KONTAGORA JOURNAL OF INTELLECTUAL DISCOURSE (KJID)
ONLINE ISSN: 2756-5599
November, 2025
Vol. 3 No. 2, 2025

EFFECTS OF A-Z APPROACH TEACHING STRATEGY ON CHEMISTRY ACADEMIC ACHIEVEMENT OF STUDENTS IN SENIOR SECONDARY SCHOOLS IN NIGER STATE, NIGERIA.

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DOI: https://doi.org/10.5281/zenodo.17467148

Abstract

The effectiveness of A-Z approach teaching strategies on academic achievement of students in chemistry was investigated in this study. The researcher adopted quasi-experimental research design. The sample for the study consisted of 126 senior secondary school II (SSII) students from two intact classes. The classes were randomly assigned to Experimental and control groups. The instrument used for the study was chemistry Achievement Test (CAT) designed by the researcher. Two research questions were raised and two hypotheses were formulated and tested at 0.05 alpha level of significance The data were analyzed using mean, standard deviation and t-test statistics. The results indicated that there was significance difference between the mean achievement scores of control and experimental groups t (123)=3.866, P<0.05 level of significant, there was no significance difference in the mean academic achievement scores of male and female students taught with A-Z approach teaching strategy t(54)=0.601, Pz 0.05 . It was therefore concluded that A-Z approach teaching strategy improves students' academic achievement than the conventional lecture method that explain theories and concepts before application. It is therefore recommended among others that teachers should be encouraged to employ the use of Z-A approach teaching strategy and that government should provide and sustain opportunities for retraining, symposia, conference and seminars for the secondary school teachers on the appropriate selection and application of innovative teaching strategies (Z-A inclusive) in teaching science, chemistry in particular.

Keywords: Z-A Approach, teaching strategy, academic achievement, chemistry.

Introduction

Chemistry is a subject of universal interest in human development with regard to the utility of its knowledge in real life situations to be faced with many students (Jegede, 2014). The objectives of chemistry education at the senior secondary school level include; to show everyday benefits and hazards, and to provide a course which is complete for individuals not proceeding to higher education (Federal Ministry of Education, 2012). Therefore, chemistry Education is a platform of developing both individual and the entire society. The

importance of chemistry to national development cannot be overemphasized. Despite this importance, Nigerian Senior Secondary School Certificate Examination (SSCE) has continued to record poor performance in chemistry over the year. For instance, the WAEC Chief Examiners' report reveal that the performance of candidates in chemistry paper 2 as at 2022 with mean score of 29 and standard deviation of 13.78 was worse than candidates' performance in 2021 with mean score of 47 and standard deviation of 15.78. Similarly, they further reported that the performance of candidates in chemistry paper 3 as at 2022 with mean score of 24 and standard deviation of 9.95 was worse than candidates' performance in 2021 with mean scores of 26 and standard deviation of 8. These result analyses denote a decrease in the performance of standard in chemistry for those years. Those analyses agreed with Kozma and Russelin Pekdag (2016) and Ikwuka and Samuel (2017) that chemistry is seen as an abstract subject that is difficult to understand. This is because the basic concepts in chemistry have to be mentally visualize by students to understand the chemistry phenomena.

The need to improve chemistry education achievement through more effective instructional strategies and the increasing awareness of teaching and learning situation have directed a lot of attention to discovering and understanding more innovative means of enhancing learning. The effort in assisting learners to learn led to the discovery of different strategies to enhance meaningful learning (Babkie & Provost, 2022; Thomas & Barksdale-ladd, 2000). In science, chemistry is one of the subjects that attract multidimensional studies as to improve students' achievement and to remedy some of the challenges circumnutating around its teaching and learning across institutions of learning in Nigeria. This is because, it has made great impact in the development of nations and its important chances the need to expose chemistry students to innovative method like Z-A approach in teaching and learning in secondary schools.

However, the effects of teaching strategies on students learning should be of interest to every intellectual. The method used in teaching is very important as the method used may promote or hinder learning. The methodology used in teaching has the capacity of sharpening students' mental activities which are the bases of social power or may discourage initiatives and curiosity, thus making self-reliance and survival difficult

(Ameh & Dantani 2015). There are several innovative teaching strategies that are used in Nigerian institutions of learning today. They include Guided Discovery, Cooperative learning, case studies, computer simulation, Z-A approach, JIGSAW strategies; to mention but a few, Z-A is one of the nearest innovative strategy that is not yet saturated in teaching.

The Z-A strategy attempts to explain the application part of a particular concept initially, that is, the teacher explains the application of a particular concept first and later the effect of such application. For example, Demodharan and Regarajan (n.d) explain how this strategy was demonstrated in the application of Galileo's theorem. Two balls with different mass were thrown from the tower of Pisa and they all reached the ground at the same time. Here, the teacher explains how the two objects reached the ground as they were put from a particular distance from ground level. Traditional way of teaching method will be explaining the theorem first and followed by its application. But this Z-A approach goes opposite in a manner that the proof or application is explained first followed by theory. As a result, learners would be more curious to knowing the cause of the effect, hence motivation will be enhanced among them.

Another example is what this study demonstrated. Alcohol (local gin, Burukutu) were provided to the students in the class before teaching of fermentation commenced. The students in the process developed interest in Knowing how was alcohol produced. The teacher usually explains the process in retrogressive manner using the advantage of students' curiosity, interest and motivation. The approaches help make concepts clear, stimulate students' interest in knowing a concept and above all, create long lasting memory (Damodharan and Regarajao, n.d). Consequently considering these properties of Z-A teaching strategy, it has potentials of improving learners' academic achievement.

Academic achievement is the result of instruction, that is, the degree to which a student, teacher, or an establishment has accomplished their instructional objectives. It is regularly measured by examination or continuous evaluation (Annie, etal 2015). Several empirical studies have demonstrated the effectiveness of Z-

A teaching strategies in some subjects like Biology and Physics when compared to the conventional teaching strategy (Lawan, 2016). However, no study has relatively assessed the effect of Z-A on student's achievement in chemistry.

Statement of Problem

The desire to know the cause of poor performance in chemistry has been the focus of research over decades. It has been observed that poor performance in sciences generally, and chemistry in particular is attributed to poor quality of science teachers, overcrowded classroom, lack of suitable and adequate science equipment, large class size, heterogeneous classroom in terms of ability level, ill equipped laboratories, overloaded chemistry syllabus and poor teaching methods (Ahmed, 2014; Kareem, 2016). These factors encourage chemistry teachers to resort to only lecture method most of the time. It is a well-known fact that the quality of education depends on the teachers and so the strategy they used in teaching matters a lot.

The analysis of Chief Examiner's report of West African Examination Council (2020-2023) on students; performance in chemistry revealed consistent fluctuation of performance rates below 50% for more than five years. Researchers have then been conducting studies to find a lasting solution to the declining students' performance in chemistry most significantly, by exploring innovative strategies of teaching as to enhance learning of sciences in secondary schools. In view of this, the study is therefore, aimed at examining the effectiveness of using Z-A approach teaching strategy on students' academic achievement in chemistry which is limited in the local literature.

Aim and Objective of the Study

The aim of the study was to determine the effect of Z-A approach teaching strategy on the academic achievement of chemistry students in senior secondary school in Niger State.

In order to achieve this aim, the following objectives are to be focused on:

1. To determine the effect Z-A approach teaching strategy on the academic achievement of chemistry students in Niger state compared to those taught using conventional teaching method
2. To find out if there is any gender influence on the students' achievement when taught chemistry using Z-A approach teaching strategy.

Research Questions

The following research questions were raised to guide the study;

1. What there any different between the mean achievement of students taught chemistry using Z-A approach teaching strategy and those taught using conventional teaching method.
2. What are the difference between the mean scores of male and female students taught chemistry using Z-A approach teaching strategy.

Research Hypotheses

The following research null hypothesis were formulated to guide the research:

$H0_1$: There is no significant difference in the mean achievement scores of chemistry students taught using Z-A approach teaching strategy and those using conventional teaching method

$H0_2$: There is no significant difference in the mean achievement scores of male and female chemistry students taught using Z-A approach teaching method.

Research Methodology

The research design adopted for this research is quasi-experimental research design in which non-equivalent control group design was used. Thus, intact classes were used for the study. The experimental group was taught using Z-A approach teaching strategy while the control group were taught using conventional teaching method. The population for the study comprised all senior secondary schools in zone-C Educational zone of

Niger state of chemistry students while the target population were 3,450 SSII students in twenty five (25) schools. Two schools were randomly selected from the 25 schools and were used for the study. Two SS II intact classes were involved in the study which were randomly assigned to experimental and control groups. The sample comprises 38 male and 32 female students in the experimental group, while 29 male and 27 female students were in the control group given a total of 126 students. The instrument used for the data collection was chemistry Achievement Test (CAT). The test items used was developed by the researcher using the scheme of work and relevant text books for senior secondary schools. The instruments had 20 multiple choice test items which covered topic like preparation and the uses of alcohol using fermentation method. It had option (A-D) with only one correct answer. The instrument was confirmed valid by three experts in science education. The reliability of the instrument was ascertained through test-retest method using person product correlation coefficient (PPMCC) formula in which correlation coefficient of r=0.86 was obtained. The reliability coefficient shows that the test instrument is consistent and reliable.

Method of Data Collection

Researcher administered pretest to the students in order to determine their entry behaviour. Lesson plans developed by the researchers in line with Z-A strategy for experimental group and conventional lecture method for control group were used in teaching which lasted for three (3) weeks. In the fourth week, posttest was conducted.

Method for Data Analysis

The data collected for the study were analysed with respect to the research questions and hypotheses used for the study. Mean standard deviation, and t-test statistics were used to analyzed the data generated with the aid of statistical package for social sciences (SPSS) version 26.0.

Pre-test Results

Table1: t-test Comparison of pretest scores of experimental and control groups.

Group	N	Mean	SD	Df	t-cal	P
Experimental	57	22.16	3.47			
				123	1.625	0.017*
Control	69	20.99	4.22			

* Not Significant at 0.05 level

Table 1 shows the t-test comparison of pretest scores of experimental and control group. The experimental group has a mean scores of (22.16) with a standard deviation of (3.47) while the control group has a mean score of (20.99) with a standard deviation of (4.22). An examination of the table shows there is no significant difference between the two groups $t(123)=1.625$, $P<0.05$. This implies that the two groups were equivalent before treatment.

Answer Research Question One:

What are the different between the mean achievement of students chemistry using Z-A approach teaching strategy and those taught using conventional teaching method

Table 2

Group	N	Mean	SD
Experimental	57	22.16	3.47
Control	69	20.99	4.22

The table 2 shows that the students exposed to Z-A approach teaching strategy had a mean scores of 22.16 with standard deviation of 3.47 while those students exposed to conventional teaching method had mean score of 20.99 with standard deviation of 4.22. This implies that the students exposed to A-Z approach teaching method performed better than those exposed to conventional teaching method.

Null hypothesis One ($H0_1$): There is no significant difference in the mean achievement scores of chemistry students taught using Z-A approach teaching strategy and those taught using conventional lecture method

Table 3: t-test Analysis of the posttest score of Experimental and Control Group

Group	N	Mean	SD	Df	t-cal	P
Experimental	57	30.16	3.47			
				123	3.866	0.000*
Control	69	23.88	3.11			

* Not Significant at 0.05 level

Examination of the table shows that there is significant difference between the two groups (t(123)=3.866, p=0.000) since the p-vale is less than the alpha level of significance. On the bases of this, hypothesis one was rejected. This implies that there is significance in the mean achievement scores of chemistry students taught using Z-A approach teaching strategy and those taught using conventional lecture method in favour of those taught using Z-A approach teaching strategy.

Answer Research Question Two: What are the difference between the mean scores of male and female students taught chemistry using Z-A approach teaching strategy.

Table 4: Posttest Mean scores of male and female students exposed to Z-A approach teaching strategy

Group	N	Mean	SD
Male	27	15.07	3.47
Female	29	15.09	4.34

The result on table 4 show that the male students in Z-A approach teaching strategy obtained a mean scores of 15.07 in chemistry while the female counterpart had a mean scores of 15.09. This shows that there is no significant difference in the mean scores of male and female students taught chemistry using Z-A approach teaching strategy.

Hypothesis Two ($H0_2$): There is no significance difference in the mean scores of male and female chemistry students taught using Z-A approach teaching strategy.

Table 5: t-test Analysis of the posttest score of male and female students in experimental group

Group	N	Mean	SD	Df	t-cal	P
Male	27	15.07	3.47			
				54	0.601	0.550*
Female	29	15.09	4.34			

* Not Significant at 0.05 level

An examination of the table shows that there is no significance between the two groups (t(54)=0.601,p=0.550). Since the p-value is greater than the alpha level of significance on the basis of this, hypothesis two was accepted. This implies that there is no significance difference in the mean scores of male and female chemistry students taught using Z-A approach teaching strategy.

Discussion of Result

The mean objective of this research was to determine the "Effects of Z-A approach teaching strategy on the academic achievement of chemistry students in Senior secondary School in Zone-C educational Zone of Niger State". The pretest results in table 1 showed no significance in pre-entry behaviour of the experimental and control group. Table 2 showed that the experimental group has higher mean scores (30.16) and standard deviation (3.47) than the mean score (23.88) and standard deviation (3.11) of the control group after the treatment. The result of the t-test as showed in the table 2 showed that the experimental group performed

significantly better than the control group. This could have been than that the approach highly stimulated the learners in the experimental group to study well. They were curious to see how alcohol is produce and as well curious to known the raw materials for the production. Consequently, that help in sustaining their attention, concentration and readiness to learn throughout the teaching period. This by implication suggests that Z-A approach teaching strategy enhances learning of chemistry concepts than the conventional lecture method at secondary school level. This result was in line with the finding of Ameh and Dantani (2015) that methodology, used in Z-A approach has the capacity of sharpening students' mental activities which are the bases of social power to improve initiative and curiosity of students. It also corroborates the findings of Akanbi and Kolawole (2014) who examined the effects of guided discovery (GD) and staff-learning (SL) strategies as innovative teaching strategies on senior secondary school students' achievement in biology. They discovered that, self-learning and guided discovery strategies improves students' achievement in chemistry.

The posttest mean scores of male and female students as shown in table 3, indicated that female students performed better than male students after the treatment. The results of the t-test was significant at 0.05. this result strengthens the findings of Bilesanmi and Woderu (2015) who all reported that there were no longer distinguishing deference in the cognitive, effective and psychomotor skills achievement of students in respect of gender differences. But on the other angle, it supported the finding of Uchenna and Philmoena (2015) who investigated the comparative effectiveness of the expository and concept mapping instructional strategy of presenting secondary school chemistry concept to slow learners. Specifically female slow learners taught with the concept mapping instructional strategy performed significantly better their male counterparts taught by the same method. The result of this study further established the fact that Z-A strategy is gender friendly. By implication, the application of this strategy of teaching, both in science and art discipline is lacking, and this study seemed to be one of the fore-front students experimenting this approach of teaching; most especially in chemistry as a science subject. The strategy was only reported by Demodham and Regarajan (n.d) in the

application of Galileo's theorem in physics by falling two objects at difference mass from the same distance. None of this type of experiment was found by the researchers in respect to chemistry or chemistry concept.

Conclusion

Based on the research findings as related to the hypotheses formulated and tested, the following conclusion were made:

1. Exposing students to Z-A approach teaching strategy improves the students' performance in chemistry
2. In respective of students gender, male and female exposed to Z-A approach teaching strategy performed equally better that is, it is gender friendly

Recommendations

On the bases of research findings, the following recommendations were made:

1. Secondary school principals should encourage and give necessary assistance to teachers for effective use of the Z-A approach teaching strategy particularly in teaching chemistry
2. Since the use of Z-A approach teaching strategy enhances students' achievement, teacher should be encouraged to employ the use of the strategy in teaching and learning of chemistry in schools.
3. Curriculum planners should also make sure that the curriculum put in place the appropriate innovative teaching strategies to be employed in teaching appropriate concepts of art and science subjects.
4. The government should also provide and sustain opportunities for retraining symposia, workshops, conferences and seminars for the secondary school teachers on the appropriate selection and application of innovative teaching strategies (Z-A inclusive) in teaching of sciences, chemistry in particular
5. Teacher and researchers should endeavour in testing some of these strategies in schools in order to confirm and establish their effectiveness.

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