Effect of Innovative Instructions and Teacher-Students' Demonstrative Approach in Scientific Process Skills Acquisition in Organic Chemistry

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Abstract

This study investigated the effects of innovative instructions on the acquisition of prediction and identification skills among senior secondary school 2 Chemistry students in Eleme Local Government Area of Rivers State. Three schools were selected purposively. A quasi experimental design was adopted comprising of two experimental and one control respectively. A total of 79 students constituted the study sample. Three research questions and three hypotheses guided the study. The instrument for data collection comprised of Organic Chemistry Achievement Test (OCAT) made up of 40 items to assess prediction and identification skills. 20 items each were constructed to assess students' skills. The instrument was validated, reliability coefficient of 0.81 was obtained using test retest method. The experimental groups were taught using problem-based and collaborative approaches respectively and local resources containing carbonyl compounds, while the control group was taught using Teacher-students demonstration approach (TSDA) with standard analytical grade reagents with validated lesson packages. The result shows that students taught using innovative instructions, problem-based approach (PBA) and collaborative approach (CA) performed better than those taught with teacher-students demonstration approach (STDA) in prediction and identification skills. The male students performed better than their female counterparts when taught with PBA and STDA and CA in prediction skill. The study recommended that chemistry teachers should adopt innovative instructions of teaching organic chemistry and utilize natural environmental resources that contain organic functional groups to teach organic chemistry.

Introduction

The shift from the traditional teaching approach which is teacher-centred to a more students-centred approach is the main concern of science educators in the teaching of science subjects particularly chemistry. The need to improve the teaching and learning of chemistry requires more of student's active participation in the learning of the concepts using step-by-step approach that will create awareness of scientific skills acquisition in the students. This will enable students to master scientific and chemistry principles and technology more deeply, using

chemistry knowledge to analyze and solving scientific related problems as well as to develop the ability of thinking independently (Dai, 2004).

"Chalk and talk", approach of teaching is the predominant teaching style in the traditional approach of teaching and is a teacher-centred approach (Nna, 2012). The poverty level among the Nigerian youths especially among the graduates is high and can be as a result of shortage of entrepreneurial oriented individuals in the society (Efuk, 2003). Non-utilization of instructional resources by chemistry teachers has been noted globally as one of the challenges facing the teaching and learning of science according to Agusiobio (1994) in Dike and Ugbe (2011).

However, one factor that contributes to poor state of achievement in science is traceable to the inadequate exposure of the students to laboratory work (Nna 2012). Arokoyu and Nna (2012) opined that the methods employed by Nigerian science teachers do not encourage appreciable significance in the sustenance and acquisition of scientific skills among science students.

This is noticeable in Organic chemistry, which is the aspect of chemistry that deals with the reaction and behaviour of carbon and its compounds with exception of oxides of carbon. To acquire these scientific skills, the laboratory is an ideal environment for both active and cooperative learning becomes relevance (Hass, 2000). Student's active engagement in experimental exercises promotes understanding of the concepts described in lectures. A further enhancement of the laboratory experience can be gained by encouraging students to interact with each other during the discovery process. This will to a large extent help increasing the students' ability to resolve problems. The shift from the teacher-centred method of teaching science to child-centred activity based innovative instructions, encourage and develop in the students the spirit of inquiry. It is interesting to note that for science to be functional and relevant, it must adequately reflect the nature of science in terms of its process, products which gave birth to technology. The shift from teacher centred approach to a more students centred and active participatory approach is the basis of this study. Collaborative and problem-based approaches are examined in this study as the innovative instructions.

Objectives of the Study

The main objective of the study is to compare the effectiveness of teacher-students demonstrative approach and innovative instructional approaches on students' acquisition of scientific skills in organic chemistry through qualitative analysis in senior secondary schools in Rivers State. Specifically, the study seeks to:

1. Examine the prediction skills of students taught using teacher-students demonstration approach with those taught using innovative instructions.
2. Investigate the identification skills of students taught using teacher-students demonstrative approach with those taught using innovative instructional approaches.
3. Compare the prediction skills acquired by male and female students in organic chemistry when taught using teacher-students demonstration approach with those taught using innovative instructional approaches.

Research Questions

The study was guided by the following research questions:

1. What difference exist in the prediction skills of students taught using teacher-students demonstration approach and those taught with innovative instruction?

2. What is the difference in the identification skills acquired by students taught using teacher-students demonstration approach and those taught using innovative instruction?
3. To what extent do the prediction skills acquired by male and female students in organic chemistry when taught using TSDA, differ from those taught with innovative instructions?

Hypotheses

The following null hypotheses were generated to guide the study:

1. There is no significant difference between the prediction skills of students taught using TSDA and those taught using innovative instructional approaches.
2. There is no significant difference between the identification skills of students taught using TSDA and those taught using innovative instructional approaches.
3. There is no significant difference between the prediction skills acquired by male and female students when taught using TSDA and innovative instructions.

Research Methodology

A quasi-experimental, non-randomised pretest, post test design was adopted. The experimental and control groups were in their intact classes. All senior secondary school two (SSS 2) chemistry students in Eleme Local Government Area totaling 148 constitute the study population. Purposive sampling technique was adopted to select 3 schools. 79 students constituted the sample size randomly assigned to three groups; two experimental and one groups respectively. The experimental groups were taught using innovative instructions (collaborative approach and problem-based approach respectively) while the control group was taught using Teacher-Students Demonstration Approach (STDA).

Achievement test on qualitative analysis (ATQA) on carbonyl compound was used by the researchers. The instrument was validated with a reliability coefficient of 0.81. A pre-test tagged Achievement Test on Qualitative Analysis (ATQA) was administered as pretest before treatment. The samples were taught the concept of carbonyl compounds using local resources (experimental group) and standard laboratory reagents (control group) using a prepared and validated lesson packages respectively with the support of the research assistants in the three sample schools, for three (3) weeks. At the expiration of the three weeks, the three groups were post tested with a reshuffled (ATQA). This accessed the prediction and identification abilities of the students on the spot using a scoring grid of four (4) points; very proficient (4) proficient (3), fairly proficient (2) and not proficient (1) for prediction skills. For identification skills; absolute accurate (4), very accurate (3) fairly accurate (2), not accurate (1).

Data collected were analysed using mean and standard deviation for research questions and analysis of covariance (ANCOVA) to test the significant difference (hypotheses).

Results and Discussions

The following results were obtained:

Research Question 1

What difference exist in the prediction skills acquired by students taught using TSDA and those taught using innovative instructions?

Table 1: Mean and standard deviation scores of students taught prediction skills acquisition using TSDA PBA and CA

Treatment	N	Post-test	SD	Pre-test	SD	Gain

		mean		mean		
TSDA	26	19.00	5.71	10.92	3.95	8.08
PBA	25	47.04	3.02	17.76	4.82	29.28
CA	28	47.11	3.56	16.68	3.23	30.43

Source: Field Survey, 2015.

Table 1 showed that the mean gain score in prediction skills of the students taught using TSDA was 8.08, the mean gain score of students taught with PBA was 29.28, while those taught with CA had mean gain score of 30.43.

Research question 2:

What is the difference in the identification skills acquired by students taught using TSDA and those taught using PBA and CA innovative instructions?

Table 2: Mean and standard deviation scores of students taught identification skills using TSDA, PBA and CA

Treatment	N	Post-test mean	SD	Pre-test mean	SD	Gain
TSDA	26	20.19	5.95	10.31	3.59	9.88
PBA	25	47.64	3.50	15.52	3.78	32.12
CA	28	45.43	3.80	17.89	4.47	27.54

Source: Field Survey 2015

Table 2 showed that the mean gain score in identification skills of the students taught using TSDA, PBA and CA was 9.88, 32.12 and 27.54 respectively.

Research Question 3

What is the mean difference in prediction skills acquired by male students in organic chemistry and their female counterparts when taught using TSDA and innovative instructions?

Table 3: Mean and standard deviation scores of male and female students taught prediction skills acquisition using TSDA, PBA and CA.

Treatment	Gender	N	Post-test mean	SD	Pre-test mean	SD	Gain
TSDA	M	11	20.82	6.16	11.82	4.51	9.00
	F	15	17.67	5.16	10.27	3.49	7.40
PBA	M	11	47.82	2.75	18.36	3.41	29.45
	F	14	46.43	3.18	17.29	5.77	29.14
CA	M	11	47.45	2.91	17.09	3.18	30.36
	F	17	46.88	4.00	16.41	3.34	30.47

Table 3 showed that the mean gain in prediction skills of male and female students taught using TSDA were 9.00 and 7.40 respectively. The mean gain in prediction skills of male and female students taught using PBA were 29.45 and 29.14 white 30.36 and 30.47 were recorded by male and female students taught with CA respectively.

Hypothesis one

There is no significant difference between the prediction skills acquired by students taught organic chemistry using TSDA and those taught using PBA and CA.

Table 4: Summary of ANCOVA of test scores of students classified by treatment on prediction skill of in qualitative analysis.

Source	Type III sum of df squares	Df	Mean square	F	Sig.
Corrected model	13760.984	3	4586.995	251.871	0.000
Intercept	6605.286	1	6605.286	362.695	0.000
Pre-prediction skill	11.761	1	11.761	0.646	0.424
Treatment	8492.718	2	4246.359	233.1	0.000
Error	1365.877	75	18.212		
Total	128217.000	79			
Corrected total	15126.861	78			

Table 5 showed that there is no significant difference between the prediction skills of students taught using TSDA with those taught using CA and PBA in organic chemistry (F2, 75=233.167, p=0.000). The null hypothesis one was rejected at 0.05 alpha level.

Hypothesis two: There is no significant difference between the identification skills of students taught using TSDA with those taught using CA and PBA in organic chemistry.

Table 5: Summary of ANCOVA of test scores of students classified by treatment on identification skills in qualitative analyzing.

Source	Type III sum of df squares	Df	Mean square	F	Sig.
Corrected model	12112.825	3	4037.608	193.286	0.000
Intercept	7765.580	1	7765.580	371.750	0.000
Pre-identification skill	1.962	1	1.962	0.094	0.760
Treatment	8075.126	2	4037.563	193.284	0.000
Error	1566.694	75	20.889		
Total	126694.000	79			
Corrected total	13679.519	78			

Table showed that there is no significant difference between the identification skills of student taught organic chemistry using TSDA with those taught using CA and PBA (F2, 75=193.284 p=0.000). The null hypothesis two was rejected at 0.05 alpha level.

Hypothesis three: There is no significant difference between the prediction skills acquired by male and female students when taught using TSDA and innovative instructions.

Table 6: Summary of ANCOVA of test scores of students classified by treatment on prediction skills in organic chemistry.

Source	Type III sum of squares	Df	Mean square	F	Sig.
Corrected model	13809.832	4	3452.458	193.984	0.000
Intercept	6602.457	1	6602.457	370.973	0.000
Pre-prediction skill	5.954	1	5.954	0.335	0.565
Gender	48.849	2	48.849	2.745	0.102
Treatment	8539.681		4269.841	239.910	0.000
Error	1317.028	75	17.798		
Total	128217.000	79			
Corrected total	15126.861	78			

Table 7 showed that there is no significant difference between the prediction skills acquired by male female students when taught using TSDA and those taught using CA and PBA (F1, 74 = 2.754, p=0.102). The null hypothesis three was not rejected at 0.05 alpha level.

Discussion

Table 1 shows that students using collaborative approach performed higher than those taught using TSDA and PBA. The mean gain scores of CA, PBA and TSDA were 30.43, 29.28 and 8.08 respectively in prediction skills students taught with PBA performed better than those taught with CA and STDA in their identification skills. The mean gain difference noticed could be attributed to the fact that the both PBA and CA did not subject the students to the positive of passivity due to the use of environmental resources as against the use of standard laboratory reagents by STDA group.

The male students performed better than their female counterparts when taught with PBA and TSDA in both prediction and identification skills. The revenue was the case in CA regardless of the materials used (table 3 and 4)

Table 4, 5 and 7 rejects the hypothesis that there is no significant difference between prediction and identification skills acquired by students when taught organic chemistry using TSDA, PBA and CA as well as no much gender effect of these skills irrespective of the materials and methods used. This result is in consistent with the findings of Olayiwola (2000) who reported hat comparable use of natural environmental and the standard resources in teaching chemistry can enhance students performance. However, Arokoyu and Nna (2012) also reported that the method of teaching a particular concept could enhance the level of acquiring process skills in the students

Conclusion

The study from its findings reveals that innovative approach (CA and PBA) enhances the acquisition of both prediction and identification skills regardless of the material used and gender. The results shows that the innovative approach which encourage critical thinking, cooperative learning, integration of academic and professional knowledge among students could enhance problem-solving skills through resolving real word problems which is the main aim of scientific process skills.

Recommendations

This present study recommended that chemistry teachers should adopt innovative instructions of teaching organic chemistry which the students can learn much by engaging in the process. That teacher should endeavour to utilize natural environmental resources that contain organic functional groups to teach organic chemistry.

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