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Impact of 5E Teaching Cycle on Retention of Pre-NCE Biology Students with Varied Abilities in North-West Zone, Nigeria

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Abstract

The study investigated the "Impact of 5E Teaching Cycle on Retention of Pre-NCE Biology Students with Varied Abilities, North-West Zone, Nigeria". Quasi-experimental Design involving pretest, posttest and post-posttest was used for the study. The population was 2,231 pre-NCE Biology students made up of 1,168 males and 1,063 females. Simple random sampling technique by balloting method was used to select two schools out of the eleven coeducational colleges of education that served as population of the study. A total of one hundred and ten (110) students were used as sample for the study. The experimental groups were exposed to 5E teaching cycle while the control group was exposed to lecture method. Pretest was administered on the subjects, before they were exposed to the treatment to determine that they are not different significantly in their ability level. The experimental and control group subjects were assigned to sub-groups according to their ability levels(high, average and low) by stratifying sampling technique after the pretest. The posttest was given to determine the effects of exposure to 5E learning cycle which was for experimental and control groups. The Post-posttest was administered after six weeks from the administration of the Post-test in order to determine the retention ability of the subjects in the study. Genetics Academic Performance Test (GAPT) with reliability coefficient of 0.79 was used as instrument for data collection. A research question and hypothesis guided the study which were answered and tested using Mean scores and Analysis of Co-Variance (ANCOVA) test statistics at $P \leq 0.05$ level of significance. The findings of the study showed that pre-NCE Biology students exposed to 5E teaching cycle in the teaching and learning of genetics concepts in all the ability levels retain more than those in the control group exposed to lecture method of instruction. One of the recommendations made based on the findings of the study is: The teaching of Biology especially genetics should be conducted using 5E teaching cycle as it enhances better retention of knowledge of Biology students at pre-NCE level.

Keywords: *5E Teaching cycle, Retention, Pre-NCE, Biology students, Varied abilities*

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Background to the Study

Pre-National Certificate in Education(NCE) students are students that graduated from secondary school, but did not have enough credits in Senior Secondary Certificate Examination (SSCE)or National Examination Council(NECO) Examination to be admitted into direct NCE program, but were given one year program to meet up (NCCE, 2009). According to Ketim and Olowo (2013), the idea of pre-NCE started even before the establishment of National Commission for Colleges of Education (NCCE) in Nigeria. In the program, some Colleges of Education (COE) admitted students who were deficient in some subjects into a remedial Science or Arts Class for one academic year, while those who passed final SSCE examinations were admitted into NCE program proper. The action was meant to produce teachers in some specific areas of needs. In Nigeria, many researches were done using Secondary School without involving pre-NCE Biology students despite their peculiar problem of not having enough credits to enable them have direct admission to NCE 1. This research covered pre-NCE students in North-West Zone of Nigeria to find out if they retain genetics concepts better.

Retention of knowledge is a very important factor affecting teaching and learning of science in general and Biology in particular. Bichi (2002) supported this statement by saying that understanding and retention are products of meaningful learning when teaching is effective and meaningful to the students. Many researchers defined retention in different ways for example Lakpini (2006) sees retention as the ability of the memory to store information which can be recalled after interval of weeks when exposed to a series of instructions and trainings. Hornby (2010) defined retention as the ability to remember things. In another definition Lawal (2009) viewed retention as the ability of the memory to store information which can be recalled sometime after exposure to series of instruction or training.

Retention takes place when learning is coded into memory. According to Bichi (2002), appropriate coding of incoming information provides the index that may be consulted so that retention takes place without an elaborate search in the memory lane. Bichi further stated that the nature of the material to be coded contributes to the level of retention. There are many factors that influence retention. According to Bichi (2002) learning improves retention while confusion or interference leads to forgetting.

Several studies have been carried out by different researchers on retention, some of which are: Akinbobola and Folashade (2009) compared the effectiveness of Constructivist Teaching Methods and the conventional method with reference to achievement, retention and attitude found that students exposed to constructivist teaching method had higher cognitive achievement, more positive attitude and higher retention level than those taught using the conventional teaching method. Jiya (2011) found that NCE I Biology students taught Biology using Teaching with Anology Strategy retain evolution concepts better than those taught with lecture method. Also, Aminu (2012) found out that students taught with Integrating Instructional Models with Lecture Method retain Biology concepts better in different class size than those not taught with lecture method only. For example Lakpini (2006), Anaso (2008) and Bunkure (2012) in their separate findings in Biology, Chemistry and physics stressed that experimental group of varied abilities retain scientific concepts more than the control group.

The 5E teaching cycle is an instructional model proposed by Bybee, Taylor , Gardner , Scotter, Powell, Westbrook, & Landes (2006) where the learners build or construct new ideas on top of their old ideas.5E Teaching cycle have five phases of which each of the 5Es describes a phase of learning, and begins with the letter "E". Engage, Explore, Explain, Elaborate, and Evaluate. The 5Es can be used with students of all ages and ability levels. It enables students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning, and to continually asses their understanding of a concept.

The Bybee's 5Es lesson Planning Model is illustrated on a flow chart as follows:

The 5E Teaching Cycle Model

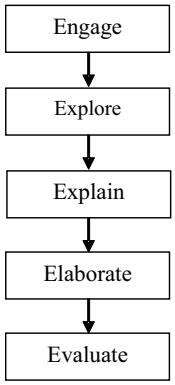

Fig 1: Flow chart 5E Teaching Cycle Model

1. In the engagement phase the teacher captures students' interest and makes them curious about the topic and concepts to be learnt. This phase provides an opportunity for the teacher to find out what students already know or think they know about the topic and concepts to be developed.
2. The exploration phase of 5E's provides students with a common base of experiences. They identify and develop concepts, processes, and skills. During this phase, students actively explore their environment or manipulate materials. This phase enable the students to acquire adequate knowledge of the science concepts taught to them. Thus the 5E Constructivist Instructional Model facilities and enhances academic achievement.
3. The explanation phase of the 5Es helps students explain the concept they have been exploring. They have opportunities to verbalize their conceptual understanding or to demonstrate new skills or behaviors. This phase also provides opportunities for teachers to introduce formal terms, Definitions, and Explanations for Concepts, Processes, Skills or behaviors.
4. The elaboration phase of the 5Es extends students' conceptual understanding and allows them to practice skills and behaviors. Through new experiences, the learners develop deeper and broader understanding of major concepts, obtain more information about areas of interest, and refine their skills.

Both the explanation and elaboration phases provide opportunity for the learner to retain the science concepts taught to them.

5. The evaluation phase of the 5E encourages learners to assess their understanding and abilities and allows teachers to evaluate students' understanding of key concepts and skill development.

From the literature reviewed, it has been shown that improved instruction could enhance retention. This study is therefore conducted on the impact of 5E teaching cycle on retention of biology concepts among pre-NCE students of varied abilities in North-west zone since other researches known to the researcher have been carried out.

Statement of the Problem

It is established from literature that constant use of lecture method did not make students retain biology concepts (Lakpini, 2006 and Lawal, 2010). This is because it is not thought provoking and students centered that involve active participation of students like inquiry method, problem solving method. This makes students to have less interest on the subject and the situation leads to poor performance of students in Biology, especially at Senior Secondary school level (WAEC 2012). There is therefore the need for Biology teachers to use active and thought provoking teaching strategy such as 5E teaching cycle that improve the retention ability of students, hence, the purpose of this study is to investigate the impact of 5E teaching cycle on retention of pre- NCE Biology students of varied ability in North-West Zone of Nigeria.

Objective of the Study

The objective of this study is to:

Find out if pre-NCE Biology students of varied abilities retain Genetic concepts when taught using 5E teaching cycle;

Research Question

The following research question is formulated for answering:

Do pre-NCE Biology students of varied abilities taught with 5E teaching cycle retain genetic concepts than those taught with lecture method?

Null Hypothesis

Based on the objective and research question stated above, the following null hypothesis is formulated for testing at $P \leq 0.05$:

Ho1: There is no significant difference in the retention ability of pre-NCE Biology students of varied abilities taught with 5E teaching cycle and those taught with lecture method.

Methodology

Quasi-experimental Design involving pretest, posttest and post-posttest was used for the study. The population was 2,231 pre-NCE Biology students made up of 1,168 males and 1,063 females. Simple random sampling technique by balloting method was used to select two schools out of the eleven coeducational colleges of education that served as population of the

study. Federal College of Education Zaria served as experimental group while Federal College of Education Katsina served as the control group. A sample of one hundred and ten (110) students was used for the study. Fifty five (55) Pre-NCE Biology students (38 males and 17 females) were selected from each college for the study as guided by Central Limit Theory which proposed that thirty or more subjects are considered as large sample for experimental research of this nature. Equal numbers of subjects were selected for each group in order to have a fair representation of the subjects in the study. Pretest was administered on the subjects, before they were exposed to the treatment to determine that they are not different significantly in their ability level. Post test was administered on the subject after the treatment and the Post posttest was administered on the subjects six weeks after they were given the Posttest. The experimental and control group subjects were assigned to sub-groups according to their ability levels by stratifying sampling technique after the pretest. The ability grouping was carried out by categorizing the subjects into high average and low ability group where students who scored 60-100 range of scores comprised high ability, those that scored 40-59 were categorized as average ability and those with 0-39 comprised low ability subjects. The experimental groups were exposed to 5E teaching cycle while the control group was exposed to lecture method. The posttest was given to determine the effects of exposure to 5E learning cycle which was for experimental and control groups. The Post-posttest was administered after six weeks from the administration of the Post-test in order to determine the retention ability of the subjects in the study. Genetics Academic Performance Test (GAPT) consisted of thirty items with reliability coefficient of 0.79 used as instrument for data collection. A research question and hypothesis guided the study which were tested using Mean score, Analysis of Covariance (ANCOVA) at $P \leq 0.05$ level of significance.

Results

Research Question 1:

Do pre-NCE Biology students of varied abilities taught with 5E teaching cycle retain genetic concepts than those taught with lecture method?

To answer this research question descriptive statistics of mean and standard deviation was used. The detail of the result is presented in Table 1:

Table 1: Mean and Standard Deviation of Retention Ability of Experimental Group and Control Group.

Ability groups	N	Treatment group	Mean	Std. Deviation	Mean difference
High	15	Exp	26.4667	1.50555	5.73
	15	Control	20.7333	2.78944	
Average	30	Exp	22.1667	2.54725	3.63
	30	Control	18.5333	1.83328	
Low	10	Exp	19.7000	1.41814	10.4
	10	Control	9.3000	2.00278	

The results in Table 1 showed that the experimental group with mean of 26.47 for High ability, 22.17 for Average ability and 19.70 for low ability sub-group retain higher than the control group with mean of 20.73 for high ability group, 18.53 for average ability and 9.30 for low ability group. To show whether the difference is significant or not, null hypothesis was formulated and tested using Analysis of Covariance (ANCOVA) statistic.

H_{01}: There is no significant difference in the retention ability of pre-NCE students of varied abilities taught with 5E teaching cycle and those taught with lecture method.

Table 2: Analysis of Covariance (ANCOVA) of Difference in the Mean Retention Ability of Experimental and Control Groups.

Source	Sum, of Squares	Df	Mean Square	F	P-value	Remark
Corrected Model	1983.218[a]	5	396.644	85.850	.001	*S
Intercept	34164.025	1	34164.025	7394.503	.001	*S
Ability G	997.868	2	498.934	107.990	.001	*S
Tg	976.803	1	976.803	211.420	.001	*S
Ability G * Tg	172.614	2	86.307	18.680	.001	*S
Error	480.500	104	4.620			
Total	47227.000	110				
Corrected Total	2463.718	109				

*S = Significant at P≤ 0.05 level

From Table 2 Analysis of Covariance (ANCOVA) statistics showed that significant difference exist in the mean retention ability of pre-NCE Biology students of varied abilities taught with 5E teaching cycle and those taught with lecture method. Reasons being that the intercept P-value of 0.001 is less than P≤ 0.05 alpha level of significance. The significant P-value for varied abilities was 0.001 and that of treatment group was 0.001. The P-value of treatment group was 0.001 which were all found to be lower than P≤0.05 alpha level of significance. Therefore, the null hypothesis which states that there is no significant difference in the mean retention ability scores of pre-NCE Biology students of varied abilities taught with 5E teaching cycle and their counterparts taught with lecture method is hereby rejected.

Table 3: Post Hoc Test of Analysis of Variance Differences in the Mean Retention Ability of Experimental and Control Group

	(I) Ability groups	(J) Ability groups	Mean Difference (I-J)	Std. Error	P-value	Remarks
Scheffe	High	Average	3.2500	.48063	0.001	*S
		Low	9.1000	.62050	0.001	*S
	Average	High	-3.2500	.48063	0.001	*S
		Low	5.8500	.55499	0.001	*S
	Low	High	-9.1000	.62050	0.001	*S
		Average	-5.8500	.55499	0.001	*S

*S =Significant at P≤0.05 level

The post hoc analysis in Table 3 using the scheffes test showed that significant difference exist between the pair wise mean of high ability level compared with each of the mean of those in either average or low ability groups retention abilities and vice versa. This is because in each pair wise comparison of means, the calculated P-value was found to be less than $P \leq 0.05$. Therefore, the null hypothesis which states that there is no significant difference in the mean retention ability scores of pre-NCE Biology students of varied abilities taught with 5E teaching cycle and their counterparts taught with lecture method is hereby rejected.

Discussion

The findings of the study showed that significant difference exist in the mean retention abilities of pre-NCE Biology students of varied abilities levels taught with 5E teaching cycle and those taught with lecture method as seen in Table 1,2 and 3.This agrees with the findings of Lakpini (2006), Anaso (2008) and Bunkure (2012), who found that students in the experimental group of varied abilities had higher retention than the control group of varied abilities .The analysis of the hypothesis showed that the use of 5E teaching cycle led to higher retention than the traditional method. The result of the mean scores of the subjects in the three ability groups of experimental group maintained higher retention rates than the subjects in parallel levels in the control group. This is because 5E teaching cycle strategy facilitates better understanding of Biology concepts and deeper understanding of the concepts leads to better academic achievement and retention.

Conclusion

As a result of the findings in this study, it could be concluded that a better retention of genetics concepts in Biology was provided by 5E teaching cycle among pre-NCE students of varied abilities in North-west Zone, Nigeria. This because all pre-NCE students exposed to it, showed higher retention ability when compared to those not exposed to it.

Recommendations

On the basis of findings emanating from this study, the following recommendations were made:

1. The teaching of Biology especially genetics should be conducted using 5E teaching cycle as it make students learn meaningfully therefore enhancing higherretention of knowledge in genetics. It should therefore be incorporated into the main stream of pedagogy in the teaching of pre-NCE Biology students of varied abilities in all colleges of education.
2. Appropriate learning environments should be provided for the students for effective application of 5E teaching cycle method in the classroom.
3. In-service training for science teachers in form of seminars, workshops -conferences should focus more on how to use 5E teaching cycle for the teaching of genetics concepts."The government or relevant professional bodies like Science Teachers' Association of Nigeria (STAN) could do this.

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