IMPACT OF USING ORGANISED OBJECTIVE QUESTIONS AS AN ADVANCED ORGANISER ON STUDENTS' ACHIEVEMENT AND RETENTION IN CHEMISTRY

Udogu, M.E. (Mrs.)

Abstract

An experimental research consisting of pre-test, post-test experimental and control groups was carried out to determine the effectiveness of using structured objective questions as an advance organiser in enhancing students' achievement in chemistry. Four secondary schools out of sixteen secondary schools in Idemili South Local Government Area made up of two boys and two girls were purposely selected for this work. One boys' school and one girls' school were randomly assigned to experimental group (E) while the other two served as control group (C), Selected course topics in physical chemistry were taught to both "E" and "C" groups using traditional teaching mode. But "E" groups were given objective questions prepared from the same course topics as advance organiser prior to the actual teaching. These groups were pre-tested and post-tested after treatment using validated and characterised teacher-made achievement test (TMAT) and were also post-tested after four weeks to monitor knowledge retention. Analysis of covariance was applied, so as to adjust post-test scores initial difference and control for unequal number of subjects in the different cells (groups). In the analysed data collected. From the result, it was clear that the group exposed to advance organiser performed better the control group. This proves that advance-organiser is effective both for conceptual understanding and knowledge retention. Suggestions were made based on observations.

Introduction/Problem

A National Policy on Science and Technology (1987) has actually been published by the Ministry of Education. This policy goes on in its consideration of the strategies necessary for implementing the policy to call for the provision of programmes for the recognition, encouragement, development and promotion of scientific and technological talents at all levels. This emphases on science and technology calls for added effort on the part of teachers to ensure that the policy is practicalised. One should understand children attempt to make sense of the natural world long before they begin the process of formal education (Kule and Abell, 1989). They maintained that as children develop, they begin to construct sets of ideas, expectations and explanations about natural phenomena to make meaning of their everyday experience. The ideas and explanations that children generate from a complex framework and are frequently different form the views of scientists. Teachers have always recognized the need to start instruction where students are. This is in line with observation made by Abdullahi (1982), who believed that, learning is an individual thing. Hyle and Abell (1989) still maintained that the unlearning of preconceptions might well prove to the most determinative single factor in the acquisition and retention of subject matter knowledge. Hence Ausuble (1968) contends that, "the most important single factor influencing learning is what the learner already knows. If learning of science involves a process of conceptual change, it becomes necessary that students must be provided time individually with teacher to think and talk through the implications and possible explanations of what they are observing. After all Vygosky in House (1990), believed that learner constructs knowledge: that is, that what we know is not a copy of what we find in the environment but is instead, the result of thought and action. This is why constructivism in Lorsbach and Tobin (1992), asserts that knowledge resides in individual, that knowledge cannot be transferred intact from the head of a teacher to the head of student. Udogu (2005), contends that, formal expository method of instruction often leaves unchanged many of the misconceptions as alternative framework held by some students with the result that poor performance is recorded each year in SSCE in chemistry in partial. But with Ausubel (1960), the presentation of specific facts to students should normally be preceded by advance organiser, which is generalised ideational field present prior to the specific facts relevant to the field. Such advance organiser then serves as the general concept which the material to be learnt can be subsumed or anchored artied to cognitive structure. Okoye (1979) identified the questioning technique among other techniques capable of fostering meaningful learning by inducting a learner to process task thoroughly.

One of the problems that necessitated this research work is that the chemistry teachers have not faced the challenge to utilize classroom-learning strategies that can promote positive attitudes, allow conceptual change and prepare the youngest to think for themselves. Rather they bent on emphasizing the memorization of facts by teaching disjointed concepts in the chapter-by-chapter lecture mode which often leaves unchanged many misconceptions held by many students. This leads to poor performance in examination (Udogu, 1998).

Therefore, there is every need to experimentally x-ray the impact of organised questions (advance organiser) on students' performance in chemistry in secondary schools.

Purpose of the Study

1. The study was designed to investigate experimentally the efficacy of the use of study questions as advance organiser in promoting teaching and learning of chemistry by combining it with the conventional (lecture) mode.
2. To ascertain the extent to which the use of this advance-organiser helps in the retention "-of knowledge gained.

Hypotheses

The following null hypotheses were stated to guide the studies.

1) There will be no significant difference in the achievement scores of students issued with study questions during teaching and those who received instructions without study questions (advance organiser).
2) There will be no significant difference in the achievement scores of subjects in experimental and control groups on knowledge retention.

Methodology *Area of Study*

This was conducted in Idemili South Local Government Area, which was very convenient for the researcher who is resident in the area.

Design

THE DESIGN FOR THIS STUDY WAS A pre-test, post-test experimental and control groups. The groups were exposed to different treatment condition.

Population

The population was all (SS II) secondary school chemistry students in Idemili South Local Government Area of Anambra State. Out of these, 164 students from four purposively selected secondary schools formed the sample for the study. Two schools were male while the other two female. One male and one female schools were randomly selected and exposed to the teaching using advance organiser, these serve as experimental group. While the other one male and one female schools serve as control group who received instructions by conventional method only.

Table 1: Distribution of Subject by Gender and Treatment

Gender	**Taught With Advance Organiser**	**Taught by Conventional Method**
Male	**E, = 44**	**C, = 43**
Female	**E_2 = 37**	**C, = 40**

The application of advance organiser is not new in the teaching field but it has not been applied in the teaching the subject chemistry along side with other methods. Few topics in the area of physical chemistry were chosen like types of reactions, energy changes in chemical reactions and rates of reactions. These topics serve as the course content for the study. These topics were chosen partly because

they appear in the scheme of work for SSII chemistry in time the researcher was carrying out her work and partly because, they are the areas students always find very difficult to comprehend

Instrumentation

The instrument utilized in this study is a teacher-made achievement test (TMAT). Three teacher-made tests in selected topics in physical chemistry were prepared. These were test, I, II and III. The Test I was a 40 item multiple-choice objective tests of four options based on the content of the learning task and guided by a test blueprint to ensure coverage of the six-levels of Bloom's cognitive taxonomy. *This was designed for pre-test. Test II* was a *re-arranged version of Test I and* served as an immediate post-test (achievement) measure. Test III was further rearranged version of test I after four weeks, which was used to monitor knowledge retention (Retention test).

Validation of Instrument

The teacher made test was content-validated by experts and colleagues in the field. After a pilot study, the test scores obtained were used to characterised the instrument. Using split-half odd-even plot reliability technique and parson-product moment correlation formular, its reliability coefficient was fixed at .84. Also, the difficulty and discrimination index were determined and fixed at (0.49 -0.78) and (0.54 - 0.59) respectively.

Pre-Test Session

Before the commencement of the main treatment, pre-test was administered to both E and C groups to ascertain the equivalency of the groups.

Treatment Session

Each group (E and C) were exposed to the selected topics in the physical chemistry. This exposure lasted for eight weeks.

Teaching Chemistry Using Advance Organiser to the Experimental Group

For this study, questions having elements in both pre-requisite background information as well as in the incoming task were presented to subjects as questions, which they should be able to cope with either during or after the learning task. These questions were called pre-questions because they preceded the learning task. The questions were organised logically from simple to complex to fall in line with the text arrangement of the learning tasks. These questions were issued to the experimental groups (E, & E_2) only.

The researcher goes on to deliver normal classroom .instruction using lecture mode to these group but went on to encourage them to find answers to these pre-questions on their own. Efforts made by individual students were rewarded by the researcher who enlightened tern on some difficult questions any time she was consulted. Additional take home assignments were also issued.

Teaching Chemistry to the Control Groups

Normal exposure to lessons selected from the learning task for the study using lecture mode (conventional method) was carried out additional take home assignments of any form were also given to the group and efforts made by the researcher to check new attempts. All the treatment was done by the researcher to avoid results jeopadization.

Administration of Test

Finally, both groups (experimental and control) were post-tested to measure their performance (achievement). After four weeks, test III was administered to both experimental and control groups to monitor knowledge retention.

Data Analysis

The scores obtained from post-test were processed and analysed using analysis of covariance. This was applied to take care of the initial differences and unequal number of subjects in the different group.

The experimental E] and E_2 were pulled together and control C1and C2 pulled together also and this gave rise to only two groups. This was to make the analysis easier. All the analysis were carried out at a

probability level of 0.05.

Presentation of Results

This table presents clearly the mean scores, standard deviations for pre-test, post-test and test after four weeks.

Table 2: M= 164

Types of Test	Experimental Group Male E_1	Experimental Group Female E_2	Control Group Male C_1	Control Group Female C_2
Mean pre-test score S.D	8.41	10.50	9.73	8.63
Mean post-test score S.D	53.01	49.71 7.91	40.04	43.79
Mean	49.70	46.3!	41.09	40.22
score after weeks S.D	5.81	5.11	4.90	5.03

The Table 2 above indicates that, the experimental groups performed better than the control groups as shown by the mean values. But one cannot say yet whether these differences observed is significant or not as to reject or accept the null hypotheses.

Hypothesis 1 (No Significant Difference of Experimental and Control Groups)

Table 3: Analysis of Covariance of the Post Test Scores of the Subjects (Experiments and Controls) by Treatment

	Between	Within	Total
Sum of squares Y	195.23	635.23	831.23
Sum of squares X	.94	176.17	177.01
Sum f products	-3.14	338.11	334.88
Degree of freedom	K-l-I	N-K=162	163
Adjusted sum of squares Y	27.39	347.30	
Degree of freedom for adjusted sum of squares	1	N-K-1=161	162
Variance estimate	27.39	2.14	

F $\frac{27.39}{2.14}$ F CALCULATED = 12.79

Key Y = Post-test scores (achievement scores) X = Pre-test scores (covariate) K. = No of groups involved N = No of subjects involved

Table 3 above shows that, there is a significant difference in the achievement scores of students exposed to advance organiser and those not exposed to advance organiser. Since the F-calculated is greater than the Table 1, it shows that, advance organiser makes for a better instructional strategy then purely lecture method. This can be inferred from the mean scores of the two groups *(E, and E_2)* and *(C\ and C_2) in the Table*

2 above. This means that, the *null hypothesis is rejected.*

Hypothesis II: There is no significant difference in the achievement score between students exposed to different treatments on the retention of knowledge gained.

Table 4: Analysis of Covariance and of the Post-Test Scores of the Experimental and Control Groups on the Retention of Knowledge Gained

—	Between	Within	Total
Sum of squares Y	175.19	693.41	868.60
Sum of squares X	18	165.23	183.23
Sum f products	-3.33	336.17	332.84

Degree of freedom	K-l = 1	N-K=162	163
Adjusted sum of squares Y	31.40	388.61	
Degree of freedom for adjusted sum of squares	1	= 161.	162
Variance estimate	31.40	2.21	

$$F \quad \frac{31.40}{2.21}$$

From the Table 4 above, one can conclude that, advance organiser makes for better knowledge retention. Since there is significant difference in the post-test scores of students taught chemistry using advance organiser and those taught without. Hence F calculated (14.21) is greater than the table one (3.07). Therefore, the null hypothesis of no significant difference is rejected.

Discussion

The results show that the experimental groups performed significantly better than the control groups as indicated by the values of the f-criticals and values. The findings agree with those of Ausubel (1960) and Dienye (1990), that questioning conditions used as an aid to learning (advance organiser) is quite facilitative to learning outcome. These also tally with observations made by Okoye (1979), that questioning technique among other teaching techniques is capable of fostering meaningful learning by inducing a learner to process learning task thoroughly. Analysis in respect of the tables 3 and 4, show a clear proof of the effectiveness of the advance organiser as aid to knowledge retention and this agrees with the work of Hasubel and Fitzgerald (1962), in Seweje (1997), that retention of learned materials is improved through the use of advance organiser. In the same vein Meats (2005) and Mondal (2005), maintained that, advance organiser assists students with transferring or applying what they know to what they are learning. That it helps them to clarify the big ideas that the students will be exploring.

Conclusively, when students are exposed to generalised concept prior to actual teaching an ideational scaffold is generated upon which the new concepts can be intelligently and meaningfully anchored.

Implication of Results for Teaching and Learning of Chemistry

The problem that generated this study that the teachers are in poor knowledge of the strategies that promotes active learning, which leads to poor performance in the SSCE Chemistry. Therefore, in order to alleviate these problems, teacher of chemistry should as a matter of fact adapt and incorporate advance organiser regularly in their instructional system. Advance organiser provides clue and link to previous knowledge and helps to embed new knowledge or concept into the long-term memory.

Conclusion

Exposure to advance organiser will invariably help the children to see the applicability of science in their day-to-day activities as it gives a previous of what is to come - next to and provide links between old and new knowledge.

References

Ausubel, D.P. (1960). The use of advance organiser in the learning and retention of meaningful verbal material. *Journal of Educational Psychology 5(member),* pages 31-39.

Dienye, N.E. (1990). The Effect of a News Paper Story Used as Advance Organiser on Achievement in Integrated Science. *Journal of Education in Developing Area* Vol. 3 (1), pages 28-45.

Jane, L. (1991). *Studies in Higher Education.* Routledge Group Inc. USA.

Howe, A.C. (1990). *Research Matters to the Science Teachers. Journal of National Research for Science Teacher* (NARST) 25(2), pages (36-41).

Lorsbach, A. and Tobin, K. (1992). Constructivist as a Reference for Science Teaching. *Journal of National Association for Research in Science Teaching No. 30.*

Meats, R.R. (2005). *Album by Science Teacher.* Horns www.google.com.

Nigeria Federal Republic (1986). *National Policy on Science and Technology.* Ibadan: N I Port Press.

Udogu, M.E. (2005). *The relative Effectiveness of two Teaching Method in Secondary School Chemistry* 7(1), pages 81-86.

Udogu, M.E. (1998) Effect of Concept Mapping Instructional Technique on Students Performance in Chemistry. *Journal of Pure and Applied Science 2* (1) 90-100.

Appendix

Table 5: Test Blue-Print for Physical Chemistry Course Levels of Educational Objectives

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total
Types of reactions	(2.0) 2	(2.4) 2	(2.4) 2	(3.2) 3	(3.6)	(2.4) 3	16
Energy changes in chemical reactions	(1.6) 2	(1.9) 2	(1.9) 2	(2.6) 3	(2.9) 3	(1.9) 1	13
Rates of reactions	(1.3) 1	(1.6) 2	(1-6) 2	(2.2) 2	(2-4) 2	(1.6) 2	11
Total questions-	5	6	6	8	9	6	40