chinweoke (2009) who reported that the students taught using prior knowledge of study questions and behavioral objectives performed better than the students taught with conventional lecture method in Senior School Mathematics in Awka South Local Government Area of Anambra state. They emphasized that when a teacher states the questions whose answers are to be known by the students before commencing his/her lessons, the students are more focused than when a teacher just starts teaching any concept. Also, the finding in this study is in alignment with the finding of Hartly and Davis (1979) who pointed out that students with prior knowledge of study questions in the same concept to be taught by the teacher have a clear goal that can be used to organize learning activities, are permitted to study more effectively by reducing the time wasted on irrelevances as well as are provided with a bench work against which they can objectively evaluate their own progress. The finding in this study further agrees with the finding of Mkpa (1985) that the use of questions in

instruction does not simply provide students with answering skills, but in addition, indicates to students what they are to do and how they are do it, giving them greater control over their own learning process and encourages students' motivation and learning. Carefully designed introductory activities can do a great deal to bridge the gap between what is known and what the students need to know. The finding of this study also supports Staver (1998) who opined that learning relies on complex synthesis of biological maturation, prior knowledge of study questions, experience, reasoning ability and instructional methods.

Conclusion

The pretest MAA of students in experimental and control groups showed no significant difference when analyzed which z-test. This really showed that the two groups were homogenous and very comparable. The posttested MAA of students in experimental and control groups were significantly different with experimental groups having a better or higher MAA. The implication is that teachers are advised to use prior knowledge of student questions method in teaching students biology.

Recommendation

It is, therefore, recommended that:

(i) teachers should be encouraged to apply prior knowledge of study questions instructional method in the teaching-learning process and

(ii) seminar/ workshop should be organized for all categories of science teachers to enable them get used to applying prior knowledge of study questions for effective and efficient teaching-learning process.

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