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Prof. Fidelis A. Onwioduokit
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Class Groupings and Students Performances in Electrolysis Using Problem Based Learning Approach.

Rebecca U. Etiubon & Dr. M. E. Udo
Department of Science Educaton
University of Uyo

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ABSTRACT

The study investigated the effects of class groupings on students' performances on concepts of electrolysis, when taught using problem based learning approach. Two research questions and two hypotheses were raised. 120 SS2 chemistry students (65 males; and 55 females) were used. Three public secondary schools in Uyo Local Government Area were selected using purposive sampling technique. The study was a quasi-experimental research using non-randomized pretest-posttest control group design. A researcher-developed instrument; Achievement Test on Electrolysis (ATE) with a reliability index of 0.88, was used in gathering data. The results of data analysis using Analysis of Covariance (ANCOVA) showed that class groupings are a significant predictor of students', performances in electrolysis. Students in small group setting performed significantly better than their counterparts in individualized and whole class settings. Students in whole class setting had the poorest results in pretest and posttest performances. It was recommended that teachers should consider small group and individualized class settings as a necessary structure for enhancing students' achievement in chemistry.

INTRODUCTION:

Chemistry will always remain a vital subject to the learning of science and technology for the development quest of an evolving nation such as Nigeria to be actualized. As a school subject, chemistry is fundamental to our physical environment, as it has found numerous uses and applications in everyday life and in all sciences and has been the pivot on which scientific and technological feats are developed. Achieving competence and proficiency in it is of paramount concern nationally (Bajah & Onwu, 1999).

Observations have shown a declining interest and low enrolment of students as a recurring appendage towards attaining high performance in chemistry. Even the few students that enrol in chemistry have demonstrated low achievement in chemistry examinations (Eniayeju, 2005; Olayiwola, 2001). Ogunshola (1998) observed that these deterioration in students achievement in chemistry must have been contributed by the methods of teaching students chemistry. Akpan (1997) observed that the present mode of teaching chemistry in secondary schools whereby teachers adopt only the conventional method does not in any way provide for sequence of learning experiences. The problems of teaching and learning of chemistry have been traceable to the nature of the subject, teaching approach, inadequate teaching facilities, non-availability of the right caliber of chemistry teachers, and students attitude towards the sciences (Ezeife, 1993; Onwioduokit, 1996), and as such students view the sciences particularly chemistry as a difficult subject to understand.

There is a need therefore, to stimulate students and achievement using small class sizes as this will enhance and facilitate understanding and acquisition of the knowledge of what is being taught particularly in integrating discipline skills across the sciences.

National Policy on Education (2004) views class size as the population of a given class in terms of number of students and recommends a class size of 35 learners to one teacher at the junior secondary school, and 30 learners to one teacher at the secondary school level. Class size may therefore be a singular problem with contributory factors such as increase in the teachers workload, inadequacy of learning facilities, lack of adequate space, high level of indiscipline and their resultant psychological and physiological consequences on students achievement (Pong & Pallas, 2001). Studies have shown that a large number of students in a class affect the learning environment and academic development of students. (Wilberg, Rost,1997; Jimoh,1999; Rice,2001).

It has been observed that, the larger the class, the greater the routine operational practices of the teacher and the difficulty of assessing class integration. Abdullah (1996) identifies large class size as one of the factors militating against hitch-free curriculum implementation. Albers (1994) opined that there could be better utilization of resources in a small class, and that the larger the class, the more difficult it becomes to control, hence there could be a poor overall output.

The application of problem based learning approach could facilitate the learning and retention of chemistry and its concepts understanding in students in small groups and in individualized settings. It could also help to develop criteria that accurately characterize dimensions of teaching that may contribute to students' learning of specific ideas and skills and provide multiple ways for creating a classroom climate where all students are involved in learning.

The purpose of the study is to investigate the effects of class groupings on students' performance in electrolysis using problem based learning approach.

Research Questions

The following research questions guided the study:

1. How does class grouping affect students' performance in electrolysis when taught using problem based learning approach?
2. What is the effect of class grouping on students' retention of concepts in electrolysis when taught using problem based learning approach?

Hypotheses

1. There is no significant effect of class grouping (individualized, small group, and whole class settings) on students' performance in electrolysis when taught using PBL.

2. There is no significant effect of class grouping (individualized, small group, and whole class) on students' retention of electrolysis when taught using problem based (PBL).

METHODOLOGY

Design

The study adopted the quasi-experimental research design. Specifically, the study was non-randomized pretest posttest control group design. This design was chosen because intact classes were used instead of randomly composed samples.

Sample and Sampling Technique

A purposive sampling technique was employed to sample Uyo Local Government Area since it was the Local Government Area that has the highest number of co-educational schools.

Intact classes of three co-educational schools randomly selected from secondary schools in the target population were used. A total of 120 SS2 chemistry students formed the sample for the study. This was drawn from 2,120 of the student population in Uyo LGA.

Instrument for Data Collection

The instrument used for data collection was Achievement Test on Electrolysis (ATE), an instructional and lesson package following PBL guidelines. The Achievement Test on Electrolysis (ATE) was a 25-item multiple choice test drawn from concepts on electrolysis. The test was used for pretest, posttest and retention test performance measurement. The posttest and retention test were reshuffled versions of the one used for pretest. The duration between posttest and retention was 4 weeks. It was designed to assess students in cognitive domain. A table of specification based on concepts of electrolysis covered was developed to ensure comprehensive representation of lesson taught. Problem based learning approach was used in teaching the concept of electrolysis.

The instrument was face and content validation by professionals in both measurement and evaluation and Science Education by adhering to the table of specification in the final selection of the ATE items.

A reliability coefficient of 0.88 was established for the ATE using Kuder-Richardson formula – 21

Data Analysis:

The research questions were answered by computing mean achievement scores and standard deviations of the treatment groups; while the hypotheses were tested at $p<0.05$ probability level using Analysis of Covariance (ANCOVA).

Result

The result in respect of Mean and Standard Deviation of the students achievement are in Tables1,2,3 and 4.

Table 1: Mean and Standard Deviation scores of Students' on Pretest and Posttest Performance Classified by Treatment Groups.

Treatment Groups Gain in Mean	N	Pretest X_1	SD_1	Posttest X_2	SD_2
Small group setting 38.85	38	33.68	9.14	72.53	7.85
Individualized setting 36.85	38	33.26	9.26	70.11	8.71
Whole class setting 25.09	44	37.64	7.97	62.73	8.13
Total 33.17	120	35.00	8.93	68.17	9.12

In Table 1, the gain in mean (posttest – pretest mean difference are: individual setting = 36.85; small group setting = 38.85 and whole class setting = 25.09. These results indicate that students taught in small groups performed better than those given individualized attention, while those given individualized attention performed better than their counterparts taught in whole class setting.

Table 2: Mean and Standard Deviation scores of Students' on pretest and Retention Test Classified by Treatment Groups.

Treatment Groups Mean	N	Pretest X_1	SD_1	Retention Test X_2	SD_2	Gain in
Small group setting	38	33.68	9.14	57.47	7.23	23.79
Individualized setting	38	33.26	9.26	57.26	8.17	24.00
Whole class setting	44	37.64	7.97	49.64	7.83	12.00
Total	120	35.00	8.93	54.53	8.55	19.5

The results in Table 2, show that the retention-pretest mean difference (mean gain) of the students' on electrolysis were small group, 23.79; individualized setting, 24.00; and whole class setting 12.00. These results indicate that students taught using individualized instructional approach had the best retention followed by their counterparts in small and whole class settings respectively. This implies that individualized instructional approach facilitates retention better than whole class and small group settings.

Table 3: Analysis of Covariance (ANCOVA) of students' Posttest performance classified by treatment groups with pretest as covariate.

Sum of Variance	Sum of Squares	df	Mean square	Fcal	Fcrit	Decision
Corrected model	2578.87[a]	3	859.62	13.27	2.68	significant
Pretest (covariate)	411.98	1	411.98	6.36	3.92	significant
Main effect:						
Treatment	2484.07	2	1242.03	19.18	3.07	significant
Error	7513.80	116	64.77	-	-	-
Corrected Total	10092.67	119	-	-	-	-

* = Significant at $p < 0.05$ alpha

In Table 3, the calculated F-value for the effect of class grouping, F-cal, on students' performance is 19.18 while its corresponding critical value at df 2, 116 and 0.05 alpha level of significance, F-crit is 3.07. As seen, the F-cal (19.18) is greater than the F-crit (3.07). This implies that at $p<0.05$, the effect of class grouping on students' performance is statistically significant. That is, there is a significant effect of using small group, individualized and whole class instructional approaches on students' performance in electrolysis. Hence, hypothesis one was rejected.

Table 4: Analysis of Covariance (ANCOVA) of Students' Retention using Pretest as Covariate.

Sum of Variance	Sum of Squares	df	Mean Square	Fcal	Fcrit	Decision
Corrected model	5591.27[a]	3	1863.76	69.50	2.68	significant
Pretest (covarite)	3924.43	1	3924.43	146.35	3.92	significant
Main effect: Treatment	110.67	2	55.33	2.06	3.07	Not significant
Error	3110.60	116	26.82	-	-	-
Corrected Total	8701.87	119	-	-	-	-

* = Significant at $p < 0.05$ alpha

In Table 4, the calculated F-value, F-cal, for the effect of class grouping, on students' retention is 2.06 while its corresponding table value, F-crit, at df 2, 116 and 0.05 alpha is 3.07. The F-cal is less than the F-crit. This implies that there is no significant effect of problem based learning on students' retention. Hence, null hypothesis 2 was retained.

Discussion

The mean achievement scores of students showed that class setting exerted a significant effect on students' performance. The small group instruction proved most effective followed by individualized and whole class settings in that order. These observations corroborate with Sharan and Sharan (2002) and Thornburg (1997). The observed superiority of students in the small group setting over their counterparts in individualized and whole class settings could be explained in terms of three factors-viz- the greater students involvement in the learning situation, the cooperative learning environment created by the small group setting which encouraged greater students interaction and exchange of information and ideas between students with mixed ability. It could have been expected that students in individualized learning arrangement should have had the best performance, however, though they received greater teacher attention, they were denied the opportunity to share ideas with their colleagues. The poor performance of the students in whole class arrangement could be attributed to the teachers' inability to give individualized attention to the students due to large class size and less involvement of the learners in the learning situation.

In the case of class groupings and students' retention of concept in electrolysis, the results indicate that the setting had no significant effect. This observation suggests that class grouping, on its own, is not a significant predictor of students' retention. Other factors, like the students' cognitive ability, numerical ability and interest may also contribute to students' retention level. This result is an agreement with the findings of Thornburg (1997), who opined that repeated use of PBL for class interaction increases students retention.

Conclusion

Small group and individualized class instructions using problem based learning facilitate learning and retention better than whole class approach irrespective of students' cognitive ability in electrolysis concepts. Problem based learning could be a vital tool used to stimulate the learners interest in dealing with problem-solving in the study of chemistry.

Recommendation

1. In view of the better facilitative effects of small group and individualized instructional approaches using problem based learning, chemistry teachers should always adopt these in their class interactions; and whole class approach should be minimized.
2. The state, Federal Ministries of Education, schools and other stake-holders in education should organize and encourage regular attendance to workshops, conferences and seminars for secondary school chemistry teachers mandatory to update their content and pedagogical knowledge using problem based learning strategies.

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