

EFFECT OF DIFFERENTIATED TEACHING APPROACH ON STUDENTS' INTEREST, MOTIVATION, ACHIEVEMENT AND RETENTION IN CHEMISTRY IN FCT, ABUJA

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Abstract

The study examined the impact of differentiated instruction on chemistry students, interest and motivation, as well as their achievement and how they retained what is learned when taught chemistry using differentiated instruction. Today, all over the world, researchers have suggested several approaches to teaching aimed at enhancing learning and retention of what has been learned. This study therefore compared the use of differentiated approach to learning chemistry with the one-site fit-all approach. The population of the study consisted of 604 senior secondary II students in Bwari Area Council of the Federal Capital Territory (FCT). The study adopted a non-randomized, quasi-experimental design, with an intact class of 604 students forming the sample of the study. Three instruments—CSIIQ, SAT, and STMLCQ—were used to gather data from the respondents. The instruments were pilot tested, and their reliability was computed using Kuder-Richardson (KR-21) yielding a coefficient of 0.78, 0.72, and 0.86, respectively. The collected data was used to

answered the research questions and test the hypotheses stated. Research questions were answered using mean and standard deviation score while Analysis of Covariance (ANCOVA) was used to test the hypotheses. The result of the study revealed that the differentiated approach significantly affects students' interest ($F = 116, p = 0.001 < 0.05$) and motivation ($F = 126.243, p = 0.002 < 0.050$) to learn chemistry as compared to the one-site fit-all approach. It was also revealed that students exposed to differentiated learning approaches achieved significantly higher mean scores ($F = 146.112, p = 0.001 < 0.050$) and higher retention mean scores ($F = 136.162, p = 0.003 < 0.05$). It was recommended that chemistry teachers adopt differentiated approach to teaching and learning to draw students' interest in chemistry. The study concluded that, in addition to reducing students' attrition in chemistry, differentiated instruction is key to motivating students toward learning chemistry.

Keywords: Differentiated instruction, Interest, Motivation, Achievement and Retention

Introduction

Students' achievement has been an issue raised by No Child Left Behind (NCLB).

When schools do not meet certain academic progress expectations, they are put on a watch list where there is a chance their

federal funding could be eliminated if they do not make progress. Students' achievement is a concern among parents, teachers, students, and the community. National Education Development (NED) is an organisation that helps close achievement gaps. Achievement gaps are when students of equal abilities are not performing the same in school. This gap includes students' interest, motivation, and ability to retain what is learned. In order to close this gap, require a deliberate attempt by introducing approaches that would allow students to be academically engaged in their work because they are presented with materials that engage their interest, therefore leading to greater motivation and thereby enhancing their retention of what is learned. Differentiated approach is one method that recognizes that each student is at a different academic level and that these differences affect students' interest, motivation to learn, and how the learned skills are retained.

Differentiate instruction is a new approach in education, particularly in the teaching and learning of chemistry. Differentiated instruction is a strategy that teachers can use when they plan content to make it challenging for students who are at a higher level and make accommodations for students who are at a lower level. Thus, it requires that teachers modify or change assignments to meet the needs of individual students (Heacx, 2002). It starts with the teacher assessing where their students are academically

(Schlemmer, 2008). In this case, the teacher often administers interest inventories at the beginning of the year to find out which style or styles a student has. This allows the teacher to provide curriculum that is relevant, meaningful, and appealing to the students' interests, which could lead to motivation to learn the concepts taught.

The challenges of 21st century teachers are to determine how best to meet their students' needs, especially in terms of their interest in learning and motivating them to like the subject, which could necessarily enhance their achievement and retention of the concept learned. Tomlinson (2001) suggested the use of differentiated instruction as a possible solution to this challenge and to improve the quality of education provided to students. Differentiated instruction is a teaching method in which the teacher changes teaching depending on the academic needs of each student (Levy, 2008). Differentiated instruction requires teachers to combine teaching strategies into new or meaningful combinations to meet each student's different learning interests and therefore motivate them to work on their own, thereby promoting achievement and retention. Chemistry teachers today present chemistry as an abstract and difficult subject as a result of the approach adopted. A differentiated approach is a deliberate attempt to reduce difficulty in the learning of

chemistry. According to Wormeli (2007), in a differentiated classroom, teachers accept and work with the differences of students instead of trying to ignore them. Ignoring their differences could result in the attrition of students in the chemistry classroom as their interest is not met, and therefore retention of what is learned becomes difficult. Sternberg and Zhang (2005) argue that the main idea of differentiation is to maximize students' levels and overcome difficulties. Students are not containers waiting to be filled with knowledge. On the contrary, they build their knowledge and understanding of the world around them. Diversity in students' academic achievements, interests, and previous life experiences can lead to different learning needs. Teachers use a differentiated approach to evaluate students' prior knowledge and skills, and these results can be used as multiple entry points at the beginning of the course unit (VanTassel-Baska & Stambaugh, 2005). This requires that teachers take into account the diversity of students, and they have to create the appropriate environment to understand, respect, and respond to this diversity (Tulbure, 2013). Teachers are aware that each student is different from each other and that their differences are remarkable (George, 2005). The teacher designs the teaching according to the student's needs, which are determined by frequent measurements and evaluations

(Boushey & Moser, 2006; Cusumano & Mueller, 2007). The absence of a differentiated approach could make talented students see school as a place to tolerate and think that learning will take place in out-of-school settings. Some of these students have less interest in lessons, and some of them pose disciplinary issues. Therefore, teachers often overlook these students' talents (George, 2005). In differentiated instruction, each child has characteristics that determine "what is best for him/her," what type or frequency of instruction they need to support them, what discipline and guidance are needed, and what is interesting to them (Ducey, 2011). By creating lessons and activities based on students' interests and intelligences, a chemistry teacher can increase students' interest and motivation and, as well, enhance their achievement and retention of what is learned (Winarti, 2019). Thus, for teachers to differentiate instruction in order to cater for the diverse class, there is a need to maintain a flexible learning group based on academic ability and test the students' level of knowledge, grouping based on their learning preferences. In doing so, much time and training are required to effectively implement the approach, and if done, it could have a positive impact on the learning ability of the learners and foster retention. This study aimed to determine the impact of differentiated instruction on students' interest and motivation to learn

chemistry in secondary school and how the learned skills are retained.

Abbey (2021), in a study titled *Impact of Differentiated Instruction on Learning Activities on Students' Engagement and Motivation in the English Language Arts Classroom*, revealed that there was a little impact on students' motivation and engagement in the 19th grade English Language Arts classroom. The study also revealed that students in the differentiated group were motivated to complete their work more frequently than students in the non-differentiated class. In the same vein, a study by Thomas Armstrong (1996), a special education teacher who completed research on the diagnosis of ADD (attention deficit disorder), cited in Hileman (2009) on the impact of differentiated instruction on students' achievement, revealed that in order to ensure students are successful, activities need to be authentic and challenging using differentiated strategies.

Yasar and Karadag's (2010) study on the effects of differentiated instruction on students' attitudes and interest in Turkish courses revealed that the approach influenced students' interest positively in Turkish courses.

Statement of Problem

As years pass, new research and new methods of teaching are introduced into the

world of education. One method that researchers have come out with to improve the learning of students is the differentiated approach. The method provides that teachers should learn how their students prefer to learn and create lessons and activities catering for those preferences. Previous approaches such as experimental, discovery, discussion, lecture among others have been used separately by teachers particularly in the teaching of chemistry. In adopting such methods teachers do not take into cognisance, the different learning ability of students and therefore putting many students at a disadvantage and thereby loses interest due to lack of motivation leading to high attrition of students in chemistry. Many researchers over the years have studied the effect of experimental method, demonstration and discussion method separately in enhancing students' interest and motivation in chemistry and as well its effects on students' achievement and retention. However, there is little or none on the effects of differentiated approach on students' interest, motivation and achievement in chemistry known to the researcher. Could the use of differentiated approach in the teaching of chemistry be part of solution to development of students' interest and motivates students towards the leaning of chemistry? This is the focus of this study. The study investigates the effect of differentiated approach on students' interest and motivation

to learned chemistry on one hand and the effect of differentiated approach on students' achievement and retention in chemistry on the other hand.

Purpose of Study

The study investigates the effects of differentiated approach on students' interest to learn chemistry. Specifically, the study determines:

1. The effects of differentiated approach on students' interest rating towards chemistry.
2. The effects of differentiated approach on motivation of chemistry students towards the learning of chemistry.
3. The effects of differentiated approach on students' achievement of chemistry.
4. The effects of differentiated approach on students' retention in chemistry

Research Questions

1. what is the effects of differentiated instruction on students' mean interest rating towards the learning of chemistry?
2. What is the effects of differentiated approach on students' motivation towards learning of chemistry?
3. What is the effects of differentiated approach on students' mean achievement score in chemistry?

4. What is the effects of differentiated approach on students' mean retention score in chemistry?

Research Hypothesis

Ho: There is no significant difference between the mean interest rating scores of chemistry students in differentiated class and those in the control method.

Ho₂: There is no significant difference between the mean motivation scores of chemistry students in differentiated class and those in the control method.

Ho₃: There is no significant difference between the mean achievement scores of students taught chemistry using differentiated approach and those taught using the control class.

Ho₄: There is no significant difference between the mean retention scores of students taught chemistry using differentiated approach and those taught using the control class.

Methodology

The study adopted qualitative research and non-randomized control group, pre-test-post-test research designs. This was suitable for the study as it allowed the researcher to use a narrative-descriptive approach to gather data from the respondents to understand their opinion on the impact of differentiated instruction on their interest and motivation

towards learning chemistry. However, the non-randomized method was used since the groups were of the same level at the beginning of the study.

The participants were all the 604 senior secondary two (SSII) chemistry students in the Bwari Area Council of the Federal Capital Territory (FCT), Abuja. The sample consisted of 604 SSII students from the selected schools as an intact class. This was found to be convenient as it does not disrupt the class arrangement and since the content of the study was based on the current first-term syllabus as already arranged by the FCT Board for Senior Secondary school education. The students were divided into two groups: treatment and control, to enable the researcher to determine the impact of differentiated instruction on their interest and motivation towards learning chemistry, as well as the efficacy of differentiated instruction on the students' academic achievement and retention.

Three instruments of Chemistry Students' Interest Inventory Questionnaire (CSIIQ), Students' Motivation Towards Learning Chemistry Questionnaire (SMTLCQ), and Students' Achievement Test (SAT) were used to gather data from the participants. SMTLCQ and CSIIQ, which scored Strongly Agreed, Agreed, Disagreed, and Strongly Disagreed as 4, 3, 2, and 1 for positive items and 1, 2, 3, and 4 for a negative item using

the four-point Likert scale, contained 10 items each. The SAT, which consisted of 20 multiple-choice questions with three options (A, B, and C) were scored such that a correct answer (✓) is 1 mark, while a wrong answer (✗) is 0 mark.

The CSIIQ, SMTLCQ, and SAT were validated by four experts drawn from the Faculty of Education, including two chemistry educators and two psychologists. They were asked to determine the content and construct, as well as any grammatical errors that may be present. Their constructive suggestions were used in developing the final instruments. CSIIQ, SMTLCQ, and SAT were pilot tested in one school in Bwari Area Council using 100 senior secondary chemistry students who formed part of the population but did not form part of the study sample. The result obtained was used to determine the internal consistency of the instruments, which yielded a reliability coefficient of 0.78, 0.86, and 0.72 for the CSIIQ, SMTLCQ, and SAT, respectively, and was considered reliable and used.

The CSIIQ was used to gather information from the respondents on the impact of differentiated instruction on their interest in chemistry, while the SMTLCQ was used to gather information on their motivation to learn chemistry concepts when taught using the differentiated approach, and the SAT was used to test their performance after being

taught chemistry concepts using the differentiated approach. Since differentiated instruction required that the teacher assess the prior knowledge (level of entry) of the students before applying the method, the CSIIQ, SMTLCQ, and SAT were administered to the students at the beginning of the class to determine their prior knowledge as well as their interest in chemistry and how motivated they are before at 0.05 level of significance.

Data Presentation

The data is presented in tabular form based on the research questions raised and hypotheses stated.

Research Question One: What is effects of differentiated approach on students ‘mean interest rating score towards the learning of chemistry?

Table 1: Mean and Standard Deviation Scores of the Pre-test and Post-test Score of Students Interest Towards Chemistry

Group	N	Pre- test score		post- Test score		Mean difference
		mean	SD	Mean	SD	
Experimental	302	67.76	13.54	89.80	12.51	22.04
Control	302	68.80	11.51	73.76	14.75	4.96
Mean diff.		-1.04		16.04		17.08

Table 1 shows the mean and standard deviation of chemistry students’ interest in chemistry when taught using a differentiated approach and the one-site fit-all method. The table revealed that the mean post-test score for the experimental group was 67.76 and a standard deviation of 23.54, with a post-test score of 89.80 and a standard deviation of

treatment. In each case, the pre-test score and post-test score were gathered.

Method of Data Analysis

Data collected were used to answer the researcher questions raised and test the hypothesis stated. Thus, mean and standard deviation was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses

12.51. The mean interest score of chemistry students in the control group was 68.80 with a standard deviation of 11.51, and the post-test mean score was 73.76 with a standard deviation of 14.75. The mean difference in the post-test pretest of the experimental group was 22.04 in the experimental group and 4.96 in the control group. The mean

difference between the pretest of the experimental and the control was -0.04, while the difference in mean score of the post-test in the experimental and control group was 16.04

Research Question Two: What is the effects of differentiated approach on students' motivation towards learning of chemistry?

Table 2: Mean and Standard Deviation Scores of the Pre-test and Post-test Score of Students Motivation Towards Chemistry

Group	N	Pre - test score		Post - test score		Mean difference
		mean	SD	Mean	SD	
Experimental	302	57.56	11.65	81.80	9.51	24.24
Control	302	57.80	13.40	70.76	11.75	12.96
Difference		-0.24		11.04		11.28

Table 2 shows the mean and standard deviation of chemistry students' motivation towards chemistry when taught using a differentiated approach and the one-site fit-all method. The table revealed that the mean post-test score for the experimental group was 57.56 and a standard deviation of 11.65, with a post-test score of 81.80 and a standard deviation of 9.51. The mean score of chemistry students' motivation for the control group was 57.80 with a standard deviation of 13.40, and the post-test mean score was 70.76 with a standard deviation of 11.75. The mean difference in the post-test pretest of the experimental group was 24.24 in the experimental group and 12.96 in the control group. The mean difference between the pretest of the experimental group and the control group was -0.24, while the mean difference in mean score of the post-test in the experimental and control group was 11.04

Research Question Three: What is the effects of differentiated instruction on students' mean Achievement score in chemistry?

Table 3: Mean and Standard Deviation Scores of the Pre-test and Post-test of Students Achievement score in Chemistry

Group	N	Pre- test score		post- Test score		Mean difference
		Mean	SD	Mean	SD	
Experimental	302	57.06	12.54	78.40	8.52	21.34
Control	302	56.80	10.51	68.74	11.75	11.94
Mean diff.		0.26		9.74		

Table 3 shows the mean and standard deviation of chemistry students' interest in chemistry when taught using a differentiated approach and the one-site fit-all method. The table revealed that the mean post-test score for the experimental group was 67.76 and a standard deviation of 23.54, with a post-test score of 89.80 and a standard deviation of 12.51. The mean interest score of chemistry students in the control group was 68.80 with a standard deviation of 11.51, and the post-

test mean score was 73.76 with a standard deviation of 14.75. The mean difference in the post-test pretest of the experimental group was 22.04 in the experimental group and 4.96 in the control group. The mean difference between the pretest of the experimental group and the control group was 16.04, while the mean difference in mean score of the post-test in the experimental and control group was 17.08

Research Question Four: What is the impact of differentiated instruction on students' mean retention score in chemistry?

Table 4: Mean and Standard Deviation Scores of the Pre-test, Post-test and Postpost- test Score of Students' Mean Retention in Chemistry

Group	N	Pre- test		post- Test		Post-post test		Mean diff.
		Mean	SD	Mean	SD	Mean	SD	
Experimental	302	60.23	9.54	74.64	10.31	83.42	4.65	8.78
Control	302	59.80	9.90	65.74	12.05	68.02	8.76	2.28
Mean diff.				8.90		15.40		

Table 4 shows the mean and standard deviation of chemistry students' retention scores in chemistry when taught using a differentiated approach and the one-site fit-all method. The table revealed that the mean post-test score for the experimental group was 74.64 and a standard deviation of 10.31, with a post-test mean score of 83.42 and a standard deviation of 4.65. The mean chemistry students' retention score for the control group was 65.74 with a standard

deviation of 12.05 post-test, while the mean post-test score was 68.02 with a standard deviation of 8.76. The mean difference in the post-test post-test of the experimental group was 8.78 in the experimental group and 2.28 in the control group. The mean difference between the post-test of the experimental group and the control group was 8.90, while the mean difference in mean score of the post post-test in the experimental and control group was 15.40

H₀₁: There is no significant difference between the mean interest scores of chemistry students in differentiated class and those in the control class.

Table 5: ANOCOVA Test for Mean Interest Score of Students Taught Chemistry Using Differentiated Approach and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	1225.300	2	370.701	123.189	.000
Intercept	1020.801	1	1020.801	2900.401	.000
Pre-test	172.118	1	172.118	103.809	.00
Interest	18.044	1	18.044	116.045	.001
Error	568.133	72	5.324		
Total	61074	76			
Corrected Total	430.008	74			

a. R squared = .185 (adjusted R squared = .161)

Table 5 presents the t-test analysis for differences in the mean interest of chemistry students taught using a differentiated approach and those taught using the lecture method. The table revealed that $F(1,602) = 116.045$ at $p = 0.001 < 0.050$. This shows that there is a significant difference in the mean interest score of chemistry students towards chemistry when taught using a differentiated approach as compared to those taught using a one-size fit-all. Therefore, the null hypothesis, which states that there is no significant difference, is rejected.

H₀₂: There is no significant difference between the mean motivation scores of chemistry students in differentiated class and those in the control class.

Table 6: ANOCOVA Test for Mean Achievement Score of Students Taught Chemistry Using Differentiated Approach and Lecture Method

Source	Type III sum of Square	df	Meansquare	F	Sig
Corrected Model	1765.300a	2	430.651	134.100	.000
Intercept	1150.623	1	1150.623	591.321	.000
Pre-test	232.438	1	232.438	76.809	.00
Motivation	1993.034	1	1993.034	126.243	.002
Error	699.300	161	4.224		
Total	61074	164			
Corrected Total	2103.898	163			

a. R squared = .175 (adjusted R squared = .151)

Table 6 presents the ANCOVA test for differences in the mean motivation score of chemistry students taught using a differentiated approach and those in the control class. The table revealed that $F(1,562) = 126.243$ at $p = 0.002 < 0.05$. This implies that there is a significant difference between

the mean motivation score of chemistry students towards chemistry when taught using a differentiated approach as compared to those taught using the lecture method. The hypothesis, which states that there is no significant difference, is therefore rejected.

H₀₃: There is no significant difference between the mean achievement scores of students taught chemistry using differentiated approach and those taught using the conventional method.

Table 7: ANOCOVA Test for Mean Achievement Score of Students Taught Chemistry Using Differentiated Approach and Lecture Method

Source	Type III sum of squares	df	Mean Square	F	Sig
Corrected Model	1875.110	2	340.340	145.811	.000
Intercept	1140.801	1	1140.801	300.401	.000
Pre-test	182.118	1	182.118	113.119	.00
Method	19.044	1	19.044	146.112	.0001
Error	678.323	145	6.123		
Total	51074	143			
Corrected Total	430.008	146			

a. R squared = .195 (adjusted R squared = .171)

Table seven presents the ANCOVA analysis for differences in the mean achievement score of chemistry students taught using a differentiated approach and those in the control class. The table revealed that $F(1,432) = 146.112$ at $p = 0.0001 < 0.050$. This implies that there is a significant difference

between the mean motivation score of chemistry students towards chemistry when taught using a differentiated approach as compared to those in the control group taught using a one-size fit-all. The hypothesis, which states that there is no significant difference, is therefore rejected.

H₀₄: There is no significant difference between the mean retention scores of students taught chemistry using differentiated approach and those taught using the conventional method.

Table 8: ANOCOVA Test for Mean Retention score of Students Taught Chemistry Using Differentiated Approach and Lecture Method

Source	Type III sum of squares	df	Mean Square	F	Sig
Corrected Model	1876.382	2	425.078	132.009	.000
Intercept	1789.801	1	1789.801	569.401	.000
Pre-test	172.118	1	172.118	78.790	.00
Retention	1774.044	1	1774.044	136.162	.003
Error	699.004	151	2.114		
Total	116470.200	153			
Corrected Total	2143.561	154			

a. R squared = .186 (adjusted R squared = .141)

Table 8 presents the ANCOVA test for differences in the mean motivation score of chemistry students taught using a differentiated approach and those in the control class. The table revealed that $F(1,151) = 136.162$ at $p = 0.003 < 0.050$, which implies that there is a significant difference between the mean motivation score of chemistry students towards chemistry when taught using a differentiated approach as compared to those in the control taught using the one-size fit-all. The hypothesis, which states that there is no significant difference, is therefore rejected.

Discussion of Findings

The study examines the effect of a differentiated learning approach on chemistry students' interest and motivation towards the learning of chemistry on the one hand and its effects on students' achievement and retention in chemistry on the other hand.

The findings of the study pointed to the fact that students that were exposed to differentiated instructional strategies achieved a higher post-test mean score (89.80) in their interest in learning chemistry compared to the control group, which registered a post-test mean score of 73.76. The result of hypothesis one indicated that a significant difference exists between the post-test mean score of students in the differentiated classroom group and the control group in favour of the differentiated classroom. This is in line with the findings of Yasar and Karadag (2010), whose study revealed that a differentiated approach impacted positively on the attitude and interest of Turkish students in Turkish courses.

The study also revealed that differentiated instruction has positive effects on the motivation of chemistry students towards learning chemistry, as the treatment group

achieved a higher mean post-test (81.80) as compared to those taught using the one-site fit-all approach, which registered a lower post-test mean score (70.76). The result of hypothesis two revealed a significant difference in the mean motivation score in favour of the differentiated classroom. This finding is in line with the findings of Abbey (2021), whose study revealed that differentiated instruction impacted positively on the learning activities of students' engagement and motivation in the English language arts classroom. The study also revealed that students in the differentiated group were motivated to complete their work more frequently than students in the non-differentiated class.

The findings of the study also show that students taught using a differentiated approach achieved a higher mean in the achievement test score (78.40) and retained learning as shown in the post-test mean retention score (83.42) as compared to those taught using the one-site fit-all approach (68.02). The ANCOVA test revealed that the difference is significant. This supported the findings of Thomas Armstrong (1996), a special education teacher, whose research on the diagnosis of ADD (attention deficit disorder) cited in Hileman (2009) on the impact of differentiated instruction on students' achievement revealed that in order to ensure students are successful, activities

need to be authentic and challenging using differentiated strategies.

Conclusion and Recommendation

From the study, it can be concluded that a differentiated approach is an excellent strategy for attracting more students to chemistry. This is because it enhances their interest and, at the same time, motivates them to learn chemistry. Many students withdraw from the sciences, possibly because of teachers' approaches to teaching and learning.

The study therefore recommended that, as a way of reducing students' attrition in science and chemistry in particular, chemistry teachers should adopt a differentiated approach. The government should ensure that teachers at all levels incorporate a differentiated learning approach into their classrooms.

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