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Impact of Interactive-Engagement Strategy on Performance in Chemistry among Secondary School Students in Gusau Metropolis

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Abstract

This study examined the impact of interactive-engagement strategy on chemistry academic performance among secondary school students in Gusau Metropolis. A total of 1,154 students constituted the target population. 152 students formed the sample for the study. Simple random sampling using ballot method was used to select four (4) schools for the study. Two schools were selected based on the fact that their mean scores were not significantly different. The target population were divided into two groups; the experimental group N= 93 and the control group N=59. The study adopted the pretest, posttest, quasi experimental and control groups design. The experimental groups were taught using interactive-engagement strategy, while the control groups were exposed to lecture teaching method for a period of six weeks. The chemistry concept taught was chemical equilibrium. The treatment instrument explored was the Chemical Equilibrium Performance Test (CEPT). The reliability coefficient of the instrument was 0.75. The instrument was validated by experts. Two research questions were raised to guide the study and two null hypotheses were tested using t-test statistical analysis at 0.05 level of significance. Result of the study revealed that there was significant difference in the mean scores of experimental and control groups in favor of experimental group. Thus, it was further concluded that academic performance on the concept chemical equilibrium can be enhanced by the use of interactive-engagement strategy. It was therefore recommended that secondary school chemistry teachers should adequately explore the use of interactive- engagement strategy so as to make chemistry teaching and learning interesting, meaningful and thereby improves academic performance.

Keywords: Interactive - engagement, Academic performance, Chemistry

Introduction

Chemistry is one of the major science subject offered at the senior secondary schools. Ababio (2010) defined chemistry as a branch of pure science which deals with the composition properties and uses of matter. Thus chemistry can be defined as a branch of science that deals with substances of which matter is composed, their properties and reactions to form new substances. Chemistry is a very important science subject that is required for studying science related professional courses like medicine, pharmacy, engineering, agriculture among others. The importance of chemistry as a valuable science subject is further emphasized in the Joint Admissions and Matriculation Board syllabuses (JAMB, 2020/2021), it is stipulated that a minimum of credit pass in Chemistry is required as one of the criteria for admitting candidates aspiring to study science-related courses in tertiary institutions.

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In spite of the important position of chemistry among other science subjects and related disciplines, literature revealed that, students' performance in chemistry at Senior Secondary School Examinations (SSSCE) have been consistently poor, (Udo, 2019, Asim, 2019 & WAEC Chief Examiners' report 2015 - 2020). The performance of senior secondary school students in chemistry has been attributed to passive teacher-centered instructional strategies mostly the Lecture Method (Olorukooba, 2021, MDG's project, 2020). This lecture method of teaching is a strategy commonly used by most teachers in Nigerian schools. This method is teacher-centered and characterized by verbal one-way presentation of ideas, concepts, generalization and facts. The teacher does most of the activities in form of talking while the students are either passive listeners or slightly involved and does not take care of the varied needs of the learner especially in the teaching of chemistry.

As a result of the shortcomings of the lecture method, other teaching strategies have been investigated such as process-based learning method and computer assisted learning (MDGs project, 2011), inquiry and demonstration methods (Obeka, 2019), use of conceptual change instructional strategies (Lakpini, 2019) among others. However, little have been done in interactive-engagement strategy especially in the teaching of chemistry.

Interactive-engagement is a teaching strategy in which students are engaged in minds-on activities involving the pre-read of textbooks prior to the teaching of a concept or concepts. At the beginning of the instruction, students are giving interactive session to discuss the concept amongst them which was previously given as a pre-class assignment. Questions on the concepts are posed by the teacher at the end of the interactive session, students then discuss the questions, choose answers using flashcards and then the teacher clarifies misconceptions, (Ayodele, 2019). The use of a Student-Response-System (SRS) or flash cards (as the case may be) serves as a source of instant feedback which informs the teacher and the learners of goal progress. Thus, the steps to be followed when using Interactive-engagement strategy as adopted by Mazur (2018) involves;

1. Giving a pre-class assignment on the concept to be taught
2. Giving students interactive session to discuss the concept at the beginning of the instruction
3. Asking questions based on the pre-class assignment by the instructor
4. Students in groups are allowed to engage in a class discussion
5. Students choose their answers using flashcards
6. Based on students' feedback, the instructor gives a detailed explanation of concepts
7. The instructor summarizes what has been learned

The influence of gender on students' performance in Nigeria has for a long been a concern to educational researchers. Surprisingly, no consistent result has been obtained. Some researchers found that male students achieve significantly higher than female students while some reports indicated that the reverse is the case. Studies on gender and academic performance such as that of Usman (2017) and Ibrahim (2018) showed that boys perform better than girls in terms of academic performance but a study conducted by Atadoga (2017) pointed out that there is no gender-related difference in academic performance. From these reports, it could be inferred that the findings about the effect of gender on performance though widely spread, are inconclusive. It is for this reason that this study intends to investigate the impact of interactive- engagement teaching strategy on chemistry academic performance among secondary school students in Gusau Metropolis.

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Objectives of the Study

The main objective of this study is to determine the impact of interactive-engagement strategy on chemistry academic performance in among secondary school students in Gusau metropolis. Specifically, the objectives of this study were to investigate;

1. The difference between the mean performance scores of students taught chemical equilibrium concepts using interactive-engagement strategy and those taught using lecture methods.
2. The mean performance score of male and female students taught chemical equilibrium concepts using interactive-engagement strategy.

Research Questions

1. What is the difference between the mean performance scores of students taught chemical equilibrium concepts using interactive-engagement strategy and those taught using lecture method?
2. What is the mean performance score of male and female students taught chemical equilibrium concepts using interactive-engagement strategy?

Hypotheses

1. There is no significant difference between the mean scores of students taught chemical equilibrium concepts using interactive-engagement strategy and those taught using lecture methods.
2. There is no significant difference between the mean scores of male and female students taught chemical equilibrium concepts using interactive-engagement strategy.

Methodology

The research design used for this study was pretest, posttest quasi experimental design. A pretest was administered to both the experimental and control groups to determine the equivalence in academic ability in chemical equilibrium concept. Then a posttest was administered to all groups after the treatment to determine the effectiveness of the treatment on the concept taught. The population of the study comprised all SS2 chemistry students in nine senior secondary schools in Gusau metropolis. All these schools are co-educational. Simple random sampling technique by balloting method was used to select four (4) schools within Gusau metropolis. A class in each of the four schools was pretested to determine their level of academic equivalence. Mean scores obtained from the pretest were subjected to ANOVA statistics to determine any significant difference. Two schools were selected based on the fact that their mean scores were not significantly different; they were assigned into experimental group consisting of 93 students with 59 males and 34 females and control group consisting of 59 students with 37 males and 22 females. Thus, a total of 152 students were used for the study.

Chemical Equilibrium Performance Test (CEPT) was the instrument used for the study. The CEPT was validated by two senior lecturers at Ahmadu Bello University, Zaria and two chemistry teachers of senior secondary schools in gusau metropolis. Thereafter, based on suggestions and recommendation raised during validation of CEPT, some questions were modified. The reliability coefficient of the instrument was determined using test-retest method at interval of two weeks (Tuckman, 1975). It was found to be $r = 0.75$.

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Two major treatments were given to the groups. The experimental groups were taught using interactive - engagement strategy while the control group was taught using the lecture method. The students exposed to interactive - engagement teaching strategy were asked to read on the concept that was taught followed by a pre-class assignment. Students were asked to group themselves into mixed group of seven or eight students per group, flashcards were distributed to the students, with each student having the two alternatives; true (white) and false (blue). Students were given interactive session to discuss the concept at the beginning of the instruction. Questions were posed to the students based on the pre-class assignment, students were given time to engage in class discussion in each group to ascertain the correctness of the alternative chosen by each member of the group. The students were then asked to choose their answers using their flashcards. The researcher used the feedback from the flashcards to correct wrong answers and then gave detailed explanation of the concept and summarized. Students in the control group were taught the same concept using lecture method. At the end of the treatment, the posttest was administered to both experimental and control groups. The scores of both groups were collected and subjected to t-test statistics at significance level of $P \leq 0.05$.

Results

Research Question 1

What is the difference between the mean performance scores of students taught chemical equilibrium concepts using interactive-engagement strategy and those taught using lecture method?

Table 1: Mean and Standard Deviation Posttest Scores for Experimental and Control Groups

Variable	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
Male	93	31.17	8.60	0.89	
					6.46
Female	59	24.71	6.91	0.90	

Table 1 revealed that the academic performance means scores for the experimental and control group was 31.17 and 24.71 respectively with the mean difference of 6.46. This means the experimental group achieved higher than the control group, and this can be attributed to the treatment. i.e. the use of interactive - engagement strategy.

Research Question Two: What is the mean performance score of male and female students taught chemical equilibrium concepts using interactive-engagement strategy?

Table 2: Mean and Standard Deviation of Posttest Scores of Male and Female Taught Interactive-engagement Strategy

Variable	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
Experimental	59	33.56	7.88	1.03	
					6.53
Control	34	27.03	7.30	1.42	

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Table 2 presents data on the mean and standard deviation of the posttest scores of male and female students. From the result obtained, there was a difference in the mean posttest scores of the male and female students taught using interactive-engagement strategy. The male students mean score was 33.56 while that of the female was 27.03 with a mean difference of 6.53. This means that male students achieved higher than the female students and this can be attributed to the treatment. i.e. the use of interactive - engagement strategy.

Hypothesis 1

There is no significant difference between the mean scores of students taught chemical equilibrium concepts using interactive-engagement strategy and those taught using lecture methods**.**

Table 3: t-test Analysis of Academic Performance Mean Scores of Experimental and Control Groups

Variable	N	Mean	Std. Deviation	df	t-Cal	p-value
Experimental	93	31.17	8.60	150	3.12	0.00
Control	59	24.71	6.91			Significant

The result from Table3 showed that the P - value is 0.00 which is less than 0.05 level of significance at 150 degree of freedom with a t - cal of 3.12. The null hypothesis of no significant difference between the academic performances of students taught chemical equilibrium concepts with interactive-engagement strategy and those taught with lecture method is rejected. The result obtained showed that teaching with interactive - engagement strategy is effective in enhancing students' performance in chemical equilibrium concepts.

Hypothesis 2

There is no significant difference between the mean scores of male and female students taught chemical equilibrium concepts using interactive-engagement strategy. To test this hypothesis, the mean academic performance scores of male and female students were compared using t- test at $P < 0.05$. The result obtained is presented in Table 4

Table 4: t-test Analysis of Posttest Mean Scores of Male and Female Students in Experimental Group

Variable	N	Mean	Std. Deviation	df	t-Cal	p-value
Male	59	33.56	7.88	91	3.77	0.00
Female	34	27.03	7.30			Significant

Table 4 showed that the P- value of 0.00 which is less than 0.05 level of significance with the degree of freedom of 91 and a t - cal of 3.77. Hence the null hypothesis which stated that there is no significant difference between the mean scores of male and female students taught chemical equilibrium concepts using interactive-engagement strategy is rejected. This implies that interactive-engagement strategy is not gender friendly in teaching chemical equilibrium concepts as a result of higher mean performance score of male students.

Discussion of Findings

The findings of this study showed that the students taught chemical equilibrium concepts with interactive-engagement had a higher mean performance score than the students taught using

lecture method. This finding agreed with that of Khwanda, et al (2017) whose work showed that interactive-engagement strategy have positive impact on students' conceptual understanding of concepts. Antwi, et al (2018) suggested that the use of interactive-engagement approaches promote better conceptual understanding than the lecture approach. The result is also in accordance with the findings of Churukian (2019) who found that conceptual understanding of students in the experimental classes who were taught using interactive-engagement strategy is better than that in the control class which received traditional teaching strategy. The students in the experimental classes express positive responses towards the activities conducted to involve them actively in the learning process.

Findings from this study revealed that the mean performance scores of male and female students taught chemical equilibrium concept using interactive - engagement strategy were statistically significant. The finding from this study indicates that gender has effect on learning chemical equilibrium concepts with interactive-engagement strategy as a result of higher performance mean score of male students as compared to that of the female students. The result of this finding is in line with that of Nwagbo and Okoro (2020) which revealed that interaction pattern enhanced achievement of students but also showed that the average scores for boys were consistently higher than that of girls. The result of this study disagrees with that of Churukian (2019) whose result indicated that no significant correlation was found in gender when interactive whiteboards was used during instruction. The result of this finding is not in line with that of Wachanga, *et al* (2019) who observed that gender has no significant effect on chemistry performance test. The result also disagrees with that of Njue (2020) who established that gender has no significant effect in chemistry performance test.

Conclusion

Based on the findings of this study, it was concluded that the use of interactive-engagement strategy enhanced the academic performance of chemistry students on chemical equilibrium concepts at senior secondary school**.** Also, male students taught using interactive-engagement strategy achieved higher in chemical equilibrium concepts in senior secondary school than female students taught using the same strategy.

Recommendations

Based on the findings of this study, the following recommendations were made.

1. Professional Associations such as Science Teachers Association of Nigeria (STAN), Nigeria Educational Research and Development Council (NERDC) should guide the teachers on how to use interactive-engagement strategy as a means of enhancing participation of students in meaningful activities that involve social-interaction amongst the students which could be achieved through seminars.
2. Interactive-engagement teaching strategy should be incorporated in science teachers' training curriculum in order to produce teachers who are able to handle this mode of teaching
3. There is need for Government to see the provision of adequate teaching materials; flashcards, visual and audio-visual aids to facilitate the use of the strategy.
4. Chemistry teachers should imbibe the use of interactive-engagement strategy with other

teaching strategy to teach chemistry for better learning and understanding since interactive-engagement strategy alone is not gender friendly.

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