



## **EXPLORING GENDER-BASED DIFFERENCES IN CHEMISTRY RETENTION AMONG SENIOR SECONDARY STUDENTS USING FLASHCARD-ASSISTED INTERACTIVE TEACHING IN NASARAWA STATE, NIGERIA**

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### **Abstract**

This study examined gender-based differences in chemistry retention among senior secondary students using flashcard-assisted interactive teaching in Nasarawa state, Nigeria. The population of the study consisted of 1,152 chemistry students. Purposive sampling method was used to select a school for the experiment with males  $N=59$  and the females  $N=34$ . Total sample of 93 students were used for the study. The study adopted the pretest, posttest, post-posttest quasi experimental research design. The students were taught using flashcard-assisted interactive teaching, for a period of 6 weeks. Chemical Equilibrium Performance Test (CEPT) adapted from WAEC and JAMB past examination questions was used to assess chemistry retention. The reliability coefficient of the instrument was found to be 0.75. A research question was set to guide the study and corresponding null hypothesis was tested using independent sample t-test statistics at  $P \leq 0.05$  level of significance. The finding of the study showed that male students taught chemical equilibrium concepts using flashcard-assisted interactive teaching retained the concept taught better than the female students. Thus, it was concluded that flashcard-assisted interactive teaching is more effective for male students than female students in terms of retention. Therefore, it was recommended that teachers should adopt gender-sensitive teaching methods that cater for the diverse learning needs of both male and female students.

**Keywords;** Flashcard-Assisted Interactive teaching, Gender, Retention

## Introduction

Chemistry education is a vital component of science education, and its effective delivery is crucial for developing scientific literacy, critical thinking, and problem-solving skills (Apakangelo & Mumba, 2020). However, chemistry is often perceived as a challenging subject, and many students struggle to understand its abstract concepts (Orgill & Sutherland, 2016, Chandrasegaran, Treagust & Mocerino 2017). In Nigeria, the teaching and learning of chemistry have been identified as a major challenge, with students' poor performance in chemistry being a significant concern (Adebayo & Okedayo, 2018, Adeniyi, 2020; WAEC Chief Examiners' report 2016-2020). One of the reasons associated with this poor performance is the abstract nature of chemistry concepts of which chemical equilibrium is among the abstract concepts (Idris & Mohammed 2019; Ibrahim, Famuwagun, Yakubu & Mohammed 2021).

Researches has consistently shown that traditional lecture-based approaches to teaching chemistry are often ineffective, leading to students' poor understanding and retention of chemical concepts (Prince, 2004, Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt, & Wenderoth 2014). In contrast, interactive teaching strategies have been found to be effective in improving students' understanding and retention of chemical concepts (Cooper, Underwood, Hilley, & Klymkowsky, 2018). Flashcard-assisted interactive teaching is a specific strategy that has been found to be effective in enhancing students' learning outcomes in chemistry (Oyebade, 2017; Mziliquiba & Nkosi, 2020).

Moreso, gender plays a significant role in students' learning outcomes, with males and females exhibiting different learning styles and preferences (Hoyne & Yoon, 2017). Despite this, there is a dearth of

research on gender-based differences in chemistry retention among senior secondary students in Nigeria. Recent studies have highlighted the importance of considering gender in science education research (Shapiro & Williams, 2019). Therefore, it is essential to investigate whether flashcard-assisted interactive teaching has a differential effect on the chemistry retention among male and female students in Nasarawa state, Nigeria.

## Objective of the Study

This study aims to explore gender-based difference in chemistry retention of chemical equilibrium concept among senior secondary students using flashcard-assisted interactive teaching in Nasarawa state, Nigeria.

## Research Question

What is the difference in retention level between male and female students taught chemical equilibrium concepts using flashcard-assisted interactive teaching?

## Research Hypothesis

There is no significant difference in retention level between male and female students taught chemical equilibrium concepts using flashcard-assisted interactive teaching.

## Methodology

A pretest, posttest, post-posttest quasi experimental research using a within-subjects design was used for this study. Due to the constraint and the nested nature of this research, a separate control group was not feasible. However, this research used a within-subjects design, where males and females served as their own controls, thereby comparing the scores of male and female students within the same class. A pretest was administered to the students to determine the equivalence in ability of both the male and female students, and the scores from the pre-test were used to place



both the male and female students in the same prior knowledge level. Consistent delivery of the flashcard-assisted interactive teaching was ensured for all the students in the class for a period of six weeks. A posttest was administered to the students to determine the effectiveness of the treatment. Meanwhile, a post-posttest was also administered after two weeks to determine the retention level of the students.

The population of the study comprised all SS 2 chemistry students in nine senior secondary schools in Nasarawa Local Government Area of Nasarawa state. All these schools are co-educational. The population consisted of a total of 1154 students with 698 males and 456 females. The sample for the study was drawn from nine senior secondary schools of the population. Simple random sampling using ballot method was used to select four (4) schools within Nasarawa LGA for pretest to determine their level of academic equivalence. A class in each of the four schools selected was pretested and mean scores obtained were subjected to ANOVA to determine any significant difference. Two schools were selected based on the fact that their mean scores were not significantly different, a school out of these two schools was then purposely selected due to logistical constraint and it was used for the study. The school used for the experimental study consists of 93 students with 59 males and 34 females.

The main concept that was taught in the study was chemical equilibrium which is a major concept in senior secondary II (SS 2) curriculum. Chemical Equilibrium Performance Test (CEPT) was the instrument used for this study. The CEPT consisted of two sections, A and B. Section A sought personal information of respondents with respect to name, gender, and class while section B consisted 50

multiple choice objective questions from past Senior School Certificate Examination (SSCE), National Examination Council, (NECO), Joint Admission and Matriculation Board (JAMB) question papers and new school chemistry textbook. Each of the multiple-choice objective questions was followed by four (4) options from which the students were expected to choose the option that best answers the question. The CEPT was administered to the experimental group at pretest, posttest and post posttest level. Instrument was given to experts for both face and content validity. CEPT and its corresponding marking scheme were taken to two senior lecturers with the rank of PhD in science education department of Ahmadu Bello University, Zaria and two chemistry teachers of senior secondary school level for validation. They were asked to study the item and certify if questions were considered to be testing what they were meant to test, if the questions were appropriate for the level of students for which it was intended and check for possible errors in the suggested answers. The validators modified some of the questions but did not add or reduce the number of questions. They also corrected some of the answers provided. Data obtained from pilot testing was used to determine the reliability of the instrument. A test-retest method at interval of two weeks after which, Pearson Product Moment Correlation (PPMC) was used to ascertain the reliability coefficient. It was found to be 0.75.

All the students (where the male and female students served as their own controls) were taught using flashcard-assisted interactive teaching. The students were asked to read on the concept that was taught followed by a pre-class assignment. The 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 misunderstanding and then gave a detailed explanation of the concepts. At the end of the instruction, posttest was administered followed by post posttest two weeks after.

The scores of both posttest and post posttest were collected and subjected to independent sample t-test statistics at 0.05 level of significance.

### Results

Mean and standard deviation were used to answer the research question while the hypothesis was restated along with the appropriate statistical tool for testing at significance level of 0.05 as follows;

**Research Question:** What is difference in the retention level between male and female students taught chemical equilibrium concepts using flashcard-assisted interactive teaching?

**Table 1; Mean and Standard Deviation of Posttest Scores of Male and Female Students**

VARIABLE	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
Males	59	30.83	7.49	0.98	
Females	34	24.85	7.42	1.27	5.98

Table 1 shows the mean and standard deviation of the post posttest scores of male and female students. From the result obtained, the male students had a mean score of 30.83 and female students within the same class had a mean score of 24.85 with a mean difference of 5.98. This means that the male students had a higher mean

score than the female students when taught with the same type of treatment (i.e flashcard-assisted interactive teaching).

**Null Hypothesis:** There is no significant difference in the mean retention scores of male and female students taught chemical equilibrium concepts using flashcard-assisted interactive teaching.

**Table 2: Independent sample t-test Analysis of Posttest Scores of Male and Female Students**

Variable	N	Mean	Std. Deviation	Df	t-Cal	p-value	Remark
Males	59	30.83	7.49	91	3.73	0.00	Significant
Females	34	24.85	7.42				

$P \leq 0.05$  significant level

The result from Table 2 shows that the P-value which is 0.00 is less than 0.05 level of

significant at 91 degree of freedom with a t-cal of 3.73. The null hypothesis which



stated that there is no significant difference in the mean retention scores of male and female students taught chemical equilibrium concepts using flashcard-assisted interactive teaching is rejected. This indicates that flashcard-assisted interactive teaching is not gender friendly in retaining chemical equilibrium concepts as a result of higher mean retention score of male students.

### Discussion

Analysis of result showed that the male students taught chemical equilibrium concepts with flashcard-assisted interactive teaching had a higher mean retention score than the female students taught using the same method. The result of the analysis revealed that gender has a significant influence on retention of chemical equilibrium when teaching with flashcard-assisted interactive teaching as a result of higher mean retention score of male students as compared to that of the females. This is in line with the findings of Ezirim (2006), Ikwuka and Samuel (2017) which showed that gender has significant influence on retention of science concepts. Findings of Hashamdar and Ayoobi (2015) also support this finding by establishing that there is a significant difference in the retention level of male and female students. However, Babajide (2010) found that gender has no significant influence on retention level in science. This significant mean retention score of male students could be due to the fact that male students may be more likely to engage in peer-to-peer learning and discussion, reinforcing their understanding and retention of chemistry concepts.

### Finding of the Study

The result of the study revealed that male students retained chemical equilibrium concept better than female students when taught with the same teaching strategy i.e

flashcard-assisted interactive teaching method.

### Conclusion

The study explored gender-based differences in chemistry retention among senior secondary school students in Nasarawa state using flashcard-assisted interactive teaching method. The result revealed that male students retained chemical equilibrium concept better than female students. This suggests that flashcard-assisted interactive teaching may be more effective for male students than female students in terms of chemical equilibrium retention

### Recommendations

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

1. Teachers should adopt gender-sensitive teaching methods that cater to the diverse learning needs of both male and female students.
2. Incorporating technology, such as digital flashcards and interactive simulations, can enhance engagement and retention for female students, bridging the gender gap.
3. Encouraging collaborative learning activities that foster peer-to-peer support and teamwork can benefit female students, promoting a sense of belonging and improving retention.

### References

- Adebayo, O. S., & Okedayo, T. O. (2018). Challenges of teaching and learning chemistry in Nigerian secondary schools. *Journal of Education and Human Development*, 7(1), 1-9.
- Adeniyi, O. (2020). Challenges of teaching and learning chemistry in Nigerian secondary schools. *Journal of Education and Human Development*, 9(1), 1-9.





- Apakangelo, A., & Mumba, F. (2020). Effectiveness of interactive teaching strategies in enhancing students' understanding of chemistry concepts. *Journal of Science Education*, 9(2), 1-12.
- Babajide, V. F. T. (2010). Generative and Predict-Observe-Explain Instructional Strategies as Determinants of Senior Secondary School Students Achievement and Practical Skills in Physics. Unpublished PhD Thesis, University of Ibadan, Nigeria
- Chandrasegaran, A. L., Treagust, D. F., & Mocerino, M. (2017). Chemistry education: A review of the literature. *Chemistry Education Research and Practice*, 18(2), 231-254.
- Cooper, M. M., Underwood, S.M., Hilley, C.S., & Klymkowsky, M.W. (2018). Chemistry education research: A review of the literature. *Journal of Chemical Education*, 95(10), 1721-1734.
- Ezirim, M. U. (2006). Scaling up Girls Participation in Science Education: towards a score card on quality education. Retrieved from: [stanonline.org/journal/pdf](http://stanonline.org/journal/pdf) on 14<sup>th</sup> May, 2016.
- Freeman, S., Eddy, S.L., McDonough, M., Smith, M.K., Okoroafor, N., Jordt, H., & Wenderoth, M.P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410-8415. Doi: 10.1073/pnas.1319030111
- Hoyne, S. H., & Yoon, S. (2017). Gender and science education: A review of the literature. *Journal of Research in Science Teaching*, 54(5), 645-665.
- Ibrahim, I., Famuwagun, S. T., Yakubu, A., & Mohammed, N.N. (2021). Effect of analogy-based teaching on student's attitude towards chemical equilibrium among secondary school students in Nguru, Yobe state, Nigeria. *Kashere Journal of Education*, 2(2); 165-170. ISSN; 2756-6021(print) 2756 - 6013(online).
- Idris, I & Mohammed, N. N., (2019). *Influence of analogy-based teaching on students' attitude towards chemical equilibrium among secondary school students in Nguru, Yobe state, Nigeria*. Curriculum issues in science and technology education in the 21<sup>st</sup> century. 7<sup>th</sup> international conference proceedings, FUT Minna. Date 1<sup>st</sup> – 5<sup>th</sup> October, 2019. Pg 178-183. ISSN; 979-978-52341-0-7
- Ikwuka, O. I., & Samuel, N. N. C. (2017). Effect of computer animation on chemistry academic achievement of secondary school students in Anambra State, Nigeria. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS)*, 8(2), 98-102.
- Mziliqiba, N. L., & Nkosi, T. E. (2020). Effect of flashcard-assisted instructional strategy on students' achievement in chemistry. *Journal of Education and Human Development*, 9(1), 1-12.
- Orgill, M. K., & Sutherland, K. (2016). Chemistry education research: A review of the literature. *Journal of*



- Chemical Education, 93(10), 1721-1734.
- Oyebade, S. A. (2017). Effect of flashcard-assisted instructional strategy on students' achievement in chemistry. *Journal of Education and Human Development*, 6(1), 1-9.
- Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223-231.
- Shapiro, B. L., & Williams, J. M. (2019). Gender and science education: A review of the literature. *Journal of Research in Science Teaching*, 56(5), 645-665.
- West African Examination Council, (2016). Chief Examiners Reports. Sidmach Technologies (Nigeria) Limited. Retrieved from; [www.waeconline.org.ng/e-learning](http://www.waeconline.org.ng/e-learning) on 6th october, 2023
- West African Examination Council, (2017). Chief Examiners Reports. Sidmach Technologies (Nigeria) Limited. Retrieved from; [www.waeconline.org.ng/e-learning](http://www.waeconline.org.ng/e-learning) on 6th october, 2023
- West African Examination Council, (2018). Chief Examiners Reports. Sidmach Technologies (Nigeria) Limited. Retrieved from; [www.waeconline.org.ng/e-learning](http://www.waeconline.org.ng/e-learning) on 6th october, 2023
- West African Examination Council, (2019). Chief Examiners Reports. Sidmach Technologies (Nigeria) Limited. Retrieved from; [www.waeconline.org.ng/e-learning](http://www.waeconline.org.ng/e-learning) on 6th october, 2023
- West African Examination Council, (2020). Chief Examiners Reports. Sidmach Technologies (Nigeria) Limited. Retrieved from; [www.waeconline.org.ng/e-learning](http://www.waeconline.org.ng/e-learning) on 6th october, 2023