

Effect of Advance Organizer on Performance and Retention of Senior School Students in Chemistry in Lagos State, Nigeria

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Abstract:

This study investigated the effect of the use of Advance Organizer on senior students' performance in chemistry in Lagos State. The research sample comprised of eighty chemistry students randomly selected from two secondary schools in Eti Osa Local Government of Lagos State. The instrument for the study was a chemistry achievement test comprising of 50 multiple choice questions. It was found that advance organizer improves performances and retentive memory of students leading to substantial gain in learning outcomes. These findings tend to suggest that some of the problems encountered by chemistry students may be rooted to the fact that certain topics in the syllabus require different approach other than the conventional method, others that require high cognitive ability should be handled with a strategy which will enable students to delineate clearly and precisely the differences between new learning, this will help the students to grasp the learning task with few misconceptions leading to the emergence of less confused new meaning which will improve students' performance. Based on the findings from the study, it was recommended that teachers should use advance organizer strategy in addition to the existing strategies to improve the standard of performance of Nigerians secondary schools chemistry students.

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Introduction

Chemistry is a branch of science which studies the substances or elements which make up the earth, universe and living things. It is one of the science subjects in the secondary school curriculum in Nigeria. In view of the obvious importance of chemistry in scientific and technological advancement of any nation, and its usefulness in nearly all fields of human endeavor, the low performance of students in the SSCE/GCE "0" level examination has been a concern to various people. The importance of science teaching in the schools cannot be over emphasized in a developing country like Nigeria, considering its relevance to the development of any nation. The knowledge of science has tremendously helped in the area of medical care, transportation and clothing; it is science that has produced engineer, science teachers, doctors, geologists and technologists.

Over the years, emphasis seemed to have been placed on the importance of teacher/teaching at the expense of learner/learning. The understanding of chemistry concepts is not a thing that the teacher can achieve without an appropriate teaching method that will involve the students as much as possible. For science teacher to be effective in his teaching of the secondary school science, he has to perform the following tasks: (i) organize his/her students to learn science through activities in the laboratory; (ii) use good questioning techniques to evoke recall of facts, comprehension, and application of principles; (iii) utilize audio-visual aids whenever appropriate to generate and sustain the interest of students in the sciences; and (iv) hold meaningful discussions with the students.

In order to allow for large content to be covered within the available time, expository teaching do take place, there is need to improve on quality of learning for meaningful learning to take place; a well organised teaching of a task is thought to supply students with a useful perspective of what lies ahead. This educational premise has attracted considerable interest over the years and have found expression in Ausubel's advance organizer. In learning and teaching chemistry in secondary schools, the effects of teaching strategies are very essential; organization is one hallmark of a good teaching, the manner in which material is sequenced and arranged has a profound impact upon what student learn (Ausubel,1960).

Advanced organizers are a concept developed and systematically studied by David Ausubel in 1960. He was very influenced by the teachings of Jean Piaget (Geier, 1999). Ausubel has worked consistently to prove that advance organizers facilitate learning and much of his research has influenced others since the 1960s. However, throughout the history of using advance organizers, it is still undecided whether or not advance organizers fully promote learning or if other processes are more beneficial, but much of the research promotes the ability of advance organizers to be useful in improving levels of understanding and recall (Mayer, 2003).

According to Ausubel (2010) advanced organizers represent one strategy to address subsumption theory. Subsumption theory suggests that learning "is based upon the kinds of superordinate, representational, and combinatorial processes that occur during the reception of information." When new knowledge is created that is substantive and non-verbatim, and is related to existing knowledge, retention and learning are primed. Forgetting occurs when new knowledge becomes integrated into existing knowledge, and loses its individual identity. Since the advent of advance organizers, research has been able to prove that these work best when there is no prior knowledge involved, because an advance organizer becomes the

student's prior knowledge before learning the new material. If prior knowledge is available, advance organizers do not work as well for these students (Mayer, 2003).

Ausubel's advance organizer can best be classified as a deductive method. Deductive methods or reasoning provide the rule to follow then the example leading to the correct answer or learning (Mayer, 2003). This is opposite from inductive methods or reasoning that provides the example to follow then the rule. Advance organizers are also highly useful in the process of transferring knowledge. Because of the deductive reasoning, students are able to use the rule then the example for learning to occur. Mayer writes in his text, "...the effects of advance organizers should be most visible for tests that involve creative problem solving or transfer to new situations, because the advance organizer allows the learner to organize the material into a familiar structure" (Mayer, 2003).

Advance organizer are similar to overview or review except that they are written in higher level of abstraction, generality and inclusiveness than the learning itself (Ausubel, 2010). Advance organizers are designed to provide a conceptual frame with which students can use to clarify the task ahead, it plays a subsuming role, acting as a link to or a bridge between the cognitive structures of the learner and the new learning material, that has more impact with an enduring retention (Mayer, 2003). It is important to know that advance organizer must be at the appropriate reading level for the student and assist the student in accessing relevant knowledge. Advance organizer is used to provide a conceptual framework that student can use to clarify the task ahead. Meaningful learning is explained in terms of retention; retention is the term used to denote the demonstration that learning has been maintained overtime. It may be displayed through recognition or recall (Herron, 1994). Coffey (2000) describes meaningful learning in terms of reception learning, by reception learning, coffey means learning presented to rather than discovered by the learners. Meaningful reception learning involves the process of subsumption. subsumption of information occurs when information enters a student's cognitive structure and interacts with and is subsumed under more inclusive concept already possessed by the student. Advance organizers work best when there is no prior knowledge before learning the new material.

Ausubel's theory is connected with how individuals learn large amount of meaningful material from verbal textual representation in school setting. He feels that learning is based upon process that occur during the reception of information. A primary process on learning is subsumption in which new material is related to relevant ideas in the existing cognitive structure (Schema) but not entirely alike to its original presentational form. If advance organizers function as they should, that is delineate clearly, precisely and explicitly, the similarity and differences between ideas in a new learning, cognitive structure and the learning task would be grasped with fewer misconceptions leading to the emergence of clearer, less confused new meaning (Ausubel, 1966). Advance organizers act as a bridge between new ideas to existing related ideas, to this end, an organizer is chosen because of its suitability to explain, integrate and interrelate the material they precede thus strengthening the cognitive structure. Therefore, the researcher has decided to research into the effect of advance organizers as a means of improving students learning and retention thereby improving performance. This knowledge base is the foundation upon which this research stands.

The main purpose of this study was to determine the effect of advance organizer on performance and retention of senior school students in chemistry. Specifically, the study determined the:

- i. difference in the performance of students exposed to the use of advance organizer and those not exposed to it;
- ii. difference in the retention ability of those exposed to the use of advance organizer and those not exposed to it; and
- iii. difference in the performance of male and female students exposed to the use of advance organizer.

Research Questions

The following research questions were raised to guide the study:

1. Would there be any difference in the performance of students exposed to the use of advance organizer and those given the placebo (non-organizer passage)?
2. Would there be any difference in the retention ability of students exposed to the use of advance organizer and those not exposed to it?
3. Would there be any difference in the performance of male and female students exposed to the use of advance organizer?

Research Hypotheses

The following hypotheses were tested in this study.

Ho₁: There is no significant difference in the performance of students exposed to the use of advance organizer and those not exposed to it.

Ho₂: There is no significant difference in the retention ability of students exposed to the use of advance organizer and those not exposed to it.

Ho₃: There is no significant difference in the performance of male and female students exposed to the use of advance organizer.

Methodology

A total number of eighty (80) chemistry students from two randomly selected schools were involved in this study. The eighty students that took part were the SSII students, 40 students from each school. The participating students totaling 80 were distributed on school basis into experimental and control groups based on the permission from the appropriate school authority. The instruments used for this study are of three types, some were developed by the researcher, some was adapted, some of which include answer sheets, tests and materials. The materials used are the-Verbal organizer (VO), these are verbal materials prepared by the researcher with a title "flow of electron" for the learning of electrolysis and electrochemical cell. These materials are assumed to be at higher level of abstraction, generality and inclusiveness than their respective learning materials. The students in the experimental group studied the materials used as organizer for about 15 minutes preceding the introduction of the learning materials.

Learning material: this was a passage on electrolysis and electrochemical cell prepared by the researcher, they were taught in such a way as to be both comprehensive and interesting to students using necessary aids where possible and necessary. The instruments used for data collection is the chemistry achievement test (CAT), the test was used for pretest, posttest and retention test. It was administered before treatment to serve as pre-test for the experimental and control groups; it consisted of a 50 item multiple choice tests which were

derived from the learning materials. Research assistants were provided with detailed instructions on the topics to be taught in order to assist in teaching the control group, while the researcher teaches the experimental group with the advance organizer.

The teaching lasted for four weeks of three periods per week which made a total of 12 periods for the experimental class. After four weeks of using the advance organizer, the same students were post-tested using the chemistry achievement test (CAT) designed by the researcher. The control group was also taught for a period of four weeks using lecture method which does not involve the use of advance organizer but theoretical explanations of the same content outline in the topics chosen for each class. A lecture note was prepared with the students copies as the lecture goes on. The control group was also post-tested after the lecture; three weeks after the post- test, retention test was administered on the two groups. The data collected was analyzed using percentages and t-test; inferential statistics such as mean and standard deviation were obtained from data collected to get the students t-test.

Results and Discussion

Table 1: t-test statistics on the pre-test scores of experimental and control groups

Group	N	Mean	S.D.	df	t _{cal}	t _{tab}
Experimental	40	16.35	7.0	78	1.75	1.98
Control	40	16.13	7.2			

$p > 0.05$

In table 1, the pre-test mean and the standard deviation for the experimental group are 16.35 and 7.0 respectively, while those of the control group are 16.13 and 7.2 respectively. The calculated t- value is 1.75 and the t_{tab} is 1.96 at 0.05 α level. Since the calculated t-value is less than that of t_{tab} ($1.75 < 1.98$), it means that there is no significant difference in the pre-test mean scores of experimental group and control group. This shows that the two groups are equivalent and that there is no pre-existing difference in overall ability between the groups.

Research Question 1: Would there be any difference in the performance of students exposed to the use of advance organizer and those not exposed to it?

Table 2: Comparison of the performances of advance organizer and control groups in Chemistry achievement test.

Group	No of students involved	Average pass	
		50% and above	49% and below
Experimental group	40	97.5%	2.5%
Control group	40	57.5%	42.5%

In Table 2, 97.5% scored 50% & above in the experimental group, 57.5% scored 50% & above in the control group while 2.5% and 42.5% scored 49% & below in the experimental and control groups respectively. This shows that there is a high difference in the performances of those exposed to the use of advance organizer as compared to those not exposed to it.

Research question 2: Would there be any difference in the retention ability of students exposed to the use of advance organizer and those not exposed to it?

Table 3: Comparison of the performances of advance organizer group and control group in retention test.

Group	No of students involved	Average Pass	
		Above average	Below average
Experimental group	40	75%	25%
Control group	40	47.5%	52.5%

In Table 3, 75% scored above average while 25% scored below average in the experimental group. In the control group, 47.5% scored above average while 52.5% scored below average this shows that there is high retention ability in the group exposed to the use of advance organizer than the group not exposed.

Research question 3: Would there be any difference in the performance of male and female students exposed to the use of advance organizer?

Table 4: Comparison of the performances of male and female students in the Chemistry achievement test.

Gender	No of students involved	% Average Pass
Female	36	77.7%
Male	44	72.7%

In table 4, the total number of female involved in the study was 36 while that of male was 44. The table shows %average pass of 77.7% and 72.7% for female and male respectively, this implies that there is a difference in the performance of male and female students exposed to the use of advance organizer.

Test of Hypotheses

Hypothesis 1: There is no significant difference in the performance of students exposed to the use of advance organizer and those not exposed to it.

Table 5: t- test statistics of the post-test scores of the experimental and control groups

Group	N	Mean	S.D.	df	t _{cal}	t _{tab}
Experimental	40	34.2	13.3	78	7.0	1.98
Control	40	24.2	4.27			

*p<0.05

In table 5, the post- test mean score of the experimental group is 34.2 and that of the control group is 24.2. The standard deviation for the experimental group is 13.3 and that of the control group is 4.27. The calculated t-value is 7.0 and the critical value is 1.98. Since the calculated t-value is greater than the critical t- value, hypothesis 1 is rejected. This implies that the students who were exposed to advance organizer material before learning performed better than those not exposed to it.

Hypothesis 2: There is no significant difference in the retention ability of students exposed to the use of advance organizer and those not exposed to it.

Table 6: t-test statistics of the retention test scores of the experimental and control group

Group	N	Mean	S.D.	df	t _{cal}	t _{tab}
Experimental	40	30.0	5.00	78	14.22	1.98
Control	40	22.63	5.65			

*p<0.05

Table 6 shows that the retention test means score and standard deviation of the experimental group are 30.0 and 5.00, while those of control group are 22.63 and 5.65 respectively. The calculated t- value is 14.22 and the critical t- value is 1.98. Since the calculated t-value is greater than the critical t-value, hypothesis 2 is rejected. This means that, there is actually a significant difference in the retention ability of students exposed to the use of advance organizer and those not exposed to it, suggesting that the use of advance organizer aided the retentive memory of the students.

Hypothesis 3: There is no significant difference in the performance of male and female students exposed to the use of advance organizer.

Table 7: t-test analysis of the post-test scores of the male and female students in the experimental group

Group	N	Mean	S.D.	df	t _{cal}	t _{tab}
Male	26	30.00	7.75	38	0.9	2.02
Female	14	36.36	6.63			

$p > 0.05$

Table 7 shows that the calculated t -value is 0.9 while the critical t-value is 2.02 at 0.05 level of significance with 38 degrees of freedom. Since the critical t-value is greater than the calculated t-value ($2.02 > 0.9$), it means that there is no significant difference in the performance of male and female students involved in the research, thus the null hypothesis was accepted. The inference therefore is that, there was no statistically significant difference in the performance of male and female students in the chemistry achievement test.

Conclusion

The use of advance organizer in aiding meaningful learning has been subjected to critical studies and the findings of these studies favour the use of advance organizer as additional strategy for learning new materials. Teaching strategy is ranked among the factors responsible for the students' low performance in public examinations, hence, this study was undertaken to find out the effect of advance organizer on performance and retention of senior school students in chemistry in Lagos, Nigeria. From all the data gathered from the study, it could be concluded that students taught electrolysis and electrochemical cells using advance organizer performed better than students taught with the lecture method currently in use, hence there is a need to juxtapose the lecture method with the use of advance organizer since advance organizer directs students attention to what is important in the coming material, highlights relationships among ideas that will be presented and reminds one of relevant information already possessed. The findings of this study agreed with previous studies that the use of advance organizers improve performances and retentive memory of students as well as help to arouse their interest in chemistry. Also, the use of advance organizer does not depend on gender differences but rather a useful instructional strategy on both sexes.

Recommendations

From the research work, it was observed that chemistry students in the senior secondary school level requires a different approach to learning in addition to the existing conventional lecture method to facilitate learning and aid retention of learning; it is therefore recommend that:

1. Teachers should use advance organizer strategy in addition to the already existing strategies to improve the standard of performance of Nigerians secondary schools students in chemistry.
2. The learning contents of chemistry should be structured in such a way that shows the relationship of all its constituent elements before instruction commences. The sequence in the introduction of the concepts should match students' ability and readiness.
3. Teachers of chemistry should provide a preview of information prior to explanation while school authorities should cooperate with the teachers in the area of cost production of the organizer.
4. Chemistry teachers should also apply the learning in a number of situations to increase retention, frequent use of what was learned will tend to reduce the degree of forgetting.

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