EFFECT OF PRE-TEST, FEEDBACK AND OVERVIEW STRATEGIES ON STUDENTS' ACADEMIC ACHIEVEMENT IN ECOLOGY IN FEDERAL CAPITAL TERRITORY-ABUJA

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This study investigated the effectiveness of Pre-test, Feedback and Overview (PFO) strategy on students' achievement in ecology concepts. Ecology concepts have been identified as one of the perceived difficult concepts in Senior Secondary biology national core-curriculum. Sample size of 100 SSII biology students randomly assigned as experimental and control groups were used. Pre-test results were used to establish the equivalence between the 2 groups (experimental and control). Three null hypotheses were tested at $P \leq 0.05$ level of significance using t-test statistic. The results included a significant difference between experimental and control groups in favour of experimental group, and PFO is not sex-dependent in teaching ecology concepts. It was therefore, recommended among others that school authorities should organise workshops and seminars to popularize PFO strategy and equip Science teachers with Skills of using PFO strategy.

Introduction

The teaching and learning of biology at secondary school level pose serious challenges. The students are not acquiring the required competencies and skills as specified in the secondary school biology curriculum and West Africa Examination Council (WAEC) syllabus (Okebukola, 1993). An examination of WAEC / National Examination Council (NECO) results shows that the candidates are performing below expectations (WAEC Chief Examiners Report 2009). The poor performance in biology poses great concern among teachers, science educators, parents and students. The concern is largely due to the fact that biology serves as a foundation stone for professionals in biotechnology, environmental science medical sciences among others and students are performing below expectation in biology. The focal point of modern developments in science and technology is in the area of Information, Communications Technology (ICT), Biotechnology, Environmental sciences etc. As such there is a great demand on the part of those who wish to make a career in science and technology to offer biology at the secondary school (Katcha 2005).

The challenges facing biology teaching and learning have been identified by studies Jibril (2011) and Katcha to include ineffective teaching methods, perceived difficult concepts, lack of enough and efficient instructional materials, explosive number of students, dynamic nature of the syllabus amongst others. All solutions required and attempted are geared towards meaningful learning of biology. According to Novak and

Gowin (1984), learning is a continuum with rote learning at the bottom while meaningful learning is at the top. In order to achieve meaningful learning constructivists instructional strategies have been proposed and some useful results have been recorded (Timothy and Awodi 1997).

The Ausubelian theory of meaningful verbal learning lay great emphasis on the importance of prior knowledge (Ausubel, 1963). Meaningful learning stems from effective and efficient use of students' prior knowledge. Meaningful learning occurs when the learner consciously and explicitly links new knowledge to the relevant residue existing in the schemata (cognitive structures). With the theory of meaningful learning, learners are able to modify their existing schemata and form linkages with new experiences or tasks through the processes of subsumption for easy retrieval of cognitive materials from cognitive structures. Meaningful learning is more lasting, results more in reflective thinking and learners are able to learn actively even on their own as compared to rote-learning. Rote-learning kills instincts, creativity, inhibits recall and reflective thinking. (Katcha and Jibril 2012)

In order to achieve meaningful learning for our learners, teachers can do a number of activities using the theory of advance organizers. Advance organizers are cognitive strategies that make abstract constructs concrete for absorption and assimilation (internalization of concepts). They relate known information to unknown information and make complex materials simple for effective and easy retrieval, transfer and application in different but similar situations (Ausubel).

The learning and retention of complex and or abstract materials are facilitated by the advance introduction of relevant subsummarires. According to Stone in Illesanmi (2011) advance organizers are effective in the provision of framework for incorporating new materials into the existing schemata (cognitive structures) of learners. Subsummers are existing instructional materials or concepts that teachers use to present to learners to enable them incorporate the new concepts, tasks, experiences (usually abstract) to the existing schemata in the cognitive structures. Subsumption is the central idea running through the whole idea of Ausubelian psychology of meaningful learning (Stone in Ilesanmi).

Subsumption strategy is paramount in order to effectively apply the theory of meaningful verbal learning to solve many problems of science instruction especially in biology. As such there is need for biology teachers to effectively adapt subsumption strategy in classroom activities. In consideration of modern classroom practices such as activity-based, 'minds' and 'hands' on science concepts, active participation and interactions need to use subsumption strategies that will not disrupt such practices. Pre test, Feedback and Overview (PFO) strategies are some of such subsumption strategies that can be used without disrupting the modern activity-based lesson that is anchored on enabling the learners' subject science concepts to their sensory experience. PFO strategy can be used to achieve meaningful learning specifically when starting new topic (s) or concepts that are perceived to be difficult (Oloyede, 1998).

Pre-test is a test, given to learners on topic(s) they are yet to be taught. The result of such test is used to ascertain the level of learners prior-knowledge and determine the need for subsummers. Also pre-test is used to prove that the results of the post-test (test

after treatment of the new topics) is due to new instructional strategies or materials used for treatment. Feedback which is by either summative and formative evaluation (test or examination; written or verbal) is the learners' achievement after treatment or teaching of new topics. Overview is a general survey of topics taught to ascertain areas of strength and weakness of the learners. Teachers conventional strategies include all forms of strategies that are commonly used by the science teachers to achieve instructional objectives. Such strategies include presenting lesson by talk-chalk method, few or no activities, students copy notes with passive participation and interaction and occasional home work or assignment.

Therefore, this study is focused on the investigation of PFO strategy as subsummers in teaching some selected topics in ecology (ecosystem, biotic and abiotic factors, predation, parasitism, transfer of energy and matter in the trophic levels etc). Ecology is one of the broad topics of Senior Secondary (SS) biology national core-curriculum and is a part of WAEC biology syllabus. It is one of the identified difficult concepts in biology (Katcha 2003). Specifically, the study investigated the effect of PFO strategy on secondary school students' achievement in biology. Thus, the following null hypotheses were generated and tested at $P \leq 0.05$ level of significance.

Ho_1: There is no significant difference between mean scores of students taught ecology using PFO strategy and those taught ecology using teachers conventional strategies.

Ho_2: There is no significant difference between mean scores of male and female students taught ecology using PFO strategy.

Ho_3: There is no significant difference between the retention ability of students taught ecology with PFO strategy and those taught using teachers' conventional strategies.

Methodology

Study design

The study employed a pre-test, post-test and delayed post-test matched group design. The design was employed to examine any possible treatment effect due to exposure to PFO strategy.

Sample Procedure

The study population is made up of all SS 11 students in FCT. given as 46, 796 Secondary Education Board (SEB) 2006). The population had studied biology for one year at SS1 and are now in SS 11 after passing the promotional examination. Two schools were randomly assigned into experimental (50) and control (50) groups.

Instrumentation

The Biology Students' Competency Test (BBCT) was developed and used for the study. The test instrument is in two forms:-

1. BSCT Form 1 which deals with students acquisition of required ecology skills in practical activities and diagrams, while
2. BSCT Form 11 deals with students competence in ecology concepts. The two forms are multiple choice of 25 items each. The Senior School Certification Examination (SSCE) syllabus drawn up by WAEC was used for ecology topics selection which forms the contents of the BSCT Forms 1 and 11. The topics are perceived by teachers and students to be part of the difficult concepts in biology. The BSCT Forms 1 and 11, marking scheme and lesson notes were validated by a team of experts from Faculty of Education, University of Abuja. The instrument was pilot-tested using two schools which never took part in the main study. The reliability coefficient using K-R (21) formula was found to be 0.82 and considered acceptable for research.

Procedure

The study covered a period of ten weeks. The first week was for pre-test and familiarization. The pre-test results were used for establishing equivalence between the two groups-experimental and control. The treatment covered from 2nd through 3rd to 6th week. Trained teachers were used for the study. Treatment was withheld for the control group which was taught the same topics without using PFO strategy. The treatment involved pretesting the selected ecology concepts before teaching them as new topic, after teaching any topic students were tested and general survey of the topics tested was carried out. The topics taught were ecosystem, climatic factors, parasitism among others. The post-test was administered at the end of the 6th week while the delayed post-test was taken in the 10th week.

Data Analysis

Presentation of Results

The data were computer – processed using SPSS package. The null hypotheses $H0_1$, $H0_2$ and $H0_3$ were tested at $P \leq 0.05$ level of significance using t-test statistics.

Table 1: t-test analysis of post-test mean scores for experimental and control groups

Group	N	$\bar{X}$	SD	SE	Df	t.crit	t.cal	P.value	Remarks
Experimental	50	48.14	10.73	1.52					
Control	50	39.48	9.12	1.29	98	1.83	4.35	.0001	Significant

*Significant at $P \leq 0.05$

From the results displayed on Table 1 the experimental group has mean scores of 48.14 significantly higher than the control group with mean scores of 39.48. when the mean scores are subjected to t-test the t. crit of 1.83 is lower than the t.cal of 4.35 with df 98. The P. value of .0001 is rejected at $P<0.05$ level of significance. Therefore, there is a significance difference between experimental and control group on the test of BSCT

forms I and II in favour of experimental group. The null hypothesis, ($H0_1$) is therefore rejected. In essence students taught ecology using PFO strategy performed better than those taught the same ecology topics using conventional teachers method.

Table 2: t-test analysis of post-test mean scores of male and female students exposed to PFO-Strategy

Group	N	$\bar{X}$	SD	SE	Df	t.crit	t.cal	P.value	Remarks
Male students	25	43.00	7.37	1.47					
Female students	25	42.06	7.10	1.42	48	.017	.448	.0001	Not significant

* Not significant at $P< 0.05$

The results displayed on Table 2 indicate that the male students have mean scores of 43.00 while the female students made mean scores of 42.06 slightly lower than the male students. The results were subjected to t-test statistics and there was no significant difference between male and female students on their achievement at the post-test. Thus, indicating that the $H0_2$ is retained at $P<0.05$ level of significance. In effect whenever PFO strategy is used as sub summers, the instruction of ecology will not be sex-dependent.

Table 3: t-test analysis of delayed post-test mean scores of experimental and control groups

Group	N	$\bar{X}$	SD	SE	Df	t.crit	t.cal	P.value	Remarks
Experimental	50	56.44	12.66	1.79					
Control	50	42.52	7.18	1.02	98	13.77	6.77	.0001	*Significant

* Significant at $P\leq 0.05$

The results shown in Table 3 indicates that the experimental group made mean scores of 56.44 significantly higher than the control group with mean scores of 42.52. The results are subjected to t-test,- t. crit of 13.77, t.cal 6.77 with df 98 and P. value .0001 rejected at $P\leq0.05$ level of significance. The results show that there is a significant difference between experimental and control group in favour of experimental group. The $H0_3$ is therefore rejected at $P\leq0.05$ level of significance. Thus, PFO strategy enhances learners retentive memory and results in meaningful learning of ecology concepts.

Discussion

The results displayed in Table 1 indicated a significant difference between experimental group and control group in favour of experimental group. This finding is in agreement with Oloyede (1998); Katcha, (2003 & 2005); Jibril (2011) and Ncharam (2004). They reported that science lessons that are anchored on activities or methods that set the 'hands' and 'mind' of learners on science concepts will lead to active participation and interaction in such lessons. Lessons that make learners highly involved will lead to active and meaningful learning of scientific concepts. Thus, students that are taught with activity-based strategies are likely to perform significantly better than those students that

are taught by didactic or expository teaching /conventional methods of teaching. The teachers' conventional methods of teaching have less activities, the teacher is the only active participant and students rely on memorization which inhibit recall and lack of proper understanding of scientific concepts and issues. These findings also strengthen arguments from psychological points of views of Morris (1973) and Mukhejee (2000); that whenever students are pre-tested on a given concept, the teacher is able to refine their prior knowledge, when students are given a feedback on the concepts learnt, the teacher is able to facilitate their learning and when an overview of the concepts or topics is given by the teacher the students' learnings are properly guided.

The results in Table 2 reveal that male and female students are not significantly different in their post-test mean scores. In other words, the hypothesis 2 ($H0_2$) was not rejected. This finding implies that the PFO strategies have no gender bias characteristics that can lead to under achievement among secondary school students, especially in biology. Ariyibi (2004) and Udo (2006) reported zero effect of gender as a determinant factor in students' achievement in science. In essence if male and female students are given the right conditions of learning they will perform equally well in science. Factors often advance such as application of teaching styles, role models, textbooks, classroom practices laboratory practicals etc by teachers which are all in favour of male students and a disadvantage to female science students. Other influencing factors against female science students' performance in science education are stereotypes and cultural issues (Katcha and Jibril).

The results in Table 3 indicate significant difference in the retentive abilities of experimental and control groups in favour of experimental group. The students exposed to PFO strategies excelled significantly higher than those in the control group who did not receive treatment. This, the PFO strategies lead to meaningful learning and improve retentive abilities of learning (Oloyede, Ilesanmi 2011).

Conclusion

The results of this study have indicated a significant improvement on students achievement in biology. Although the use of PFO strategies are time and energy consuming, it could be used to remedy a difficult situation such as dealing with the problem of perceived difficult concepts and low achievers in biology concepts. The use of advance organizers and or subsumption strategies leads to improvement of retentive abilities due to the use of prior knowledge of the learner, instructional materials, varied assessment strategies among others (Katcha, Illesanmi and Jibril)

Recommendations

Based on the findings of this study, the following are recommended.

- Workshops and Seminars are required to popularize the strategy (PFO) for science teachers and equip them with requisite skills to use PFO strategy.
- Curriculists may need to build up curricular materials containing PFO-Strategy for science teachers to use effectively and efficiently.
- More studies into PFO-Strategy are required to strengthen the findings of this study.

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