



Comparative Study on the Effectiveness of Demonstration and Discussion Strategies on Academic Achievement and Retention of Chemistry Concepts by Students in Secondary Schools in Kaduna State, Nigeria

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ABSTRACT

This study compared demonstration and discussion instructional strategies on the academic achievement and retention of chemistry concepts by students in some secondary schools in Zaria Education Zone, Kaduna State. The population for this study consists of all SSSII chemistry students in public senior secondary schools in Kaduna State. The sample used was 100 SSSII chemistry students selected from ten secondary schools with a population of nine hundred and eighty students. Three research questions and three null hypotheses guided the study. A Quasi-experimental pre-test, post-test and a post-post-test research design was employed. Instrument developed was Chemical Equilibrium Achievement Test (CEAT) with a reliability coefficient of 0.81. The data collected was analyzed using t-test Statistics at significance level of $P \leq 0.05$. The findings from the study revealed that subjects in the experimental (demonstration) group achieved significantly higher than the control group taught with the discussion instructional strategy. For retention ability, there was a significant difference in academic achievement between students exposed to demonstration instructional strategies over the discussion instructional strategy. In terms of gender, there was no significant difference in academic achievement between male and female students taught with either instructional strategy. Thus, the use of demonstration strategy enhanced students understanding in chemical equilibrium concept. It is recommended that chemistry teachers should employ instructional strategies that are activity-based in teaching chemistry concepts to further enhance academic achievement of students in secondary schools and the Government, as well as NGOs, should sponsor the training and retraining of chemistry teachers on how to design and use the demonstration and discussion instructional strategies.

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INTRODUCTION

Science is the bedrock of any nation's economic and social development. The study of science is imperative for any nation's economic well-being and it a complex human activity that culminates in the production of a body of universal statements which serve to explain the physical

behavior of the universe. Abdullahi (2015) defines science as the activities culminating into a testable, falsifiable and verifiable body of knowledge. Anaso (2021) view science as an activity culminating in a body of knowledge that is testable, verifiable and has the potential of improving the cultural setting in which it is

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practiced. Lasisi and Daniel (2009) also view science as a systematic study of the nature and behavior of the material and physical universe through observation, experimentation, measurement and recording is made. The importance of science and technology education has become much more noticeable over the century. Despite the importance of science to national development, some educational administrators believed that science has not been properly taught in many secondary schools in Nigeria.

Abdullahi (2015) observed that the need for education in these areas (science, mathematics and technology) will become more important to the individual learner(s) and the society in general. This calls for the need to investigate the factors that may affect students' achievement in science and chemistry education in particular. The high rate of failure among secondary school students in science subjects including chemistry could be attributed to the fact that a large proportion of science teachers still use the traditional method rather than the learner-centered strategies advocated for (FME, 2004; Bonet, 2007).

Chemistry is one of the science subjects that require that all the students wishing to study the course have to develop some basic scientific skills such as the ability to observe, manipulate apparatus, construct, interpret tables and data and also have the ability to find relevant information from reference sources. The students' active participation in the learning process and their interaction with instructional materials would serve as an effective means of increasing the rate of retention among students (Jibrin, Mohammad and Abdulhamid (2015). The major problems affecting chemistry teaching could be attributed to the inappropriate usage of some instructional techniques by teachers. Anaso (2017) indicated that inadequate provision of instructional materials and laboratory equipment could affect the acquisition of functional skills needed by learners for solving problems in life. Mahmud (2009) and Auwal (2011) added that the problem could be due to the nature of science concepts which demand the use of mathematical manipulations for their

explanations, poor method of teaching and insufficient instructional materials.

Teaching method or method of teaching is the overall plan for the orderly presentation of content or learning materials. Abdullahi (2015) posits that method of teaching is a procedure by which a goal is reached, a purpose is accomplished or a result achieved. The National Teachers Institute (NTI, 2009) stated that there is no single method which can be applied in the teaching of concepts and principles. Due to the importance of chemistry education, the need to teach chemistry using various innovative and effective instructional strategies becomes vital thus, the availability of various strategies, amongst them are; Discovery Inquiry, Field Trip Process Approach, Demonstration and Discussion strategies. Ngada (2008) suggested that the discussion and demonstration methods might give students the opportunity to interact among themselves and with the teacher, thus making learning more effective. In view of the above, demonstration and discussion instructional strategies are adopted for this study. The reason for adopting both teaching strategies is due to the fact that students are given the opportunity to participate in the learning process and both strategies are innovative in nature and learner-centered. Therefore, both instructional strategies were compared to determine their effects on the academic achievement of chemistry students in senior secondary schools.

Demonstration strategy is one of the contemporary strategies which is an attention inducer and a powerful motivator. It is carried out by the teacher and extended to the students individually or in small groups. It helps the learner to learn by doing. Yusuf (2012) stated that demonstration strategy is a process where the classroom teacher provides the learner with the necessary opportunities available to discover new facts, methods, rules or techniques of solving problems as well as new values for themselves. The teacher simply provides continuous support to students till they become self-learners. This method therefore challenges the learners to source information for themselves.

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Discussion strategy is also a student-centered approach which equips students to have background information about the topic under discussion (Anaso 2021). The strategy is simply based on knowledge, which arises within the student rather than from any external source. Anaso (2021) stated that students are free to express their viewpoints which are motivated by the teacher's questions thus enabling learners to reason rather than recall. The teacher assists in directing the students' views towards the objectives of the lesson. This approach to teaching encourages students' active participation in the class. According to Anaso (2021), discussion is a type of activity which involves breaking the class into small groups for effective dialogues on a topic, a problem or issues. It is a "thinking-together" process in which students talk freely to the teacher and/or one another. For a successful implementation of discussion method, every student should have the background knowledge of what is to be discussed. Discussion methods develop leadership and followership skills as well as, stimulate critical thinking. The method could be effective if it is deliberately planned and systematically used with the teacher moderating the process.

Retention of chemistry concepts by students forms an aspect of this study so as to establish the difference in academic achievement in relation to the instructional strategies employed to teach students in this study. Retention refers to the condition of retaining, keeping or holding previously learned materials. Wikipedia (2010) observed that some secondary school students develop some form of fear, apprehension and nervousness whenever they are faced with test or examinations and this invariably leads to students' low academic achievement. Retention has great influence on the degree of achievement. Anaso (2015) found that when students were provided with the learning outcome, they retained and recalled the knowledge they have learnt. Suleiman (2007) reported that better retention and recall of what is learned is achieved as more senses were involved, and more-so, as the students observe and do things by themselves. Liz and Lisa (2022) also reported that many reasons have been

attributed to the possible causes of students' poor achievement in science subjects, one of such is retention. The retention in schools has a negative effect on students' academic achievement in the classroom especially in test or examination situation or both. This disturbing situation needs to be investigated, and this is one of the motivating factors for carrying out this study.

Gender discrimination in Nigeria is a common phenomenon that cuts across various human endeavors. The belief that males are superior to females have affected women/girls in quite a number of ways both socio-cultural and educational aspects (Anaso (2015); Nuru, (2009)). They further observed that the achievement of women right from past decades have been hindered as a result of many cultural beliefs, one of such, is that women are the weaker sex and incapable of doing things often regarded as rigorous and seen as men's vocation. Apparently some research studies have been conducted in this area of gender. Some of such studies include those of Usman and Akor-Ebute (2006) who reported no significant difference between male and female students in geometry. Aweriable (2006) reported no significant difference between male and female students in physics. Anaso (2015) found no significant difference between male and female students in volumetric analysis when exposed to guided discovery approach. Jibrin, Mohammad and Abdulhamid (2015) reported significant difference in the academic achievement of male and female NCE students taught genetics using problem-solving instructional strategy in favor of the males. The study on gender-related differences and achievement is inconclusive and no research findings appear to have been reported that examined the effects of demonstration and discussion strategies on gender.

It is against this background, that the study seeks to determine the academic achievement of male and female chemistry students and also determine whether Demonstration and Discussion Instructional Strategies have the same effect on the academic achievement and retention of chemistry students at the secondary school level.

STATEMENT OF THE PROBLEM

Several reports and studies have shown persistent failure in the Senior Secondary School Students' academic achievement in chemistry, which may be as a result of poor teaching methods. (WAECE Chief Examiner's Reports 2007, 2008, 2009 and 2020). Research studies by Vogel & Collins (2010) have earlier shown that several factors such as poor methods of teaching, family background, school/classroom environment, peer group among others were found to be some of the reasons why the academic achievement of Senior Secondary School chemistry students falls below what might be expected of individuals of similar intellectual capacities. Bonet (2007), Jibrin, Mohammad and Abdulhamid (2015) reported that the type of teaching method used is one of the many factors responsible for poor academic achievement among science and chemistry students. Ngada (2008) indicated that Demonstration and Discussion strategies might give students the opportunity to interact among themselves and with the teacher, thus making learning more effective. Thus, due to the inconclusive reports, this study aimed to compare the effectiveness of the Demonstration and Discussion strategies on SSS II chemistry student's academic achievement and the involvement of students' gender on the level of retention in Zaria, Kaduna State.

Objectives of the Study

This study is aimed at achieving the following objectives:

1. Compare the effects of demonstration and discussion instructional strategies on the academic achievement of chemistry students when taught the concept chemical equilibrium.
2. Compare the retention level of students when exposed to the demonstration strategy and those taught with discussion strategy on the concept chemical equilibrium.
3. Determine the effects of demonstration and discussion methods on academic achievement of male and female students on the concept chemical equilibrium

Research Questions

The study seeks to answer the following questions:

1. What is the effect of demonstration and discussion instructional strategies on the academic achievement of chemistry student's when exposed to the concept chemical equilibrium?
2. What is the difference between the retention level of students when exposed to demonstration and discussion instructional strategies on the concept chemical equilibrium?
3. What is the effect of Demonstration and Discussion instructional strategies on academic achievement of male and female students when exposed to the concept of chemical equilibrium?

Null Hypotheses

The study has the following null hypotheses

- Ho₁:** There is no significant difference on the mean scores of students exposed to demonstration and discussion instructional strategies when taught chemical equilibrium concept.
- Ho₂:** There is no significant difference in the retention level of students taught chemical equilibrium concept using demonstration instructional strategy and their counterparts taught using discussion strategy.
- Ho₃:** There is no significant difference in the academic achievement of male and female students' taught chemical equilibrium concept using demonstration strategy and their counterparts taught using discussion instructional strategy.

Significance of the Study

The study has the potential of contributing to an existing knowledge in the field of chemistry education planning. Specifically, the result would provide useful information to chemistry teachers on the appropriate methods to adopt for the teaching and effective learning of chemistry. It would enhance students' academic achievement and retention and also improve their

learning abilities and interests by finding out facts for themselves.

METHODOLOGY

Research Design

This study used Quasi - experimental - control group design employing pre-test, post-test and post-post-test. This involved two groups namely the experimental (demonstration group) (E) and control (discussion group). The two groups were given a pre-test in order to find out the equivalence of both groups in their academic achievement before the treatment, while the post-test and post-post-test were administered on the students to determine their academic achievement and retention after exposure to the treatment. Two intact classes were used. The Experimental group (E) was taught using Demonstration instructional learning strategy (X1) and the Control group (C) was taught using Discussion instructional learning strategy (X2). The research design is illustrated in Figure 1.

EG----->O1----->X----->O2----->O3
CG----->O1----->X2----->O2----->O3
Fig.1: Research Design Illustration

Where:

EG=Experimental group CG=Control group
O1=Pretest
O2 =Posttest. O3 = post-posttest X1=
Demonstration learning Strategy
X2= Discussion learning Strategy

Population for the Study and Sampling Technique

The population of this study was all SSS II chemistry students in Senior Secondary Schools in Zaria educational Zone, Kaduna State. The sample size used was 100 SSSII chemistry students selected from ten secondary schools with a population of nine hundred and eighty students. Two separate intact classes located in different schools were selected to avoid interference between the two groups. Group 1: Experimental Group used Demonstration strategy and Group2: Control Group used Discussion strategy. This technique was also undertaken so as to include

female students. Fifty (50) students per school were drawn from SSII classes. Senior Secondary school (SSII) students were used in this study because they are rooted and knowledgeable in chemistry concepts and have already been exposed to chemistry teaching for at least one year.

Research Instrument, Procedure and Data Collection

The research instrument used for the study was a researcher developed instrument containing 20 items Chemical Equilibrium Achievement Test (CEAT). The questions were drawn from West African examination Council (WAEC) past questions for the years 2015 to 2022.

Two sets of scores obtained (test and re-test) was subjected to Pearson Product Moment Correlation Co-efficient (PPMCC) formula which showed the reliability index of 0.81. This indicated that the instrument was consistent in measuring what it was supposed to measure. The pre-test consisted of 20 multiple choice questions (CEAT) on the concept chemical equilibrium, was administered on the students in their classrooms under the supervision of the researcher for the duration of 30 minutes after which the scripts were collected and marked. The administration of the treatment was carried out by the researcher and a research assistant. The treatment for both groups lasted for four weeks after which a post-test was administered. On the fifth week, the post-post-test was administered to both groups to ascertain the levels of retention of the concepts taught. The main treatment involved teaching using demonstration and discussion teaching approaches/strategies.

The lesson package (lesson note) on discussion teaching approach was provided by the researcher and given to each member of the group to study and also come up with question(s) related to the instructional contents. The questions were vetted by the researcher in preparation for the discussion process. The questions also determined the course of the discussion. The presentation of the lesson involved clarifying the aims of the lesson to the

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students and how each student was expected to ask or answer question(s) and/or make contribution(s). The data collected was analyzed using t-test statistics at $P < 0.05$ level of significance

RESULTS

Table 1: The Mean Academic Achievement Scores of Students in Experimental (Demonstration) and Control (Discussion) Groups

Group	N	Mean(X)	S.D	Mean Diff
Experimental GP	50	58.08	13.0	8.56
Control GP	50	49.52	16.92	

Table 1 shows the mean scores (x) for each group. For experimental group, $X = 58.08$, which is greater than the control group where $X = 49.52$, showing that the experimental group performed better than the control with mean difference of 8.56. This answers research question one, which shows that there is statistically significant difference on the mean

Results of the Analysis were presented in Tables 1-6.

Research Question One: Is there any statistically significant difference on the mean scores of students exposed to demonstration strategy and those exposed to discussion strategy.

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Research Question Two: Is there any statistically significant difference between the retention of students exposed to demonstration and those exposed to discussion instructional strategies?

Table 2: The Mean Retention Scores of Students in Experimental and Control Groups

Groups	N	Mean	S.D
Experimental (Demonstration)	50	63.7	6.61
Control (Discussion)	50	54.8	9.74

Table 2 shows the mean scores (X) for both groups. For the experimental group mean score $X = 63.7$, which is greater than the control group mean score (X) of 54.8 showing that the experimental (demonstration) group performed better than the control (discussion) group with a mean difference of 8.9. This answers research question two as there is statistically significant difference between the mean scores in retention

of students exposed to both instructional strategies.

Research Question Three: Is there any statistically significant difference between males and females exposed to demonstration and discussion instructional strategies on academic achievement among senior secondary school chemistry students?

Table 3: The Mean Academic Achievement Scores of Male and Female Students in Experimental and Control Groups

	Experimental (Demonstration)				Control (Discussion)		
	N	Mean	S. D		N	Mean	S. D
Males	26	33.07	3.10	Males	28	27.13	3.10
Female	24	31.73	2.71	Female	22	26.9	2.71

Table 3 shows the mean (X) for each group. For experimental group (X) is 33.07 and

31.73 for males and females while for the control group the mean (X) is 27.13 and 26.9 for males

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and females respectively, showing that both groups (experimental and control groups) had the same level of academic achievement. This answers to research question three, there is no statistically significant difference in their mean scores implying that both demonstration and discussion strategies were gender friendly.

Testing of Null Hypotheses

Ho₁: There is no statistically significant difference on the mean scores of students exposed to Demonstration and those exposed to discussion instructional strategies

Table 4: t-test Comparison of Mean Scores of the Experimental and Control Groups

Study Groups	N	Mean	Std. Dev	Df	t-cal	t-tab
Experimental (Demonstration)	50	58.08	13.0	98	4.00	1.96
Control (Discussion)	50	49.52	8.1			

Significant at $p < 0.05$

From the result in Table 4, the obtained t-value (calculated) is 4.00. This value is greater than the t-value critical which is 1.96 with df 98. p-value 0.00 at a significant level 0.05. The result shows that there is statistically significant difference between the achievements of the subjects in the two groups. The P-value of 0.00 is also significant. The null hypothesis which states that there is no significant difference on the mean academic achievement scores of students exposed to demonstration method and those exposed to discussion method is thus rejected.

Hypothesis Two: There is no statistically significant difference in the level of retention of students exposed to demonstration and discussion instructional strategies on the concept chemical equilibrium.

To test null hypothesis two, the mean retention scores (post-posttest) of students exposed to demonstration and discussion strategies were subjected to independent t-test statistic at $P \leq 0.05$. Summary of the analysis is presented in Table 5.

Table 5: Summary of t-test Analysis comparison on retention scores(post-posttest) of students exposed to Demonstration and Discussion strategies

Group	N	Mean	Std. Deviation	Df	t-cal	t-cal
Experimental (Demonstration)	50	63.7	6.61	98	5.35	1.96
Control (Discussion)	50	54.8	9.74			

Significant at $p \leq 0.05$ level

Table 5 shows that the calculated t-value was 5.35 and critical t-value of 1.96 was obtained at degree of freedom 98. The P-value of 0.00 at 0.05 was significant. The t-value of 5.35 is higher than the critical t-value of 1.96. The null hypothesis is thus rejected. There is statistically significant difference in the level of retention of students exposed to demonstration and discussion instructional strategies. In other words,

subjects in experimental (demonstration) group retained the materials learnt.

Hypothesis Three: There is no statistically significant difference on the academic achievement of male and female students exposed to demonstration and discussion instructional strategies on the concept chemical equilibrium.

Table 6: Summary of t-test Analysis of Males and Females exposed to Demonstration and Discussion strategies on Academic Achievement

	Group	N	Mean	Std. Deviation	Df	t-cal	t-crit
Experimental group (Demonstration)	Male	26	33.07	4.82	48	1.25	1.96
	Female	24	31.73	4.12			
Control group (Discussion)	Male	28	27.13	3.10	48	1.05	1.96
	Female	22	26.90	2.71			

Significant at $p \leq 0.05$ level

From the result in table 6, it was observed that t-calculated is 1.25 and 1.05 respectively for both groups (experimental and control groups); they are less than t-critical which is 1.96 at 0.05 under 48 degree of freedom for each group. P-value of 0.22 at level of significance of 0.05 is not significant. The null hypothesis is thus not rejected. Therefore gender is not a significant factor to students exposed to both teaching strategies.

SUMMARY OF FINDINGS

The major findings of this study are as following:

1. There was statistically significant difference in the academic achievement of students taught chemical equilibrium with demonstration strategy and those exposed to discussion instructional strategy.
2. There was statistically significant difference in the level of retention of students exposed to demonstration and discussion instructional strategies.
3. There was no statistically significant difference in the academic achievement of students (males and females) taught chemical equilibrium exposed to demonstration strategy and those exposed discussion strategy.

DISCUSSION OF FINDINGS

This study compared the effects of demonstration and discussion instructional strategies on the academic achievement, retention and impact of gender of chemistry

students taught the concept chemical equilibrium. The result from testing hypothesis one showed that there was statistically significant difference in the academic achievement of students taught chemical equilibrium with demonstration strategy and those exposed to discussion instructional strategy. That is, the experimental group exposed to demonstration instructional strategy had higher academic achievement gain than their counterpart exposed to discussion strategy. The improvement in the performance of the subjects in the experimental group over the control group suggests a greater effectiveness of demonstration instructional strategy over discussion approach to instruction. This finding is in conformity with the study by Yusuf (2012) reported that demonstration instructional strategy helped to improve the quality of instruction leading to better academic achievement. The better achievement might have been induced by the fact that the students were able to carry on with the activities as performed by the teacher and discuss freely with one another within the group.

The result for testing Hypothesis two revealed that there was statistically significant difference in the level of retention of students exposed to demonstration and discussion instructional strategies. In other words subjects in the experimental group retained materials learnt. The high level of retention recorded in the experimental group (demonstration) could be attributed to the fact that the instructional strategy enabled teachers to provide better quality of educational experiences for students as a result of greater students-teacher interactions. This finding is in line with the studies by Anaso (2015), who



reported that when students were provided with the learning outcome, they retained and recalled the knowledge better. Suleiman (2007) also reported that better retention and recall of what is learned is achieved as more senses were involved, and more-so, as students observe and do things by themselves.

Result for testing Hypothesis three revealed that there was no statistically significant difference in the academic achievement of male and female students exposed to demonstration and discussion instructional strategies. Gender is not a significant factor to students exposed to both teaching strategies. This result agreed with the studies conducted by Usman and Akor-Ebute (2006) and Aweriable (2006), who independently found that there were no significant difference in the performance of boys and girls. The lack of significant difference could be due to the active interaction between the students and the teacher as they were cooperatively working in groups and sharing ideas. The findings of this research therefore disagreed with the study conducted by Jibrin, Mohammad and Abdulhamid (2015) who reported significant difference in the academic achievement of male and female NCE students taught genetics using problem-solving instructional strategy in favor of the males.

CONCLUSION

It has shown from the study that demonstration instructional strategy has improved the academic achievement of students in chemical equilibrium an aspect of chemistry. It has also increased the retention level of chemistry students, and has the potential of improving the academic achievement of male and female chemistry students. Both male and female students benefitted from its use as it was shown to be gender friendly.

RECOMMENDATIONS

Based on the findings and conclusions obtained from this study, it was recommended that:

1. Chemistry teachers should employ instructional strategies which are activity-based in teaching chemistry concepts so as

improve academic achievement of students in secondary schools.

2. Science educators should train chemistry teachers to be competent in appropriate teaching techniques, so that the problem of gender will be reduced.
3. Government and NGOs should sponsor the training and retraining of chemistry teachers on how to design and use the demonstration and discussion instructional strategies.
4. Chemistry teachers should make effort to be familiar and master the use of teaching methods that would help the chemistry students.
5. Curriculum development should be geared towards demonstration, discussion and other innovative instructional techniques of teaching.
6. The teaching of science in general and chemistry in particular should be done in such a way that will enable students learn effectively and perform highly. The use of these methods seems to be suitable in achieving this goal.
7. To further enhance performance and retention in the learners, teachers should make conscientious efforts to integrate discussion and demonstration methods into the teaching of chemistry concepts in secondary schools. This will reduce the abstract nature of most chemical concepts.

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