



## Using Study Questions as Advance Organisers to Improve Students' Retention Capacity in Basic Science

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### ABSTRACT

This research investigated the effect of study questions as advance organisers on students' retention in Basic Science in Makurdi Local Government Area of Benue State, Nigeria. Two research questions and 2 hypotheses guided the study which adopted a quasi-experimental, non-randomised, control-group, pre-test, posttest, research design. Purposive sampling was used to draw 167 students from a population of 1682 Upper Basic 2 students who were used for the study. Data were collected using the Basic Science Achievement Test (BSAT) which reliability co-efficient was determined to be 0.86 using Kuder Richardson formula 20 K-R<sub>20</sub>. Data collected were analysed using Statistical Package for Social Sciences (SPSS). Mean and Standard Deviation scores were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The study found that experimental subjects significantly outperformed the control subjects in mean retention  $F_{(1,164)}=21.72$ ,  $p=0.00<0.05$  while there was no significant difference between male and female students in retention  $F_{(1,77)}=0.44$ ,  $p=0.51>0.05$ . It was therefore recommended that teachers of Basic science should provide students with study questions as advance organisers to enhance parity in the retention of knowledge across gender.

**Key Words:** Study questions, advance organisers, retention, Basic science and effect.

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### INTRODUCTION

According to Woolfolk (2008), retention is the ability of a learner to remember facts and figures in memory. To Igboko and Ibeneme (2006), retention is the ability of an individual to hold factual knowledge, skills, processes, images and figures in memory and at the same time, retrieve same when needed. The retention and subsequent application of scientific knowledge and skills by students in their life endeavours is a key expected outcome of the basic science education programme. According to the Universal Basic Education Commission- UBEC (2005) students who successfully complete the basic education programme are expected to retain such knowledge and skills acquired from the classroom to the extent that they can apply the same competence gained in the workplace and in their future academic endeavours.

In highlighting the importance of basic science in the attainment of the UBEC mandate, the Nigeria Educational Research and Development Council (NERDC) (2007) affirmed that the basic science curriculum is designed in a way as to expose learners to knowledge and skills that will enhance their economic self-reliance on completion of the basic level of education. To achieve this aim, the Council stipulated that the inquiry approach be employed in teaching the subject.

However, the continued lamentation by employers of labour about the unemployability of school leavers due to school leavers' lack of requisite skills as reported by Akpan (2008) and Olujide (2010) may be due to the low retention of knowledge by the school leavers. Incidentally also, Liga (2014) was of the opinion that poor achievement trend reported may have been due to the poor retention of knowledge by students. The author's

argument was that students need to retain knowledge long enough to be able to provide adequate correct responses to achievement test questions.

Studies by Atomatofa (2013), Ajai and Imoko (2015) revealed that students tend to easily forget material taught them within relatively short periods. Both studies revealed that students mean retention scores obtained via delayed tests were lower than the scores from achievement tests which were earlier taken by students. Hence, the need to address the low retention of students becomes imperative, more so that this challenge constitutes a clog in the wheel of progress in Nigeria's quest to address the current unemployment challenge which has continued to affect both individual and national development.

Ausubel (1968) outlined some cognitive factors which influence retention. These are: "(a) the availability of relevant subsuming concepts at an appropriate level of inclusiveness in [learner's] cognitive structure; (b) the stability and clarity of these concepts; and (c) their discriminability from the learning task." The author added that "it is largely by strengthening relevant aspects of the cognitive structure that new learning and retention can be facilitated." Thus, one way of strengthening the cognitive structure is to introduce appropriate subsumers such as study questions prior to presenting the new lesson.

Ausubel (1960) referred to advance organisers as appropriately relevant introductory materials presented to learners prior to classroom instruction. The author affirmed that the introductory materials serve as frameworks to which learners attach new knowledge. Without the frameworks in place, Ausubel argued that new knowledge can hardly be anchored and retained long enough. When students are unable to retain and provide correct responses to questions during achievement tests, they fail hence, this may be a contributor to the reported failure trend.

Implied from the position of Ausubel is that the reported failure trend may be due to the absence of anchored instruction in the Basic science classroom. Since current instructional approaches employed by Basic science teachers are not effective at yielding the desired level of knowledge retention among students, the need to verify the claim by Ausubel that presenting students with advance organisers in this case, study questions can improve their retention ability becomes imperative.

### **Statement of the Problem**

Despite concerted efforts made at addressing the poor performance of students in science, it appears the problem has defied available solutions. Given a period of inactivity, students can hardly recall and apply the knowledge and skills acquired in the classroom to the workplace or in solving problems in their environment. A diagnosis of the problem reveals among others that science teachers' continued use of inappropriate instructional methods is a major contributing factor. Ineffective methods prevent students' active participation during science lessons and impair students' ability to gain and retain knowledge. The need to verify Ausubel's claim on the potency of advance organisers in enhancing students' retention in the current location and in Basic science necessitated the current study.

### **Research Questions**

The following research questions raised guided the study:

1. What is the difference in the mean retention scores of Basic science students presented with study questions as advance organisers and those not presented with the advance organisers?
2. What is the difference in the mean retention scores of male and female Basic science students presented with study questions as advance organisers?

### **Hypotheses**

The following formulated hypotheses guided the study:

There is no significant difference in the mean retention scores of Basic Science students exposed to study questions as advance organisers and those not exposed.

There is no significant difference in the mean retention scores of male and female Basic science students presented with study questions as advance organisers.

### **METHODOLOGY**

The study investigated the effect of study questions as advance organisers on the retention ability of basic science students in Makurdi Local Government Area of Benue State, Nigeria. The design for this study was the quasi-experimental, non-randomised control-group, pre-test-posttest design. The population for this study

consisted of one thousand six hundred and eighty two Upper Basic 2 students in the twenty government-owned and grant aided secondary schools in Makurdi Local Government Area, (Benue State Ministry of Education, BSME, 2013). The sample for the study comprised of 167 students made up of 95 male and 72 female Upper Basic 2 students in intact classes in four schools. The instrument used for data collection was the Basic Science Achievement (BSAT). The BSAT was validated by three experts, two from science education and one in measurement and evaluation.

A pilot study was carried out in a school that was outside the sampled schools. Test scores from the pilot were computed and used to calculate the reliability of the BSAT. The reliability coefficient of the BSAT was computed using Kuder Richardson Formula 20  $K-R_{20}$  and it yielded a reliability coefficient of 0.86. The BSAT was thus, considered reliable based on the position of Ali (2006) who stated that an instrument of this type which yields a reliability co-efficient between 0.55 to 0.99 is reliable.

Four Research Assistants (RAs) were trained and they assisted the researcher in data collection. RAs in the experimental schools were trained on the administration of the study questions as advanced organizers while RAs in the control group were trained to teach students with the inquiry strategy only. The students in both experimental and control groups were administered a pretest to determine their level of knowledge at entry. Then both experimental and control groups were taken through a period of instruction for six weeks. Study questions on each topic were presented to students in the experimental group a week before the topic/lesson was taught. After the six weeks of instruction, no treatment was administered to the students for an additional four weeks after which the retention test was administered. The entire exercise lasted ten weeks. The research questions were answered using Means ( $\bar{x}$ ) and Standard Deviation (SD) scores while the hypotheses were tested using Analysis of Covariance (ANCOVA).

## RESULTS

The data presented were analysed and interpreted based on the research questions and the hypotheses. The Mean ( $\bar{x}$ ) and Standard Deviation (SD) of scores were used to answer the research questions. Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The decision rule was that the null hypotheses are not accepted if the p value is less than 0.05. On the other hand, the null hypotheses are accepted if the p-value was greater than 0.05.

### Research Question 1

*What is the difference in the mean retention scores of Basic science students presented with study questions as advance organisers and those not presented with the advance organisers?*

**Table 1: Mean retention scores and standard deviations of students in the experimental and control groups**

Group	N	Pre-Test Scores		Retention Score		Mean Retained Difference
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental	80	7.63	2.80	14.33	4.20	6.70
Control	87	6.54	2.56	8.23	1.96	1.69
Mean Difference		1.09		6.10		5.01

Table 1 shows that the mean retention score of the experimental group was 14.33 with SD of 4.20 while the Mean retention score of the control group was 8.23 with SD of 1.96. The difference between the mean retention scores of both groups was 6.10 in favour of the experimental group. Similarly, the mean retained score for the experimental group was 6.70 while that of the control group was 1.69 with a difference of 5.01 in favour of the experimental group. This indicates that students in the experimental group retained more as compared to their counterparts in the control group.

**Hypothesis 1**

There is no significant difference in the mean retention scores of Basic Science students presented with study questions as advance organisers and those not presented with the advance organisers.

**Table 2: One-way ANCOVA for effect of advance organisers on students' retention in Basic Science**

Source	Sum of Squares	df	Mean Square	F	Sig	Remarks
Corrected Model	1759.70	2	879.85	95.46	0.00	Significant
Intercept	1416.67	1	1416.67	153.71	0.00	Significant
Pre-Test	211.40	1	211.40	22.94	0.00	Significant
Group	1271.31	1	1271.31	137.93	0.00	Significant
Error	1511.56	164	9.22			
Total	24032.00	167				
Corrected Total	3271.26	166				

Table 2 shows that  $F_{(1,164)}=137.93$  with  $p=0.00$ . Since  $p=0.00 < \alpha=0.05$ , the results indicate that the difference in Mean retention scores between the experimental and control groups was significant. The null hypothesis was therefore, not accepted. It can be implied from this finding that Basic Science students presented with study questions as advance organizers significantly retained more learnt material as compared to the students who were not presented with the advance organisers.

**Research Question 2**

What is the difference in the mean retention scores of male and female Basic science students presented with study questions as advance organisers?

**Table 3: Mean retention scores and standard deviations of male and female students in the experimental group.**

Group	N	Pre-Test Scores		Retention-Test Score		Mean gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Male Students	44	7.95	4.01	14.20	3.77	6.25
Female Students	36	7.22	4.72	14.47	4.72	7.25
Mean Difference		0.73		-0.26		-1

Table 3 reveals that the Mean retention score of male students was 14.20 with SD of 3.77 while the Mean retention score for female students was 14.47 with SD of 4.72. The difference between the Mean retention scores of male and female students was -0.26 in favour of the female students. Results shown on the Table also reveal that the difference between the mean retained and post achievement mean score of male and female students was -1 in favour of the female students.

**Hypothesis 2**

There is no significant difference in the mean retention scores of male and female Basic science students presented with study questions as advance organisers.

**Table 4: One-way ANCOVA for effect of advance organisers on male and female students' retention in Basic Science**

Source	Sum of Squares	df	Mean Square	F	Sig	Remarks
Corrected Model	134.20	2	67.10	4.10	0.02	Significant
Intercept	1089.71	1	1089.71	66.63	0.00	Significant
Pre-Test	132.78	1	132.78	8.12	0.01	Significant
Sex	7.23	1	7.23	0.44	0.51	Not significant
Error	1259.35	77	16.36			
Total	17810.00	80				
Corrected Total	1393.55	79				

Table 4 shows that  $F_{(1,77)}=0.44$  with  $p=0.51$ . Since  $p=0.51 > \alpha=0.05$ , the result indicates that the difference in mean retention scores between male and female students was not significant. The null hypothesis was therefore, not rejected. This indicates that there is no significant difference in the retention of male and female Basic science students presented with study questions as advance organisers.

## DISCUSSION OF FINDINGS

The findings of the study showed that students in the experimental group had a higher mean score as compared to the students in the control group. In testing for significance, the finding revealed that study questions as advance organisers are a significant factor in the retention of learnt materials by students in Basic Science. This finding agrees with that of Oloyede (2011), Adetunji, Bamidele and Awodele (2013) who found that the various forms of advance organisers used in their respective studies significantly enhanced retention.

The significant effect that the study questions as advance organisers yielded on students' retention in this study may most likely be attributed to the reality that the study questions served as anchoring foci in the students' cognitive structure to which they anchored the new knowledge gained in the proceeding lessons. This agrees with the postulation of Ausubel (1962) that anchored knowledge results in enhanced retention of such knowledge, but disagrees with the finding of Ezech (1992). Probably, the significant retention gains made in this study might have been due to the adequate time availed students to study the questions prior to each lesson. Unlike the study by Ezech (1992) where study questions were administered to students on the day of the lesson, between 1 to 5 minutes prior to lesson sessions, an action which was thought may have led to the non-significant retention gains reported by the study, the current study presented the students with the study questions a week in advance of each lesson. This was to avail the students enough time to study the questions thoroughly. This action is thought to have contributed to the significant retention gains recorded in this study.

On gender, the findings of this study revealed that female students outperformed male students in terms of retention. However in testing for significance, it is noted that the difference in mean retention of male and female students was not significant. This study agrees with those earlier conducted by Chukwu (2011), Abdul-Raheem (2012), Liga (2014) and Ajai and Imoko (2015) which found no significant difference in retention between female and male students.

The equal instructional opportunities availed both gender may have led to non-significant difference in the retention of males and females. This assertion is consonant with Okeke (2007) and Nzewi (2010) who earlier affirmed that the performance of female students especially in science will be at par with that of males if both genders are presented with equal instructional opportunities. In the current study, both male and female Basic science students were presented with study questions as advance organizers under the same instructional conditions. On the contrary, this study did not support findings earlier made by Alipour, Gorjian and Zafari (2012), Udo and Ubana (2013) and Nja and Kalu (n.d) that male students significantly outperformed their female counterparts in retention when presented with advance organisers and other inquiry based instructional approaches.

## CONCLUSION AND RECOMMENDATIONS

The results of this study provide empirical evidence that presenting students with study questions as advance organisers significantly enhanced students' retention in Basic science in Makurdi Local Government Area, Benue State, Nigeria. Also, there was no significant difference in the mean retention scores of female and male Basic science students presented with study questions as advance organisers. This implies that the study questions were not gender biased and can be used to enhance science students' retention capacity across gender.

Since presenting students with study questions as advance organisers is found to be an effective strategy for improving retention in Basic science irrespective of gender, teachers of Basic science should endeavour to present students with these study questions prior to instruction. Authors of Basic Science text books should carefully illustrate the approach to the use of study questions as advance organisers in their books.

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