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Effects Of Individualized Instructional Strategy On NCE Chemistry Students' Acquisition Of Process Skills In Qualitative Chemical Analysis

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ABSTRACT
The study investigated the effects of individualized instructional strategy on NCE chemistry students' acquisition of process skills in qualitative chemical analysis. The study was a 2 x 2 x 3 pretest, posttest, quasi experimental, non-equivalent and non-randomized control group design. It will involve all the NCE 1 chemistry students from two Colleges of Education in Yobe State, Nigeria. Two instruments developed by the researcher were used to gather relevant data. The instruments comprised of both the achievement test in qualitative chemical analysis (ATQCA) and acquisition of process skills test (APST). Twenty-seven structured questions on acquisition of process skills in qualitative chemical analysis adopted by the researcher were used for the study. The APST was drawn from the contents covered for the study. This was used as pre-test and later re-organized and used as post-test after the treatment. It was also re-organized and used as retention test. Mean gain scores was used to answer the four research questions raised for the study. T-test analysis was used to test hypotheses 1-3 and analysis of covariance to test hypothesis four formulated for the study.. The findings among others would be effectiveness of individualized instructional strategy over lecture method on NCE chemistry students' acquisition of process skills.
Keywords: Individualized. Instructional, Strategy, Chemistry, Students

INTRODUCTION

The crucial role science plays in the development of any nation has long been recognized. Nigeria was not left out in the raising of the standard of science teaching through curriculum development. In Nigeria for instance, the Science Teachers Association of Nigeria (STAN) and Comparative Education Study and Adaptation Centre (CESAC) have contributed immensely to curricula innovations in science by the development of Nigerian Secondary Schools Science Project (NSSSP). Most of these innovations are based on inquiry-oriented programmes with emphasis on teacher-student interaction without any mention of how students should interact among themselves to learn such materials.

Chemistry as a branch of science has attained a secured position in the curriculum of schools, colleges and universities as an essential part of general education for life. Its importance in modern societies is indisputably significant because of its requirement as a pre-requisite to the study of many other courses like medicine, pharmacy, textiles and clothing, biochemistry, microbiology, agriculture, metallurgy and all the fields of engineering (JAMB, 2004). It thus appears that without chemistry, there can hardly be science because; the scientific development of any nation is enhanced by the quality of chemistry education in its schools (Okafor, 1996). It therefore becomes pertinent that students' performances in

chemistry and in science generally should be of concern to all the stakeholders in education sector. There are several attempts through the use of carefully planned instructional strategies amid models to improve the status of chemistry teaching and learning.

Findings from researches conducted at both secondary school and colleges of education revealed that students' academic performance in chemistry has not been encouraging (Musa & Onijamowo, 2010). The teaching and learning of chemistry at the College of Education (COE) level should be such as to produce highly qualified middle-level manpower knowledgeable in the processes of chemistry and capable of impacting these to the students. Colleges of Education are dedicated tertiary institutions for teacher education program in Nigeria. These Colleges which are tertiary institutions perform the role of intermediary training between the Secondary school and University Education. Some of the goals of the Colleges of Education, as highlighted in the National Policy of Education (FRN, 2008) are to train highly motivated, conscientious and efficient classroom teachers; produce teachers with intellectual and professional background; and enhance teachers' commitment to the teaching profession (National Commission for Colleges of Education NCCE, 2012).

The deplorable state of students' academic performance in chemistry and the sciences in general at the secondary school level has been a source of worry to science educators over the years. For instance, the Chief Examiners' Annual Reports of the West African Senior School Certificate Examination, WASSCE 2007-2012 indicated a general lack of improvement in students' performance in the sciences in the last decade. Also, findings from several researches point to the fact that secondary school students are not performing well in chemistry (Oyelekan, 2006; & Olorundare, 2014). This situation is attributed to a range of factors such as; teachers' ineffectiveness, students' innate characteristics, inadequate instructional facilities, poor pedagogical strategies, and poor learning environment.

However, an improvement in students' performance in the last years, 2013 and 2014 as indicated on Table 1 could probably be due to the efforts of all stakeholders in ensuring the enhancement of the teaching and learning of Chemistry. The relative performance of students in West Africa Senior School Certificate Examination (WASSCE) (2013-2020) is shown on table 1.

Table 1: Students' performance in WASSCE Chemistry May/June (2013- 2020) in Nigeria

Year of Examination	Total Enrolled	Total sat	Total Credit pass (A1-C6)	Percentage credit Pass (%)
2013	432,230	422,681	194,284	45.97
2014	428,513	418,423	185,949	44.44
2015	478,235	422,091	194,035	45.97
2016	477,573	465,643	236,059	50.70
2017	575,757	565,692	280,250	49.54
2018	641,622	627,302	270,570	43.13
2019	649,914	639,296	462,517	72.35
2020	644,018	636,268	397,649	62.50

Source: West African Examinations Council (WAEC) Office, Yaba, Lagos (2020).

Students' poor performance in WASSCE chemistry lays credence to the difficulties still experienced by them in the subject at the NCE level in the colleges of education. Poor foundation in the sciences particularly in chemistry is no doubt a determinant factor of the students' subsequent performance at other levels especially tertiary level. Findings from the studies of Musa (2010); revealed that Chemistry students do have significant learning difficulties in the Colleges of Education. This has been a source of concern to science educators over the years. This 'poor' performance was attributed to the ineffective and unproductive strategies used by practicing teachers. The preceding situation has prompted efforts to seek for practically oriented teaching strategies that could improve science performance. It is against this background that the present study focused, among other things, on a determination of the effects of individualized instructional strategy on NCE chemistry students' acquisition of process skills in qualitative chemical analysis.

Individualized learning is a process of learning which allows learner to pursue his own learning in his way and at his own speed. This process of learning was borne out of deeper psychological knowledge of individual difference (Anih, 2007). Igwe (2007) identified the gains from individualized learning to include; learner can progress at the pace best suited to him, allows the bright child to accelerate ahead and the slow learner is prevented from being pursed too fast, helps the learner with special difficulties whether physical, psychological, emotional or cultural to develop initiative and independence in the learner, gives the teachers a clear idea of each learner's progress.

Anowor (2008) opined that individualized learning still has its negative impacts, according to Anowor, the system (individualized learning) places a heavy task in the teacher's shoulder because the teacher ensures that there are sufficient learning materials for all the students to work with, deprives learners of the social and emotional benefits of group works, and learning becomes dull without the element of competition among the learners.

Studies on the effects of students' gender on academic achievement have not produced conclusive results. Some findings indicated that significant difference exists between the performance of male and female students while other findings showed that sex factor had no impact on the students' performance. Peter (2014) investigated the effect of gender on students' academic achievement in secondary school Social Studies. The study adopted a quasi-experimental design comprising six groups made up of four experimental groups and two control groups. The instrument used in this study is the achievement instrument tagged "Social Studies Achievement Test" (SSAT).

The results in the study provide empirical evidence that students' academic achievement in secondary school Social Studies depend on the method of instruction adopted and are not influenced by gender. The study has shown that gender (male/female) had no significant effect on students' achievement in Social Studies. The researcher therefore concluded that gender of students whether male or female, does not have any influence on the effectiveness of any of the treatment employed in the study. This is an indication that if any treatment/strategies are used effectively for male and female they are likely to produce the same result.

Also, students' scoring level has been considered to be one of the factors that can influence students' academic performance. There seems to be a general agreement among educators concerning the role played by teaching method and instructional strategy adopted by the teacher as a classroom variable in affecting students' achievement. This is in agreement with findings of Dambatta (2011); Ibrahim (2008) and Akanmu (2013), who stated that instructional strategies applied strongly influence the academic performance of the three categorized scoring level of students (i.e: low, medium and high scorers).

Objectives Of The Study

The aim of this study is to examine the effect of Individualized Instructional Strategy on College of Education (COE), Chemistry students' acquisition of process skills in qualitative chemical analysis. The specific objectives the study is to:

i. Examine the effect of the use of Individualized Instructional Strategy on COE Chemistry students' acquisition of process skills in qualitative chemical analysis.

ii. Determine the effect of the use of Individualized Instructional Strategy on the retentive knowledge of the students.

iii. Determine the difference in the performance of male and female COE chemistry students' acquisition of process skills in qualitative chemical analysis when exposed to Individualized Instructional Strategy and

iv. Determine the influence of scoring levels on the chemistry students' acquisition of process skills taught using Individualized Instructional strategy.

Research Questions

i. What effect does the use of individualized Instructional Strategy have on COE chemistry students' acquisition of process skills in qualitative chemical analysis?

ii. What is the effect of the use of Individualized Instructional Strategy on the retentive knowledge of the students in acquisition of process skills in qualitative chemical analysis?

iii. What is the influence of gender on COE chemistry students' acquisition of process skills in qualitative chemical analysis when taught using the Individualized Instructional Strategy?

iv. What is the influence of scoring level on students' performance in chemistry when they are taught using Individualized Instructional Strategy?

Research Hypotheses

HO_1: There is no significant effect of the use of individualized Instructional Strategy on COE chemistry students' acquisition of process skills in qualitative chemical analysis.

HO_2: There is no significant effect of the use of Individualized Instructional Strategy on the retentive knowledge of the students in acquisition of process skills in qualitative chemical analysis.

HO_3: There is no significant influence of gender on COE chemistry students' acquisition of process skills in qualitative chemical analysis when taught using the Individualized Instructional Strategy.

HO_4: There is no significant influence of scoring level on students' performance in chemistry when they are taught using Individualized Instructional Strategy

RESEARCH METHODOLOGY

The research design was a 2 x 2 x 3 pretest, posttest, quasi experimental, non equivalent and non-randomized control group design. The population for the study was all COE chemistry students in Yobe State, while the target population was COE chemistry 1 students. Seventy-Nine (79) students (42 control group ad 37 experimental groups) were sampled for the study. Two Colleges of Education in Yobe State were involved in the study. One College of Education (Federal College of Education (T), Potiskum) was used as experimental group while another College of Education (Umar Suleiman College of Education, Gashua) was used as the control group.

Intact classes were used in each of the classes involved in the study. Achievement test in qualitative chemical analysis (ATQCA) and acquisition of process skills test (APST) was the instrument for data collection. Twenty-seven structured questions on acquisition of process skills in qualitative chemical analysis was used for the study. The APST was drawn from the contents covered for the study. This was used as pre-test and later re-organized and used as post-test after the treatment. It was later re-organized and later used as retention test. The acquisition of process skills test in qualitative chemical analysis was administered to all the students) as the pre-test.

Students in the control group were not exposed to individualized instructional strategy treatment, while those in the experimental group were exposed to individualized instructional strategy and this exercise lasted for four weeks. The acquisition of process skills test in qualitative chemical analysis was re-organized and administer on the entire subjects as the post-test. All the pre-test and post-test scripts were then marked by the researcher. A month later, the retention test (re-organized post-test questions) was administered to the same subjects in all the sampled schools. The scripts was collected and marked by the researcher as well.

Mean, standard deviation statistics, mean gain scores and difference in mean gain scores were used to answer the four research questions raised in this study. Hypotheses 1-3 were tested using t-test statistics

while hypothesis four was analyzed using Analysis of Co-variance (ANCOVA) at 0.05 alpha levels of significance in order to increase precision and hence remove initial groups' differences.

RESULTS AND DISCUSSION

Research Question One *What is the effect of the use of individualized Instructional Strategy on COE chemistry students' acquisition of process skills in qualitative chemical analysis?*

Table 2: t-test analysis of use of individualized Instructional Strategy on COE chemistry students' acquisition of process skills in qualitative chemical analysis between the control and experimental groups

Group	**Group Statistic**	**Pretest**	**Posttest**	**Mean gain score**	**Diff**
Control Group	N	42	42	10.642	
	Mean	42.548	53.191		
	Std Dev.	9.112	6.901		7.845
Experimental Group	N	37	37		
	Mean	40.649	59.135	18.487	
	Std Dev.	9.821	7.281		

Table 2 shows the mean gain score of students that participated in the test administered by the researcher. The pretest mean score of students in the control group was 42.548, posttest mean score was 53.191 with mean gain score of 10.642. The pretest mean score of experimental group was 40.649, posttest mean score was 59.135 with mean gain score of 18.487. The mean gain score of students in the experimental group was 7.845 greater than the mean gain score of students in the control group

Hypothesis One: There is no significant effect of the use of individualized Instructional Strategy on COE chemistry student's acquisition of process skills in qualitative chemical analysis

Table 3: t-test analysis of COE chemistry students' performance in acquisition of process skills in qualitative chemical analysis between the control and experimental groups

Group	**No. of Respondents**	**Mean**	**Std. Dev.**	**df**	**t-value**	**Sig.**	**Decision**
Control Group	42		53.191	6.901	77	3.723	0.000
Experimental Group	37		59.135	7.281			

The result in table 3 shows t-value -3.723 with degree of freedom (df) of 77 and p-value of 0.000. Since the p-value (0.000) was less than 0.05 stated alpha level; the hypothesis one is therefore rejected. Thus; there is a significant difference in the performance of COE chemistry students taught acquisition of process skills in qualitative chemical analysis with the use of individualized instructional strategy and those in the control group in favour of the students taught with individualized instructional strategy.

Research Question Two: *What is the effect of the use of Individualized Instructional Strategy on the retentive knowledge of the students in acquisition of process skills in qualitative chemical analysis?*

Table 4: Mean Gain Scores of COE chemistry students' retentive knowledge in acquisition of process skills in qualitative chemical analysis

Group	Group Statistic	Pretest	Retention	Mean gain score	Diff
Control Group	N	42	42		
	Mean	42.548	57.478	14.930	
	Std Dev	9.112	6.872		
Experimental Group	N	37	37		9.286
	Mean	40.649	64.865	24.216	
	Std Dev	9.821	6.856		

Table 4 shows the mean gain score of COE chemistry students that participated in the retention test administered by the researcher. The pretest mean score of students in the control group was 42:548, retention mean score was 57.478 with mean gain score of 14.930. The pretest mean score of experimental group was 40.649, retention mean score was 64.865 with mean gain score of 24.216. The retention mean gain score of students in the experimental group was 9.286 greater than the retention mean gain score of students in the control group.

Hypothesis Two: There is no significant effect of the use of Individualized Instructional Strategy on the retentive knowledge of the students in acquisition of process skills in qualitative chemical analysis

Table 5: t-test analysis of COE chemistry students' retention in acquisition of process skills in qualitative chemical analysis between the control and experimental groups

Group	No. of Respondents	Mean	Std. Dev.	df	t-value	Sig.	Decision
Control Group	42		53.191	6.901	77	3.723	0.000
Experimental Group	37		59.135	7.281			

The result in table 5 shows t-value 4.774 with degree of freedom (df) of 77 and p-value of 0.000. Since the p-value (0.000) was less than 0.05 stated alpha level; the hypothesis two is therefore rejected. Thus, there is a significant difference in the retention knowledge of COE students taught acquisition of process skills in qualitative chemical analysis with the use of individualized instructional strategy and those in the control group in favor of the students taught with individualized instructional strategy.

Research Question Three: *What is the influence of gender on COE chemistry student's acquisition of process skills in qualitative chemical analysis when taught using the individualized instructional strategy?*

Table 6: Mean Gain Scones of COE chemistry students' performance in acquisition of process skills in qualitative chemical analysis based on gender

Group	Group Statistic	Pretest	Retention	Mean gain score	Diff
Control Group	N	20	20		
	Mean	40.500	59.700	19.200	
	Std Dev	9.752	7.378		
Experimental Group	N	17	17		1.553
	Mean	40.649	58.471	17.647	
	Std Dev	10.199	7.332		

The pretest mean score of male students was 40.500, posttest mean score was 59.700 with mean gain score of 19.200. The pretest mean score of female students was 40.824, posttest mean score was 58.471 with mean gain score of 17.647. The mean gain score of the male students was 1.553 greater than the mean gain score of the female students. Further analysis was conducted in table 7 to test whether the difference in the mean scores was statistically significant or not.

Hypothesis Three: There is no significant influence of gender on COE chemistry student's acquisition of process skills in qualitative chemical analysis when taught using the individualized instructional strategy.

Table 7: t-test analysis of COE chemistry students' performance in acquisition of process skills in qualitative chemical analysis based on gender

Group	No. of Respondents	Mean	Std. Dev.	df	t-value	Sig.	Decision
male	20		59.700	7.378	35	0.507	0.616
Female	17		58.471	7.332			

The result in table 7 shows t-value 0.507 with degree of freedom (df) of 35 and p-value of 0.616. Since the p-value (0.616) was greater than 0.05 stated alpha level; the hypothesis three is therefore not rejected. Thus, there is no significant difference in the performance of COE chemistry students taught acquisition of process skills in qualitative chemical analysis with the use of individualized instructional strategy

Research Question Four: *What is influence of scoring level on COE chemistry students' performance in acquisition of process skills in chemical analysis using Individualized Instructional Strategy?*

Table 8: Mean Gain Scores of COE chemistry students' performance in acquisition of process skills in qualitative chemical analysis based on students' scoring levels Group

Group	Group Statistic	Pretest	Retention	Mean gain score	Diff
Low	N	12	12		
	Mean	28.167	53.667	19.200	
	Std Dev	3.243	5.449		10.206
Medium	N	17	17		
	Mean	44.353	59.647	15.294	
	Std Dev	4.256	6.334		
	N	8	8		0.544
High					
	Mean	51.500	66.250		
				14.750	
	Std Dev	1.773	4.950		

Table 8 shows the mean gain score of COE chemistry students that participated in the test administered by the researcher based on students scoring levels. The pretest mean score of the low scoring students was 28.167, posttest mean score was 53.667 with mean gain score of 25.500. The pretest mean score of medium scoring students was 44.353, posttest mean score was 59.647 with mean gain score of 15.294. The pretest mean score of the high scoring students was 51.500, posttest mean score was 66.250 with mean gain score of 14.750. The mean gain score of the low scorers was 10.206 greater than the mean gain score of the medium scorers, while the mean gain score of the medium scorer was 0.544 greater than the mean gain score of the high scorers.

Table 9: ANCOVA analysis of COE chemistry students' performance in acquisition of process skills in qualitative chemical analysis based on scoring level

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected model	956.636[a]	3	318.879	11.057	0.000
Intercept	260.937	1	260.937	9.048	0.005
Pretest	188.361	1	188.361	6.531	0.015
Scoring level	71.909	2	35.954	1.247	0.301
Error	951.688	33	28.839		
Total	131296.000	37			
Corrected total	1908.324	36			

From table 9 F(2, 37) is 1.247, p-value is 0.301. Since the p-value is greater than 0.05 stated alpha level of significance, the null hypothesis was not rejected. Thus, there is no significant difference among the performance of COL chemistry students' performance in acquisition of process skills in qualitative chemical analysis taught chemistry process skill with individualized instructional strategy based on students' scoring level. Though the three categorized scoring levels (Low, Medium and High) benefitted from the use of individualized instructional strategy with the low scoring students benefitted most with 25.500 mean gain score, followed by medium scoring students with 15.294 mean gain score and high scoring students benefitted with 14.750 mean gain score; but the differences among the three groups were not statistically significant.

CONCLUSION

The findings of the study revealed that the use individualized instructional strategy in the teaching and learning process enhance COE students' performance in chemistry significantly. The findings of this study also indicated that COE students taught chemistry using individualized instructional strategy were able to retain content learnt better and longer than those in the control group. Also, the findings from this study revealed that gender did not have any effect on the performance of COE students taught chemistry using individualized instructional strategy. The findings of the study revealed that the three scoring levels (low, medium and high) benefitted from the use of individualized instructional strategy.

RECOMMENDATIONS

1. Its use should be encouraged for teaching and learning of chemistry at colleges of education.
2. COE chemistry lecturers' emphasis should shift from teacher centered approach of teaching to more activities-based and leaner-centered learning strategies such as individualized instructional strategy.

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