Effect Of Differentiated Instructional Strategy on Students' Time Management and Achievement in Qualitative Chemical Analysis

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Abstract

The ability of individuals to manage time in any organization is essential for quality output. To foster students' achievement through a procedure that considers their learning style differences and take cognizance of time management. Hence, this study investigated effect of differentiated instructional strategy on students' time management and achievement in qualitative chemical analysis. The study was conducted in Onitsha Education zone of Anambra State. Four research questions and four hypotheses were formulated to guide the study. The study adopted quasi-experimental research design. The population of the study comprised 1023 SS2 Chemistry students from 15 co-educational Senior Secondary Schools in the zone. Four schools were randomly sampled from the zone for the study. A sample of 124 SS 11 Chemistry students was used for the study which comprised 56 males and 68 females Chemistry students. Two instruments that were used for data collection are Qualitative Analysis Achievement Test (QAAT) and Time Management Rating Scale (TMRS). Qualitative Analysis Achievement Test (QAAT) consisted of practical item questions culled from past WAEC and NECO Chemistry questions. Time Management Rating Scale (TMRS) consisted of 25 items developed by the researcher. The reliability coefficient for QAAT was 0.74 using Kuder-Richardson Formula 20(KR-20). The instruments were trial tested using 20 students from Aguata Education Zone. The reliability coefficient for TMRS was 0.60 using Cronbach's Alpha. Regular Chemistry teachers from each of the sampled schools who participated in the training by the researcher were used for the study. A pretest was issued to the participating students before the experiment. The experiment lasted for four weeks after which a post-test was administered. The data that were obtained were analysed using mean and standard deviation to answer the research questions and Analysis of Covariance (ANCOVA) was used to test the hypotheses at p < 0.05 level of significance. In line with the findings of the study, the educational implications of the findings were highlighted and the recommendations were equally proffered.

Key Words: Differentiated Instructional Strategy, Time Management, Achievement, Qualitative Chemical Analysis

Introduction

The present state of Chemistry achievement in Nigeria has been very unsatisfactory. This weakness is indicated in the WASCE analysis of students' achievement in Chemistry from 2015 to 2023 which showed that the achievement of students in Chemistry in most cases was less than 50% except in 2020, 2021 and 2022 where more than 50% credit pass was recorded. This is an indication that students may have some learning difficulties in the subject. The candidates' weaknesses as identified by the Chief Examiners' were: poor level of communication skills, inadequate practical exposure, poor qualitative and quantitative skills, inability to relate concepts in Chemistry to everyday life, methods of instruction and lack of

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understanding of some chemistry concepts/topics amongst others (WAEC, 2022). Studies have shown (i) that learners have difficulty in understanding many topics in Chemistry, (ii) have problems in visualizing topics in their minds (iii) have conceptual misunderstandings in some Chemistry topics (Tsaparlis, Pappa, & Byers, 2018; Adekunle, 2020). Akinleye (2017) identified teaching strategies and lack of practical in chemistry as reasons for students' persisted failure in the subject.

Several studies had addressed the poor achievement of students in chemistry stemming from poor practical performance in various ways. Shannsulbahri and Zulkiply(2021) had encouraged the use of direct activity to relate to text to improve students' achievement in qualitative chemical analysis. Shannsulbahri and Zulkiply (2021) averred that directed activity related to texts (DARTS) is a text processing method which comprises a wide range of text-based activities that improve students' understanding in practical class that deals with qualitative chemical analysis. In spite of the strategic position occupied by qualitative chemical analysis, quality attention is not given to this aspect of practical during the school year except few weeks before senior secondary school certificate examination, SSCE. Teachers rather prefer to use demonstration method to teach qualitative chemical analysis, either because the reagents are not available or for economic reasons or that they are more concerned with content coverage which they rush through by examination period.

Demonstration method is a teaching strategy that involves a demonstration being carried out by the teacher for students to observe/participate in or by the student for both the teacher and other students to observe/participate. It is a procedure where by the teacher allows the students to observe situations as the teacher performs experiment mainly using the demonstration table. It is mostly used in showing the students correct use of certain science equipment. Demonstration can be carried out by a single teacher alone or by a student or group of students. It could be seen as an audio-visual explanation, emphasizing the important points of a product, a process or an idea. It is basically an activity which combines telling, showing and doing for the benefit of an audience, be it a person or group of persons. In teaching, demonstration is generally used as a method but it is also frequently used in relation to other approaches to teaching as a special technique. In demonstration method, it is the teacher's role to demonstrate the use of observational skills, ability to record data and logical inferences. Meaning, students' involvement in hands-on activity is minimal. The implication is that students do not grasp the nitty gritty of the experimental processes. Hence, the need to consider differentiated instructional strategy.

Differentiated instructional (DI) strategy embraces most of all the methods studied and in addition takes care of students' learning styles, interests and needs. In differentiated instructional strategy, whole-class, small group and independent learning are encouraged to facilitate each learner's understanding and interest. Hands on, and minds- on activities, which are supported in DI strategy provide students with optimal opportunity for success (Witzed & Riccomini, 2021). Differentiated instruction is based on the idea that not all students are alike and they have multiple options for taking information and making sense of ideas (Hall, 2020). The model of differentiated instruction requires teachers to be flexible in their approach to teaching and adjusting the curriculum and presentation of information to learners rather than expecting students to modify themselves for the curriculum. Classroom teaching is a blend of whole-class, group and individual instruction. Different types of grouping used in DI strategy foster students' learning according to their pace and understanding. Hence, differentiated Instruction is a teaching theory based on the premise that instructional approaches should vary and be adapted in relation to individual and diverse students in classrooms. This study therefore, sought to investigate the effect of differentiated instructional strategy on students' achievement in qualitative chemical analysis aspect of Chemistry while considering the importance of time management during the practical session. This is important because

students often complain that they do not have enough time to complete all the tasks assigned to them to run through the processes of analysis written the given period (Razali1et al., 2018). Hence, the need to investigate students' in time management in qualitative chemical analysis using differentiated instructional strategy.

Time management as self-management with an explicit focus on time in deciding what to do; on how much time to allocate to activities; on how activities can be done more efficiently and on when the time is right for particular activities (Mercanlioglu, 2021). Thus, time management has processes which the student cannot ignore if success must be attained. They include: (i) organisation, (ii) planning, (iii) checklist, (iv) decision making and (v) completion of task. A student of Chemistry who wants to achieve high in qualitative chemical analysis aspect of Chemistry is expected to understand the formal and informal organization of his time in order to accomplish the given task during practical. This is particularly relevant in the context of practical Chemistry, as an increase in time management has been found to correlate with enhanced performance in practicals and overall academic achievement in Chemistry. The term "academic achievement" in the context of this research pertains to the comprehensive evaluation of a student's achievement over the duration of their educational experience. Moreover, academic achievement refers to a predetermined standard of accomplishment or proficiency in scholastic endeavours, which is assessed by educators or instructors using standardised assessments, assessments created by teachers, or a blend of both at the completion of a designated assignment or curriculum. Students who demonstrate a lack of achievement may potentially pose a disruptive presence within the society, as they frequently partake in activities or adopt lifestyles that have a negative impact on the progress of the nation. The impact of poor academic achievement extends beyond the dissatisfaction experienced by students and parents. It also has significant implications for society, particularly in terms of the scarcity of skilled individuals in many sectors of the economy and politics (Aremu & Sokan, 2018). Despite the extensive research conducted on the differentiated instructional strategy, time management, and students' academic achievement, none of these studies have specifically explored the effect of differentiated instructional strategy and time management on students' achievement in qualitative chemical analysis considering that time is an important variable that effect both boys and girls in optimum task performance. Therefore, this study aimed to address this gap, considering how these factors influence students' achievement in the subject.

Statement of the Problem

The poor academic achievement of the students in Chemistry in Senior Secondary School Certificate Examinations disfavours the teaching methods utilised by the Chemistry teachers. The present methods used in teaching Chemistry which include demonstration method appear inadequate to expose students to nitty-gritty of practical activities. Students' lack of proper time management has been delineated as one of the factors which affect students' overall achievement in Chemistry.

Thus, students' inadequate time management in organisation, planning of practical such as qualitative chemical analysis ahead of time has been underscored for improvement of students' success in chemistry. Studies have also shown that students engage in minimum practical activities in qualitative chemical analysis during the school year. More often, teachers' emphasis on the theoretical aspect of chemistry or use of demonstration method do not provide adequate opportunity for students to understand the entire procedure in qualitative chemical analysis procedure. Additionally, numerous studies have shown that time management is another problem students face during Chemistry practical exams. Yet, so far, studies that addressed students' poor achievement in qualitative chemical analysis generally do not seem to consider time management and implementation of differentiated instructional strategy as

important variables that may enhance students' achievement in chemistry especially as differentiated instructional strategy takes into consideration students' learning styles, interest, ability, skills and appropriate use of time. Put in question form therefore, the statement of problem of this study is "What will be the effect of differentiated instructional strategy and time management on students' achievement in qualitative chemical analysis?"

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of Chemistry students taught qualitative chemical analysis using differentiated instructional strategy (DIS)?

2. What are the mean time management scores of Chemistry students' taught qualitative chemical analysis taught using differentiated instructional strategy?

Hypotheses

The following hypotheses were formulated to guide the study and tested at p < .05 level of significance

H0₁.There is no significant difference in the mean achievement scores of secondary school students taught qualitative chemical analysis using differentiated instructional strategy (DIS).

HO₂: There is no significant difference in the mean time management scores of students' taught qualitative chemical analysis using differentiated instructional strategy.

METHODOLOGY

The study employed a quasi experimental design because it aimed to investigate the effect of differentiated instructional strategy and time management on students' achievement in qualitative chemical analysis which involved the use of intact classes. The research was carried out in the state of Anambra, located in Nigeria. It was conducted specifically at the educational zone of Onitsha in Anambra State. The population of the study consisted of 1023 SS2 Chemistry students from the 20 senior secondary schools in Onitsha Education Zone. Purposive sampling technique was used to draw Senior Secondary School II Chemistry students used for the study. The sample size for the study consisted 124 SS2 Chemistry students. The treatment group which was exposed to differentiated instructional strategy comprise 68 subjects (38 females and 30 males). The control group which was exposed to demonstration method consist of 56 subjects (30 females and 26 males) at the conclusion of the investigation. Two instruments used for data collections were Qualitative Analysis Achievement Test (QAAT) and Time Management Rating Scale (TMRS). The QAAT and TMRS were validated by experts and a reliability coefficients were estimated using the scores obtained from the reliability test with an index of 0.74 using Kuder Richardson (K-R-20) method for QAAT, and 0.60 using Cronbach Alpha for TMRS. The collected data were analysed through mean and standard deviation for the research questions while analysis of covariance (ANCOVA) for the hypotheses. All of the hypotheses were tested at a significance level of 0.05.

Results

Research question 1

What is the mean achievement scores of Chemistry students taught qualitative chemical analysis using differentiated instructional strategy (DIS) and those taught using demonstration method?

		Pretest	Pretest Posttest			
Instructional Approaches	N	- X -	SD	-X-	SD	Mean Gain
Differentiated	68	9.16	4.29	17.80	7.05	8.64
Demonstration	56	8.66	2.06	15.04	2.53	6.38

Table 1: Mean	Achievement Scores of Chemistry	y Students	Taught	Qualitative	Chemical
Analysis Using	Differentiated Instructional.				

The result in Table 1 showed that the group taught qualitative chemical analysis using differentiated instructional strategy had a pretest mean achievement score of 9.16 with a standard deviation of 4.29 and a posttest mean achievement score of 17.80 with a standard deviation of 7.05. The difference between the pretest and posttest mean achievement score for the group taught using differentiated instructional strategy was 8.64. The group taught qualitative chemical analysis using demonstration method had a pretest achievement mean of 8.66 with a standard deviation of 2.06 and a posttest achievement mean of 15.04 with a standard deviation of 2.53. The difference between the pretest and posttest achievement mean for the group taught using demonstration method was 6.38. The mean gain scores of 8.64 and 6.38 for the two groups respectively suggest that the group taught qualitative chemical analysis using demonstration that differentiated instructional strategy have more effect on students' achievement in qualitative chemical analysis than the demonstration method.

Research Question 2:

What are the mean time management scores of Chemistry students' taught qualitative chemical analysis taught using differentiated instructional strategy and those taught using demonstration method?

Table 2: Mean	Time Managemen	t Scores of	Chemistry	Students	Taught	Qualitative
Chemical Analy	ysis using Differenti	ated Instruct	tional Strat	egy.		

		Pretest	Pretest			
Teaching	Ν	X	SD	X	SD	Mean
Method						Gain
Differentiated	68	27.19	2.16	52.72	3.77	25.53
Demonstration	56	25.84	1.59	44.74	2.87	18.90

Results in Table 2 showed the effect of teaching methods on students' time management in qualitative chemical analysis. Results show that the students taught qualitative chemical analysis using differentiated instructional strategy had a pretest mean time management score of 27.19 with a standard deviation of 2.16 and a posttest mean time management score of 52.72 with a standard deviation of 3.77. The difference between the pretest and posttest mean time management scores for the differentiated instructional strategy had a pretest time management score of 52.72 with a standard deviation of 3.77. The difference between the pretest and posttest mean time management scores for the differentiated instructional strategy was 25.53. The students taught qualitative chemical analysis using demonstration strategy had a pretest time management score of 44.74 with a standard deviation of 2.87. The difference between the pretest and posttest mean time management score for the differentiated instructional strategy group was 25.53. For each of the groups, the posttest mean time management scores were greater than the pretest time management scores with the students taught using differentiated instructional strategy having a higher time management mean gain, which indicated that students' time management

improved when they are taught qualitative chemical analysis using differentiated instructional strategy than when they taught using demonstration method as indicated by the result.

Hypothesis 1: There is no statistically significant difference in the mean achievement scores of students taught qualitative chemical analysis using differentiated instructional strategy and those taught using demonstration method.

Source	Type III Sum of square	df	Mean Square	F	Sig.	Dec.
Corrected Model	2140.882	4	535.221	34.781	0.000	
Intercept	660.192	1	660.192	42.902	0.000	
Pre- Achievement	1734.827	1	1734.827	112.738	0.000	
Strategies	127.607	1	127.607	8.292	0.005	NS
Gender	7.732	1	7.732	.515	0.474	
Strategies	14.923	1	14.923	.970	0.327	
Error	1800.438	117	15.388			
Total	37553.000	124				
Corrected Total	3941.320	121				

 Table 3: Analysis of Covariance (ANCOVA) of Mean Achievement Scores of Chemistry

 Students
 Taught
 Qualitative
 Chemical
 Analysis
 using
 Differentiated
 Instructional

 Strategy.
 Strategy.
 Strategy.
 Strategy.
 Strategy.

The result in Table 3 showed that with respect to mean achievement scores of students taught qualitative chemical analysis using differentiated instructional strategy and demonstration teaching method, an F-ratio of 8.29 was obtained with associated probability value of 0.00. Since the associated probability value of 0.005 was less than .05 set as bench mark, the null hypothesis (H0₁) which stated that there is no significant difference in the mean achievement scores of students taught qualitative chemical analysis using differentiated instructional strategy and demonstration teaching method was rejected. Inference drawn therefore is that, there was a significant difference in the mean achievement scores of students taught qualitative chemical analysis using differentiated instructional strategy and those taught using demonstration teaching method with those taught using differentiated instructional strategy having a higher mean gain. This shows that differentiated instructional strategy has more effect on Chemistry students' achievement in qualitative chemical analysis than the demonstration method as depicted by the result.

Hypothesis 2. There is no significant difference in the mean time management scores of chemistry students taught qualitative chemical analysis using differentiated instructional strategy.

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Source	Type III Sum of	df	Mean Square	F	Sig.	Dec.
Corrected Model	square 2740.210	6	456.702	43.727	0.000	
Intercept	1152.834	1	1152.834	110.378	0.000	
Pretest	355.050	1	355.050	33.994	0.000	
Strategies	114.492	1	114.492	10.962	0.001	
Gender	443.065	2	221.532	.211	0.000	NS
Strategies *Conder	193.206	2	96.603	.249	0.000	
Error	1201.110	115	10.444			
Total	37553.000	124				
Corrected Total	3941.320	121				

 Table 4: Analysis of Covariance (ANCOVA) of Mean Time Management Scores of

 Chemistry Students' Taught Qualitative Chemical Analysis using Differentiated

 Instructional Strategy.

The result in Table 4 showed that the significant difference in the mean time management scores of Chemistry students taught qualitative chemical analysis using differentiated instructional strategy and those taught using demonstration teaching method. Result shows that with respect to the groups taught qualitative chemical analysis using differentiated instructional strategy and those taught using demonstration teaching method, an F-ratio of .249 was obtained with exact associated probability value of 0.00. Since the associated probability value of 0.00 was less than .05 set as level of significance, the null hypothesis (H0₂) which stated that there is no significant difference in the mean time management scores of Chemistry students taught qualitative chemical analysis using differentiated instructional strategy and those taught using demonstration teaching method is rejected. Thus, inference drawn therefore is that there was a significant difference in the mean time management scores of Chemistry students taught qualitative chemical analysis using differentiated instructional strategy and those taught using demonstration teaching method with the Chemistry students taught qualitative chemical analysis using differentiated instructional strategy having a higher mean gain. This shows that differentiated instruction strategy improved students' time management in qualitative chemical analysis as indicated by result.

Summary of Major Findings

The following are the findings of the study:

1. Effect of differentiated instructional strategy and demonstration teaching method on students' achievement in qualitative chemical analysis.

2. Effect of differentiated instructional strategy and demonstration teaching method on students' time management in qualitative chemical analysis.

Conclusions from the study

Based on the findings and discussion of this study the following conclusions were made:

1. Differentiated instructional strategy has more effect on students' achievement in qualitative chemical analysis than the demonstration method. The methods also avail the

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students the opportunity of a direct experience and active participation in the learning process.

2. Differentiated instructional strategy improve students' time management in qualitative chemical analysis.

Recommendations

In light of the findings of this study, the following recommendations are made:

1. Teachers and students should learn the theory of multiple intelligences. The theory of multiple intelligence of learning provides different learning processes at different levels, emphasize structure, organizing and sequencing information to facilitate optimal processing.

2. School administrators should organize workshops and seminars internally to enable teachers interact and learn from each other the art of teaching, through the differentiated instructional strategy and keep abreast with different ideas that evolve.

3. The government should advocate that Differentiated instructional strategy to be adopted by all Chemistry teachers for effective teaching and learning of Chemistry in secondary schools.

Contributions to knowledge

None of the empirically reviewed studies explored the effect of differentiated instructional strategy and time management on students' achievement in qualitative chemical analysis, which is the gap that the present study has filled.

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