

Effects Differentiated Instruction on Student' Retentive Knowledge in Chemical Bonding in Senior Secondary Schools in Federal Capital Territory, Abuja

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Abstract. This study investigated the effects of differentiated instruction on student' retentive knowledge in Chemical Bonding in Senior Secondary Schools in Federal Capital Territory, Abuja. The study employed quasi experimental, pre-test, post-test experimental and control group design research designs. The population of the study was 6,309 SS II Chemistry students in senior secondary school two (SS II) in Kuje Area Council of the FCT. The study sample of the study was made up of 75 SSII chemistry students drawn from two public schools using simple random sampling technique by balloting. The study concluded that there was significant difference in the retentive ability of students taught chemical bonding using differentiated instruction. The study also indicated that that there was no significant difference in the retention mean scores of male and female students taught chemical bonding using differentiated instructional strategy. Based on the findings, the study recommends that Principals of government secondary schools in FCT should constantly organize workshops and sensitization programme to educate parents and guardians about the benefits of differentiated instruction and how they can support their children's learning at home. Additionally, partnerships with local science organizations or universities can provide resources and opportunities for students to engage with chemistry in real-world contexts, enhancing their interest and retention of the subject matter. To aid smooth implementation of differentiated instruction in chemistry especially in chemical bonding, schools should encourage parental and community involvement in the educational process especially for the girl child.

Key words: *Academic achievement, Differentiated Instructional, Students' retention..*

Introduction

The concept of students' retention abilities refers to their capacity to retain and recall previously learned information or skills over time. It involves the ability to store knowledge in long-term memory and retrieve it when needed. Retention abilities are crucial in education as they determine how well students can retain and apply what they have learned in the future. The concept of student retention abilities in chemistry in Nigerian secondary schools is influenced by various factors. Gender, teaching resources, and academic performance have been studied in the context

of thermochemistry in Cross River State, Nigeria Ofre et al. (2019). The use of virtual chemistry laboratories has been proposed as a solution to the challenges faced in conducting practical chemistry sessions in Nigerian secondary schools (Aliyu & Talib, 2019). Additionally, the effectiveness of learning cycle models on reducing anxiety towards chemistry among Nigerian senior secondary students has been explored (Alebiosu et al., 2017).

There are many investigations on Differentiated Instructional. Ogunkunle and Henrietta (2018) examined the effect of Differentiated Instructional strategies on students' retention in geometry in senior secondary schools in Abuja Municipal Area Council, Federal Capital Territory. The results indicated that Differentiated Instructional strategies were more effective in promoting meaningful learning and enhancing mathematics students' achievement compared to the conventional method. Additionally, the retention ability of students in the experimental group was significantly higher than that of the control group four weeks after the intervention. The study recommended the adoption of Differentiated Instructional strategies in teaching geometry concepts in Mathematics. Also, Awofala and Lawani (2020) and Afurobi, Izuagba, Ifegbo, & Opara, (2017) examined the effect of Differentiated Instruction on senior secondary school students' achievement in mathematics in Nigeria using a pre-test, post-test non-equivalent control group quasi-experimental research design. The results showed that students in the Differentiated Instruction group performed significantly better than those in the conventional teaching group. While male students performed slightly better than female students with differentiated instruction, there was no significant difference in achievement between male and female students. The study recommended the adoption of Differentiated Instruction by mathematics teachers at the senior secondary school level in Nigeria and Njagi (2015) investigated the effectiveness of differentiated instruction on students' achievement in mathematics by gender in secondary schools in Meru County in Kenya. From the study there was evidence that when students were taught using differentiated instruction, gender did not affect their achievement in mathematics.

In the areas of retention, Bizimana et al (2022) determined the effects of Concept Mapping (CM) and Cooperative Mastery Learning (CML) on fostering retention in photosynthesis among secondary schools in Nyamagabe district, Rwanda. The results showed that the CM and CML treatment groups outperformed the CTM group in retention in photosynthesis. There was a statistically significant difference in favor of the CM between the two experimental groups. The male and female students taught using CM retained equally in photosynthesis while gender difference was revealed in the mean retention scores of the students exposed to the CML, with females retained significantly higher than males. The study concluded that the CM and CML strategies were more effective than CTM. Also, Francis, Mukhtar and Kabir (2023) examined the effect of scaffolding instructional technique and gender on academic performance and retention of senior secondary school students Islamic Studies in Katsina State, Nigeria was investigated in this study. When male and female students were exposed to the teaching strategy, the results revealed no significant differences in academic achievement.

Purpose of the Study

The purpose of this study is to investigate the effects of differentiated instruction on student' retentive knowledge in Chemical Bonding in Senior Secondary Schools in Federal Capital Territory, Abuja. The specific objective is to:

1. ascertain the difference in retention ability of students taught chemical bonding with differentiated instruction and those taught using conventional method in FCT Abuja.

2. find out if any difference exists in the retention ability of male and female students taught chemical bonding using differentiated instruction in FCT Abuja.

Research Questions

The following research questions were formulated to guide the study.

1. What is the difference in the retention mean score of students taught chemical bonding with Differentiated Instruction and those taught using conventional method in FCT Abuja?
2. What is the possible gender difference in the retention mean scores of male and female students taught chemical bonding using differentiated instruction in FCT Abuja?

Hypotheses

The following null hypotheses are formulated and tested at 0.05 level of significance:

HO1: There is no significant difference between the retention of Senior Secondary School Students taught chemical bonding with Differentiated instruction and those exposed to Conventional method.

HO2: There is no significant difference in the retentive ability of male and female students taught chemical bonding using Differentiated instruction.

METHOD

A pre-test was administered to the sample schools and used to establish the homogeneity of the groups. The experimental group was taught Chemistry with Differentiated Instruction, while the control group was taught with the conventional teaching method for a period of eight weeks. A post-test was administered at the end of the eight weeks and after two weeks, the Chemistry Retention Test (CRT) was administered on the students for post-post-test. The treatment lasted for (8) weeks. The study took ten (10) weeks because the treatment was based on the following topics; periodic table, water, air, hydrogen, oxygen, halogens and Nitrogen in chemistry which are contained in the SS two second term scheme of work in chemistry curriculum. Chemistry lessons were scheduled for three times a week at 80minutes for one double period and 40minutes for two single periods, and by the end of the eight weeks, each of the groups would have had 24 lessons altogether. The researcher administered the chemistry achievement test (CAT). And after two weeks they were administered chemistry retention test. The analysis of the data collected with the CAT was analyzed using the mean and standard deviation to answer the research questions and the two-way ANCOVA was used to test the hypotheses. The hypotheses were tested at a 0.05 level of significance. If the p-value is greater than 0.05 level significant, the null hypothesis is accepted and where the p-value is less than 0.05 the null hypotheses was not accepted. The computations of these statistical figures were done using the statistical package for social science (SPSS) 26.

Data Analysis

Question 1:

What is the difference in the retention mean score of students taught chemical bonding with differentiated instruction and those taught using conventional method in FCT Abuja.

Table 1 showing the difference in the mean retention scores and standard deviation of experimental and control

Group	No. of Students	Post-Test Mean	SD	Post Post-Test Mean	SD	Mean Gain
Exp.	45	55.3	3.8	57.2	8.20	1.9
Control	30	42.2	5.8	35.5	7.80	3.5
Mean diff.		13.1			21.7	1.6
Total	75					

Table 1 presented data on the mean and standard deviation of retention test of students in experimental and control groups. From the result obtained, the mean retention scores of experimental had a mean score of 57.2 while the students in the control group had a mean score of 35.50. The students in the experimental group had a slightly higher mean score compared to the mean score they had in the post test. This implies that they were able to retain knowledge. Further analysis of the results indicated that the mean score of students in the control group dropped from 42.2 to 35.5 which implies that they did not retain as much knowledge as their counterpart in the experimental group.

Question two:

What is the possible gender difference in the retention mean scores of male and female students taught chemical bonding using differentiated instruction in FCT Abuja.

Table 2 showing the difference in the mean retention scores and standard deviation of male and female students in the experimental group.

Group	No. of Students	Post-Test Mean	SD	Retention Mean	SD	Mean Gain
Male	27	45.61	9.45	48.93	4.8	3.32
Female	18	44.75	11.43	49.45	5.2	2
Mean diff		0.86		0.52	1.38	4.70
Total	45					

Table 2 above presented data on the mean and standard deviation of retention scores of male and female students in experimental group. From the analysis of results obtained, the retention mean score of boys in experimental group is 48.93, while the retention mean score of the female students is 49.45. This result on the table reveals that there was slight improvement in the retention score of male students going by the mean gain of 3.32 obtained. While the female students had a mean gain of 4.70. The difference in the mean retention scores of male and female students is 1.38 in favor of the female students. This means that the use of differentiated instruction improves the retention ability of both male and female students.

Test of Hypotheses

HO₁: There is no significant difference in the retentive ability of male and female students taught chemical bonding using Differentiated instruction.

Table 3: Analysis of Covariance (ANCOVA) of Students' retention Scores by Gender Dependent Variable: Post-test Score

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	55.213 ^a	2	25.157	1.563	.211	.007
Intercept	3896.027	1	3498.027	217.340	.000	.325
Post-	46.185	1	46.185	2.870	.091	.006
Gender	7.225	1	6.125	.449	.503	.001
Error	7274.821	452	16.095			
Total	367807.000	455				
Corrected Total	7325.134	454				

R Squared = .007 (Adjusted R Squared = .002) Table 3 shows the Analysis of Covariance carried out to determine whether male and female students taught using differentiated instruction differed significantly in their retention ability. This test resulted to F-value .449 which is not significant at 503 which is above .005 ($p < 0.05$). The Null hypothesis is hereby retained. This implies that there was no significant difference in the Mean retention ability of Male and Female Students taught chemical bonding using differentiated instruction.

HO₁: There is no significant difference between the retention ability of Senior Secondary School Students taught chemical bonding with Differentiated instruction and those taught using Conventional method.

Table: 4 Dependent Variable: Post-post-test Score

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	99.105 ^a	2	49.552	4.057	.018	.0618
Intercept	1711.271	1	1711.271	140.111	.000	.237
Post-	10.090	1	10.090	.826	.364	.002
Retention	88.453	1	77.558	6.350	.002	.014
Error	5520.601	452	12.214			
Total	380657.000	455				
Corrected Total	5619.705	454				

Table 4 discloses the analysis of data carried out to determine whether students taught using DI and those taught with conventional method differed significantly in their mean retention level of 88.453 in chemical bonding. This test resulted to F-value 6.350 for the group (Experimental and Control

group) is significant at .002 which is less than 0.05 ($p < .05$). Therefore, the null hypothesis stated was not accepted. Thus, there is a significant difference in the mean retention level of students taught chemical bonding using differentiated instruction and those taught using conventional method.

RESEARCH RESULT and DISCUSSION

The study revealed that there was significant difference in the retentive ability of students taught chemical bonding using differentiated instruction. This finding is in line with the findings of Ogunkunle and Onwunedo (2014) who investigated the effect of differentiated instructional strategies on students' retention in geometry in senior secondary schools and found that students taught geometry using differentiated instruction had higher retention ability than the conventional method. The findings shows that the male and female students taught chemistry using differentiated instruction had equal achievement. This could be adduced to the fact that differentiated instruction is gender neutral as it enhances the academic achievement of students equally. This finding is in line with that of Njagi (2015) and Pablico, Diack, & Lawson, (2017) who investigated the effectiveness of differentiated instruction on students' achievement in mathematics by gender in secondary schools in Meru County in Kenya and found that when students were taught using differentiated instruction, gender did not affect their achievement in mathematics.

There was significant difference in the retentive ability of students taught using differentiated instruction than their counterpart in the control group. This could be adduced to the efficacy of differentiated instruction in enhancing retention of students in chemistry than the use of conventional. This finding is supported by the study of Brown (2014) that established that students' retention in science seems to improve through the use of some instructional procedure aided models.

The results from the table revealed that there was no significant difference in the retention mean scores of male and female students taught chemical bonding using differentiated instructional strategy. Bizimana et al (2022) and Paul, & Dantani, (2012) are in contrary, they established statistically significant gender difference between male and female mean retention scores with females retained significantly higher than males. This means that the utilization of gender neutral instructional strategies such as differentiated instructional strategy is an effective strategy in enhancing the retention ability of both male and female students in chemistry.

CONCLUSION

The study concluded that there was significant difference in the retentive ability of students taught chemical bonding using differentiated instruction. The study also indicated that that there was no significant difference in the retention mean scores of male and female students taught chemical bonding using differentiated instructional strategy.

Based on the findings, the study recommends the followings:

1. Principals of government secondary schools in FCT should constantly organize workshops and sensitization programme to educate parents and guardians about the benefits of differentiated instruction and how they can support their children's learning at home. Additionally, partnerships with local science organizations or universities can provide resources and opportunities for students to engage with chemistry in real-world contexts, enhancing their interest and retention of the subject matter.

2. To aid smooth implementation of differentiated instruction in chemistry especially in chemical bonding, schools should encourage parental and community involvement in the educational process especially for the girl child.

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