



## EFFECTS OF DIFFERENTIATED INSTRUCTION ON ACADEMIC PERFORMANCE OF STUDENTS IN CHEMISTRY IN GWAGWALADA -ABUJA, NIGERIA

**Dalaham, Philibus Duhunkyes**

FCT College of Education Zuba-Abuja

dalahamphilibus@yahoo.com

### Abstract

*The study investigated the effect of differentiated instruction on the academic performance of students in organic Chemistry. Non-randomized Quasi-experiment design was used for the study. Purposive Sampling technique was used for the study. A total of 150 students comprising 70 male and 80 female students were purposively selected from two schools in study area formed the sample for the study. The Chemistry Performance Test (CPT) was used to collect data from the respondents. The instrument was trial tested in two schools and data collected were used to compute the reliability of the instrument using Kuder-Richardson formula 20 which yielded a reliability coefficient of 0.78. The result of the study revealed that students taught Chemistry using differentiated instruction outperformed the control group ( $t_{(148)}=1.79$  at  $p=0.05<0.03$ ). The study also revealed that differentiated instruction is gender friendly as there was no significant difference in the performance of male and female Chemistry students ( $t_{(148)}=1.69$  at  $p=0.05<0.07$ ). The study concluded that differentiated instruction when properly used enhances students' performance and is gender friendly. It was recommended that Chemistry teachers should adopt the approach as it will enable them cater for the individual difference of students in Chemistry classroom.*

**Key words:** Differentiated instruction, Chemistry, Performance and Gender

### Introduction

The use of one curriculum for students which does not take into consideration of the different needs of the individual learners has caused more harm than good, since the curriculum does not meet the aspiration of the interest and encouraging them to be all that they can be as individuals. Thus, there is need to address students' differences and interest in the learning of Chemistry by enhancing their motivation to learn while encouraging them to be committed. In order to meet their individual difference needs, Chemistry teachers should adopt differentiated strategies which could be an ideal way to reach different needs of their learners.

Differentiated instruction is a modified instruction that help students with diverse needs and learning to master challenging academic content (Kado, Dorji, Dem & Om, 2021). It is therefore, a customized approach requirement of varied set of learners. Thus, it is an approach to teaching that advocates active planning for and attention to students' differences in the classroom in the context of high-quality curriculum. It's therefore, requires teacher to purposefully plan for students' different learning abilities and varying their teaching strategies in order to create the best learning experience possible. According to Chen and Chen (2019), differentiated learning is a pedagogical-

didactical approach that provide teachers with a starting point for meeting students' diverse learning needs. Differentiated learning is a proactive and deliberate adaptations of the content, process, product, learning environment or learning time, based on the assessment of students' readiness or other relevant student characteristic such as learning preference or interest (Roy, Guay & Valois, 2013). No wonder the theories of differentiated learning approach are bound by several guiding principles which includes focus on essential ideas and skills in each content area, responsive to individual differences, integration of assessment and ongoing adjustment of content, process and products to meet students' needs (Rocks, Gregg, Ellis & Gabel, 2008 as cited in Njagi, 2015). This implies that when teachers adjust their teaching strategies to accommodate students learning preferences, it help increase their motivation and performance. Vygotsky (1978) suggested that teachers should consciously tailor their instruction within the learner's zone of proximal development, different from what the learner independently learn and what the learner can do with help of more knowledgeable others with scaffolding. This could help varied learners as instructions will be tailored as part of the learners' development. When the content delivered is beyond the learners' ability to understand, it results to frustration and withdrawal of or not. If the content is too easy, nor up to their readiness level, learners demotivated to learn resulting to creating the chaotic learning environment (Morgan, 2014). It is evidence that implementation of differentiated learning in the classroom will require that teachers to have teaching tools available at their disposal or struggle with the incorporation of the approach (teaching ideal and leaning preference) in their classroom and careful selection of content based on their level of

proximal development. According to Onyishi and Sefotho (2020), many teachers failed to do much in their class room and complains of time and lack of materials, therefore rarely use differentiated approach. This paper aims to find out the extent to which Chemistry teachers used differentiated method to enhance students' learning in Chemistry.

The integration of gender-sensitive teaching strategy remains a challenge among educators. The gender issue requires more in-depth exploration especially in the classroom so as to promoted or enhance girls' participation in science. Research by Chadwell (2010) indicates that boys and girls see, hear and engage in the learning process very differently. The learners also process information, respond to questions and make choices in different ways. Gender differences are further reason for teachers to embrace differentiated instruction within schools. All students despite the gender benefit from the availability of a variety of methods and supports and an appropriate balance of challenge and success. Given equitable learning environment girls are capable of developing talent, skills and interest and can be mathematical equals of boys. This study examined the effect of differentiated instruction on Chemistry students' performance and does this differed based on gender.

Students' performance has caused deep concern in many countries over the years. In Nigeria, Chemistry is compulsory at the senior secondary school level for those candidates wishing to offer courses in engineering, medicine, pharmacy, Agricultural science, medical laboratory science and many others. Boys and girls have different learning and behaviour management needs hence the need to differentiate for those



needs through use of instructional methodologies tailored to meet the gender needs.

Njagi (2015) investigated the effectiveness of differentiated instruction on students' achievement in mathematics by gender in secondary schools in Meru County in Kenya. The study sought to determine whether there was a difference in achievement by gender when students were instructed using differentiated instruction approach. The study employed the Quasi-experimental design and in particular Solomon Four-Group design. Simple random sampling technique was used to select the participating schools. The research instrument used was the Mathematics Achievement Test. Descriptive statistics and inferential statistics were used for data analysis. From the study there was evidence that when students were taught using differentiated instruction, gender did not affect their achievement in mathematics.

Several studies (Vanklaveren, Vonk, & Cornelisz, 2017; Abbey, 2021) have reveals that differentiated learning has greater impact on students learning outcome. Deunk, Smale-Jacobes, Deboer, Doolaard and Bosker (2018), in a meta-analysis of differentiated instruction practices in primary education, and differentiated instruction has some potential for improving students' outcome when implemented well. However, evidence for the benefits of differentiated instruction is scarce, most especially in Chemistry in the study area. Against this backdrop, this study investigated the effects of differentiated strategy on Chemistry students' performance in senior secondary school and to find out whether students taught

using differentiated instruction differed in their performance in Chemistry by gender.

### **Statement of Problem**

The choice of any method by teachers in the course of teaching is aimed at improving students' performance. Thus, the Chemistry teachers have numerous techniques that can be used in the classroom ranging from the direct (talk chalk) method to discovery, experimental and discussion. However, despite the fact that each student has his/her peculiarity, interest, learning style, learning profiles and needs, teachers teach them using the normal conventional way and expect them to perform high. Furthermore, most Chemistry teachers today base their lessons on direct instruction believing that is sufficient strategy for imparting use learning experiences. Today many students suffer because of the fact that the method adopted by most Chemistry teachers in the class room are without taking cognizance of the differences that exist among students in the Chemistry class and therefore, their Chemistry learning may degrade. Thus, the learning activities designed for some students may not work for others. As such, it would be defective for teachers of Chemistry to consider that all students learn in the same way. This scenario requires that Chemistry teachers should deploy an appropriate approach that could help them cater for all in the classroom. Could the used of differentiated instruction be part of solution to the problem of individual differences in the teaching and learning in the Chemistry classroom? This was the focus of this study. However, very little if any, empirical studies exist on the impact of differentiated strategy on students' performance on one hand in Chemistry and whether their performance

differs by gender when taught using differentiated approach on the other hand.

### **Purpose of the study**

The study examined the effects of differentiated learning on the performance of Chemistry students in secondary school. In specific terms, the study sought to:

1. determine the effects of differentiated instruction on students, performance in Chemistry
2. determine the effects of differentiated instruction on students' performance in Chemistry based on gender.

### **Research Questions**

The study provided answers to the following questions.

1. What is the mean difference in the performance scores of Chemistry students when taught using differentiated instruction and those taught using the lecture method?
2. What is the mean difference in the performance scores of male and female Chemistry students when taught using differentiated instruction?

### **Hypotheses**

**H<sub>01</sub>.** There is no significant difference in the mean performance scores of students taught Chemistry using differentiated instruction and those taught using lecture method.

**H<sub>02</sub>.** There is no significant difference between the mean performance scores of male and female students taught Chemistry using differential instruction.

### **Methodology**

The study employed non-randomised control group, pre-test post-test quasi-experimental research design. This was chosen as it allowed the researcher to use the subjects in

their real setting (intact class) for the study since the researcher was not in full control of the population under consideration.

The population of the study comprised 150 Senior Secondary II (SSII) students in two government secondary schools in Gwagwalada Area council of the Federal Capital Territory (FCT), Abuja consisted of - males and -female students. The sample of the study consists of all the 150 SSII Chemistry students with 70 males and 80 females selected from the population using purposive sampling technique in two schools in Gwagwala Area council. The subjects were divided into two classes and were classified as experimental group and control group.

Chemistry Performance Test (CPT) was used to collect data from the respondents. The CPT which consists of 20 multiples choice items test was drive from WAEC questions and which validity and reliability has already been confirmed, but for the reasons that they can be affected by sociological factors, they were re-validated by two experts in Chemistry education from University of Jos. Their constructive observations ranging from grammatical errors to content coverage and as well number of options were considered and was used in producing the final copy of the CPT. The CPT was pilot tested in two schools with 40 students who are part of the study sample but not part of the sample of study area, the result obtained was used in determining the reliability of the CPT using Kuder-Richardson formula 20 and item reliability(coefficient) of 0.87 was obtained which was considered reliable.

The CPT was administered to 150 Chemistry students in both the treatment and control groups at the first instance to determine their level of equivalency as pre-test. The pre-test scores were analysed and the result revealed



that the mean and standard deviation of the two groups do not differ significantly. The experimental group (treatment group) was taught using differentiated approach while the control group were taught using the lecture method for four weeks and the CPT was administered as post-test. The scores obtained were collated and subjected to analysis.

The researches questions were answered using mean and standard deviation while the

research hypotheses were tested using t-test at 0.05 level of significance. Since the study test the significance difference that exist between two variables.

**Research Question One**

What is the difference in the mean performance scores of Chemistry students when taught using differentiated instruction and those taught using the lecture method?

**Table 1:** Mean and Standard Deviation for Experimental and Control Group

Group	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Treatment	75	24.30	7.24	70.40	10.54	46.10
Control	75	23.85	6.79	52.10	9.05	28.25
Mean Difference		0.45		18.3		

The data on Table 1 shows that the treatment group pre-test and post-test mean scores are 24.30 and 70.40 with standard deviations scores of 7.24 and 10.54, respectively. However, the Control Group has pre-test and post-test mean scores of 23.85 and 52.10 and standard deviation of 6.79 and 9.05, respectively. Furthermore, the result in Table 1 reveals the mean achievement gain score for the treatment and control groups as 46.10 and 28.25, respectively. This shows

that students exposed to differentiated instruction have better achievement scores in organic Chemistry test compared to the control group.

**Research Question two**

What is the difference in the mean performance scores of male and female Chemistry students when taught using differentiated instruction?

**Table 2:** Mean and Standard Deviation of Achievement Score for Male and Female Students Exposed to Differentiated Instruction

Group	N	Pre -test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Male	70	27.00	6.43	73.24	10.44	46.24
Female	80	18.71	5.51	64.50	8.29	45.79
Mean Difference		8.29		8.74		0.45

The results in Table 2 revealed that for the post test, male students obtained a higher mean achievement score of 73.24 and a standard deviation of 10.44 while their

female counterparts had a lower mean of 64.50 and a standard deviation of 8.29. This gives a difference in the mean achievement scores of 8.74 in favour of male students.

However, looking at the mean pre-test – post-test gain of both male and female students the male students had a gain of 46.24 and the female subjects had a gain of 45.79 giving a difference of 0.45. This shows that the male students had a greater gain in achievement.

**Hypothesis one:** There is no significant difference in the mean performance scores of students taught Chemistry using differentiated instruction and those taught using direct approach.

**Table 3:** Independent Sampled t-test on Students’ Performance Scores in the Treatment and Control Group

Group	N	Post -Test Mean	SD	t	df	Sig(2tailed)
Treatment	75	70.40	10.54	1.79	148	0.03
Control	75	52.10	9.05			

Table 3 presents an independent sampled t-test on students’ performance in Chemistry. Results from the table reveals that  $t_{(148)} = 1.79$  and  $p = 0.03$ . This result is indicative that  $p < 0.05$  therefore the null hypothesis which states that there is no significant difference between in the mean score of students taught using differential instruction and the conventional method was rejected.

This implies that the mean scores of students taught using differential approach and those taught using the conventional method differed significantly.

**Hypothesis two:** There is no significant difference between the mean performance scores of male and female students taught using differential instruction.

**Table 4:** Independent Sampled t-test on Students’ Performance Scores in the Treatment Based on Gender

Group	Gender	Post - test Mean	SD	t	df	Sig (2tailed)
Treatment	70	73.24	10.44	1.69	148	0.07
Control	80	64.50	8.29			

Table 4 presents an independent sampled t-test on students’ performance in Chemistry by gender. Results from the table reveals that  $t_{(148)} = 1.69$  and  $p = 0.07$ . This result is indicative that  $p > 0.05$  therefore, the null hypothesis which states that there is no

significant difference between the mean performance score of male and female students taught using differential instruction was not rejected. This suggested that the mean performance scores of male and female students taught using differential

approach do not significantly differ in their performance.

### Discussion of Findings

The study examined differentiated teaching approach and its effects on students' performance in Chemistry. It also attempts to see how effective differentiated instruction is on students' performance in Chemistry on one hand and based on gender. The result of the study revealed that the treatment group (experimental) mean post test score (mean=70.40, SD=10.54) when taught organic concepts using differentiated instruction which is higher than the control group mean post test score (24.30, SD=7.24) when Chemistry taught using the traditional approach. The difference mean shows that students performed better Chemistry when taught using differentiated instruction than those taught using the one-size fits-all (mean dif.=18.3). This shows that the increase in the mean performance is caused by the intervention rather than chance. A t-test analysis of the post-test mean score shows that the difference between the two groups is statistically significance ( $t_{(148)} = 1.79$  at  $p = 0.03 > 0.05$ ). This finding is similar to that of several studies (Vanklaveren, Vonk, & Cornelisz, 2017; Deunk, Smale-Jacobes, Deboer, Doolaard & Bosker, 2018) whose results revealed that differentiated learning has greater impact on students learning outcome. Furthermore, the result of the study supported the findings of Kado, Dorji, Dem and Om (2021) whose result revealed that the t-test analysis of pre-test post-test indicates a significant difference in favour of the experimental group over the control group was discovered in the post test analysis.

It was also found that differentiated instruction is gender friendly and thus, the study revealed no significant difference in the performance of male and female students when taught organic Chemistry concepts using differentiated instruction ( $t_{(148)} = 1.69$  and  $p = 0.07 > 0.05$ ). This is also consistent with the study of Njagi (2015) who studied the effectiveness of differentiated instruction on students' achievement in mathematics by gender in secondary schools in Meru County in Kenya. The study sought to determine whether there was a difference in achievement by gender when students were instructed using differentiated instruction approach. Descriptive statistics and inferential statistics were used for data analysis. From the study there was evidence that when students were taught using differentiated instruction, gender did not affect their achievement in mathematics.

The implication of the findings is that differentiate instruction is a powerful approach and when properly used, Chemistry teachers can improve the performance of students in Chemistry. The fact that both male and female Chemistry students do not perform differently in Chemistry, it means that differentiated instruction can be used in a mixed class comprised of both males and female students

### Conclusion/Recommendation

Based on the findings of this study, the researcher concludes that differentiate instruction when used enhances students' performance and it is gender friendly. It is therefore recommended that Chemistry teachers should adopt the approach as it will enable them cater for the individual difference of students in the Chemistry classroom. Chemistry teachers and

educators should embrace differentiated instruction while teaching.

## References

- Abbey, Z. (2021). The impact of differentiated learning activities on student engagement and motivation in the English language arts classroom. A master degree dissertation, faculty of Minnesota State University, Moorhead.
- Chadwell, D. (2010). *A gendered choice: Designing and implementing single-sex programs and schools*. California: Corwin Press.
- Chen, I.H., & Chen, Y.C. (2019). Differentiated instruction in calculus curriculum for college students in Taiwan. *Journal of Education and Learning*, 7(1), 88-95.
- Deunk, M., Smale-jacobse, A.E., DeBoer, H., Doolaard, S., & Bosker, R. J. (2018). Effective differentiation practice: systematic review and meta-analysis of studies on the cognitive effects of differentiated practice in primary education. *Educational Research Review*, 24, 31-54.
- Morgan, H. (2014). Maximizing student success with differentiated learning. The clearing house. *Journal of Educational Strategies, Issues and Ideas*, 87(1), 34-38.
- Njagi, M. W. (2015). The Effects of differentiated instruction on students' achievement in mathematics by gender in secondary schools in Meru County in Kenya. *International Journal of Education and Research*, 3(3) 377-386.
- Onyishi, C.N., & Sefotho, M.M. (2020). Teachers' perspectives on the use of differentiated instruction in inclusive classroom: implication for teacher education. *International Journal of Higher education*, 9(6), 136-150.
- Rock, M.L, GGrgg, M., Ellis, E., & Gable, R.A. (2008). REACH. A frame work for differentiating classroom instruction. *Prev. sch. Fail.* 52, 31-37.
- Roy, A., Guay, F., & Valois, P. (2013). Teaching to address diverse learning needs: Development and validation of differentiated instruction. *International Journal Inclusive Education*, 17, 1186-1204.
- Kado, K., Dorji, N., Dem, N., & Om, D. (2021). The effects of differentiated instruction on academic achievement of grade eleven students in the field of derivatives in Haa, Bhutan, Kenya. *Asian Journal of Education and Social Studies*, 60-65.
- Van-klaveren, C., Vonk, S., & Cornelisz, I. (2017). The effect of adaptive versus static practicing student learning-evidence from a randomized field experiment. *Economics Education. Review*, 58, 175-187.
- Vygotsky, L.S. (1978). *Minnd in society*. The development of higher psychological processes Cambridge. M.A: Harvard University Press



