



Effect of Computer Drill-And-Practice on Students Performance and Retention in Chemical Reaction among Secondary Schools in Katsina Metropolis

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ABSTRACT

This study investigated the Effect of Computer Drill-and-Practice on Students Performance and Retention in Chemical Reaction among Secondary School in Katsina Metropolis. The study was guided by two objectives, two research questions and two hypotheses, the objectives of the study include; to find posttest scores of students taught chemical reaction concept of chemistry using Computer Drill-and-practice instructional strategy and Conventional Teaching Methods in Katsina Metropolis among other. The study was conducted using pretest, posttest and post posttest Quasi-experimental research design non-randomized groups. 2 intact classes were used for the study. The Population of the study comprised 4,505 SS2 students from the twelve (12) public secondary schools in Katsina Metropolis. The sample for this study comprised ninety-eight students from two public secondary schools. The instruments, chemical reaction performance and Retention test was used for data collection. Mean and standard deviation were used answering the research questions. All the hypotheses were analyzed using independent t-test and tested at 0.05 Alpha level of significance. The Findings of the study revealed that; significant differences existed between academic performance of students taught chemical reaction concept of chemistry using Drill-and-Practice instructional strategy and Conventional Teaching Methods in favour of Drill-and-Practice instructional strategy. The study concluded that; the use of Drill-and-Practice instructional strategy improve performance and retention of students taught chemical reaction concept of chemistry, the study recommended that; Teachers should adopt teaching using Drill-and-Practice instructional strategy for the teaching of chemical reaction concepts of chemistry Government should train teachers and provide necessary facilities.

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INTRODUCTION

In science education, chemistry is an essential subject. It plays a vital role in our everyday lives by providing a basis for understanding the natural world by clarifying the composition, characteristics, behavior, and transitions of matter (Dunlopunlop, Hodgson and Stubb, 2020). But chemistry is also a dynamic and complicated subject that demands a thorough understanding of basic ideas and concepts.

However, students find it challenging to relate abstract chemical principles to real-world situations (Dewi, Pahriah and Purmadi 2021). The main goals of chemistry education research are to improve students' comprehension of chemistry concepts and to develop relevant chemistry learning experiences. To assist students in grasping concepts and other learning elements, such as instruction and evaluation, it is usually

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centered on learning strategies and media (Dewi et al., 2021).

Computer Drill-and-practice is a time-tested instructional strategy rooted in behaviorist learning theory, which emphasizes repetition and reinforcement to ensure mastery of foundational knowledge and skills. It involves structured, repetitive activities designed to reinforce learning, enhance retention, and promote automaticity in skill performance. In essence, the drill provides the repetition, while the practice reinforces accuracy and fluency (Kulik, Kulik and Bangert-Drowns 2017).

Computer Drill-and-practice are essential components of learning, allowing students to reinforce new skills and solidify knowledge (Kulik et al., 2017). Describing the computer based drill-practice Methods of instruction, Rathakrishnan, Raman and Haniffa (2018) Stated that teachers and students are in touch with learning tasks, engage in creative information sharing, announce upcoming events, share contents of homework, note-taking, remind themselves of to-do-list, capture feedbacks, scores and upload activities for further studies. This instructional package entails acquisition of knowledge or skill through systematic training by multiple repetitions, rehearse and practice that involves repetition of specific skills (Laleye and Ogunboyede, 2023)

In chemistry education, computer drills-and- practice can help students develop problem-solving skills, improve retention, and build confidence (Liu et al., 2020). In the context of science education, and Chemistry in particular, computer drill-and-practice can be used to consolidate essential knowledge such as chemical symbols, formulae, valency rules, chemical reaction, balancing chemical equations, and periodic table trends. By engaging students in repeated exposure to these fundamental concepts, the strategy enables learners to internalize and retrieve information more efficiently. Examples of computer drill-and-practice in chemistry education include: Online quizzes and worksheets Practice problems and exercises, Flashcards and concept reviews

Performance is an individual's competence or achievement in a given task. Academic performance is the measurement of student achievement across various academic subjects. Teachers and education officials typically measure achievement using classroom performance, graduation rates, and results from standardized tests.

Retention is the ability of students to retain and recall information over time, which is a critical aspect of learning and academic success (Cepeda, Pashler, Vul, Wixted, and Rohrer 2020). Research has identified several factors that influence retention, including: spaced repetition that is Reviewing material at increasingly longer intervals to improve long-term retention (Eichenbaum, Kinner and Simons 2022), Active learning which involves Engaging students in interactive and participatory learning activities to enhance retention (Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt and Wenderoth 2020), and Emotional connection which has to do with Creating an emotional connection to the material to improve retention and recall (Tyng, Amin and Malik 2021). Some Effective strategies for improving retention include: practice testing that uses quizzing and testing to reinforce learning and improve retention (Roediger and Karpicke 2022), summarizing information in one's own words to improve retention and understanding (Bui, Myerson, and Hale 2020).

Chemical reactions are fundamental concepts in chemistry that explain how substances change to form new products. Understanding chemical reactions helps students interpret many natural and industrial processes such as rusting, combustion, and food digestion. Among the major principles used to explain chemical reactions are the rate of reaction and chemical equilibrium. The rate of reaction describes the speed at which reactants are converted into products. It is influenced by factors such as temperature, concentration, pressure, surface area, and the presence of catalysts. A proper understanding of reaction rates enables students to predict how quickly a reaction will occur and how different conditions can alter the outcome of a chemical process.

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This level of dismal performance could be attributed to the abstract nature of the concept, which usually makes teachers to teach it using lecture Methods. Consequently, student resort to relying on cramming to pass chemistry a situation which drastically affects their academic performance and by extension making it highly difficult for them to retrieve learnt material initially stored through that process.

The reasons for poor performance in Chemistry as identified by researchers over the years include: poor instructional strategies, abstract nature of science concepts, lack of qualified teachers; poor infrastructure and inadequate laboratory facilities and curriculum implementation (Omoniyi and Akinsete, 2022). The appraisal of candidates' performance in the West African Senior School Certificate Examination which attribute the tendency to students' incapacity to comprehend abstract ideas, lack of real-world experience, and excessive dependence on conventional teaching techniques. These difficulties have an impact on students' academic performance as well as their long-term memory recall, which is essential for future research and practical applications.

Innovative teaching techniques including computer simulations and drill-and-practice approaches have surfaced as a result of the growing integration of information and communication technology (ICT) into education. These Methods have the potential to enhance mental comprehension and memory. However, it's still unknown how beneficial they are in comparison, especially when it comes to Nigerian education. To support evidence-based teaching strategies, it is necessary to conduct an empirical investigation of the effects of various approaches on students' academic achievement and retention in chemistry. This study, therefore, seeks to determine the extent to which computer drill-and-practice instructional strategy can influence students' performance and retention in chemistry.

Objectives of the Study

The objectives of the study are to:

1. find posttest scores of students when taught chemical reaction concepts of

chemistry using computer Conventional Teaching Methods and Drill-and-Practice in Katsina Metropolis and

2. determine the retention ability of students taught chemical reaction using computer drill-and-practice instructional strategy in Katsina Metropolis

Research Questions

The following research questions were answered in the study

1. What are the posttest scores of students when taught chemical reaction concepts of chemistry using computer Conventional Teaching Methods and Drill-and-Practice in Katsina Metropolis?
2. What is the retention ability of students when taught chemical reaction concepts of chemistry using a drill-and-practice instructional strategy in Katsina Metropolis?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance

H₀₁: There is no significant difference between posttest scores of students taught chemical reaction concepts of chemistry using conventional teaching Methods and drill-and-practice instructional strategy in Katsina Metropolis

H₀₂: There is no significant difference in the retention ability of students taught chemical reaction using computer drill-and-practice and those taught using conventional teaching Methods in Katsina Metropolis

METHODOLOGY

The study was conducted using pretest, posttest, and post-posttest non-randomized group's Quasi-experimental research design. Specifically, two intact classes were used for the study. (Nworgu, 2015), quasi-experimental research design permits the use of intact classes. This design was adopted because it will not be possible for the researcher to randomly sample the subjects and assign them to groups without



disrupting the academic programme and the timetable of the senior secondary schools involved in the study. Hence, the design was considered quite suitable for conducting this study.

The Population of this study comprised 4505 SS2 students. The study was carried out in Katsina Metropolis, covering the twelve (12) public senior secondary schools offering Chemistry in Katsina Metropolis. The sample of this study comprised 98 students from two intact classes nonrandomized selected from two public senior secondary schools from the population of the study. The schools were purposefully selected from 12 senior secondary schools because of the availability of ICT facilities in the institutions. In assigning the selected schools into experimental groups; purposive sampling technique was employed. Purposive sampling technique is the deliberate selection of sample on the basis of the objectives of the research or sample done on purpose. Nworgu (2015) pointed out that when there is element of interest among members of

population, the researcher is free to purposefully select its sample.

The instrument used for data collection is chemical reaction Performance and retention Test (CRPRT); the instrument comprised 30 multiple-choice questions with four options each (A–D). The items were constructed to align with the curriculum objectives and the content taught during the intervention phase of the study. Each item is scored dichotomously: 1 mark for a correct answer and 0 for an incorrect one, yielding a maximum score of 30.

RESULTS

Questions 1:

What are the posttest scores of students when taught chemical reaction concepts of chemistry using computer Conventional Teaching Methods and Drill-and-Practice in Katsina Metropolis?

Table 1. Mean and Standard Deviation of posttest scores of Students Taught Using conventional teaching Methods and computer Drill-and-Practice

Group	N	Mean	S. D	Mean diff
Drill and Practice	64	13.2656	3.44223	4.9056
Conventional	50	8.3600	3.70196	

Table 1 shows descriptive mean and standard deviation of statistical difference that exist between performance of students taught chemical reaction concepts of chemistry using drill-and-practice and those taught using conventional teaching method in secondary schools in Katsina Metropolis. The mean performance of students taught chemical reaction using drill-and-practice and conventional teaching method were 13.27 and 8.36 respectively with a mean performance difference of 4.91 in favour of

those taught using drill-and-practice. This implies that the mean performance of students taught chemical reaction with drill-and-practice is higher than those taught with conventional teaching method.

Questions 2:

What is the retention ability of students when taught chemical reaction concepts of chemistry using a drill-and-practice instructional strategy in Katsina Metropolis?

Table 2: Mean and Standard Deviation on retention ability of Students Taught Using Computer Drill-and-Practice

Group	N	Mean	SD	Mean diff
Drill and Practice	64	13.5938	3.49021	7.7938
Conventional	50	5.8000	2.73302	

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Table 2 shows descriptive mean and standard deviation of statistical difference that exist between retention ability of students taught chemical reaction using drill-and-practice and those taught using conventional teaching method in secondary schools in Katsina Metropolis. The retention ability of students taught chemical reaction concept using drill-and-practice and conventional teaching method were 13.59 and 5.80 respectively with a mean retention ability difference of 7.79 in favour of drill-and-practice.

This implies that the retention ability of students taught using drill-and-practice is higher than those taught using conventional teaching method.

Hypotheses

H₀₁: There is no significant difference in the academic performance of students taught chemical reaction concepts of chemistry using computer drill-and-practice, and those taught using conventional teaching Methods in Katsina Metropolis

Table 3: Independent t-test Statistics on Difference between Academic Performance of Student's Taught Using Experimental and Control Group

Group	N	Mean	DS	Mean Difference	df	t	P
Experimental	64	13.2656	3.44223	4.0908	112	7.307	0.000
Control	50	8.3600	3.70196				

$P=0.000<0.05$, $t_{\text{computed}}=7.307>1.98$ at $df=112$

Table 3 shows independent t-test statistics, significant difference exist between the performance of students taught chemical reaction concept using drill-and-practice and those taught using conventional teaching method (Experimental and Control Group) in secondary schools in Katsina Metropolis. Reason being that The calculated p value of 0.00 is lower than the 0.05 alpha level of significance and the computed t value of 7.307 is greater than the 1.98t critical at df 112. The mean performance of students taught chemical reaction concept using drill-and-practice and those taught using conventional were 13.27 and 8.36 respectively indicating a mean

performance difference of 4.09 in favour of those taught using the drill-and-practice teaching methods. This shows that the intervention of the method has had great effect on the performance of the students. Therefore, the null hypothesis which states that there is no significant difference the mean performance of students taught using computer drill and practice and those taught using conventional teaching method is hereby rejected.

H₀₂: There is no significant difference in the retention ability of students taught chemical reaction using computer drill-and-practice and those taught using conventional teaching Methods in Katsina Metropolis

Table 4: Independent t-test Statistics on Difference between Retention Ability of Students Taught using Experimental and Control Group

Group	N	Mean	DS	Mean Difference	df	t	P
Experimental	64	13.5938	3.49021	7.79375	112	12.980	0.000
Control	50	5.8000	2.73302				

$P=0.000<0.05$, $t_{\text{computed}}=12.980>1.98$ at $df=112$

Table 4 shows independent statistics, significant difference exist between the retention ability of students taught chemical reaction concept using drill-and-practice and those taught using conventional teaching method (Experimental and Control Group) in secondary

schools in Katsina Metropolis. Reason being that the calculated p value of 0.000 is lower and the 0.05 alpha level of significance and the computed t value of 12.98 is greater than the 1.98 t-critical at df 112. The mean retention ability of students taught chemical reaction using drill-and-practice and conventional teaching method were 13.59

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and 5.80 respectively indicating a mean retention difference of 7.79 in favour of drill-and-practice. This shows that the intervention of the method has had great effect on retention ability. Therefore, The null hypothesis which States that there is no significant difference between the retention ability of the students taught chemical reaction using computer Drill-and-Practice and those taught same concept using conventional teaching method hereby rejected.

DISCUSSION OF FINDINGS

The finding from the analysis of the research question one shows that significant differences existed between academic performances of students taught chemical reaction concept of chemistry using conventional teaching Methods and Drill-and-Practice instructional strategy in Katsina State. In favour of Drill and practice instructional strategy. This shows that the treatment given is also effective and when maintained very good performance on students in chemical reaction would be maintained and Drill-and-Practice instructional strategy should be employed in teaching chemical reaction as a means of improving students' performance in the subject. This finding is also in conformity with the findings of Lanre (2021), opined that the effectiveness of each of the treatment was not dependent on academic ability and finally that each of the three treatments were effective in improving students' performance. This finding is also in conformity with that of Gachi, (2024), they always encouraged good laboratory habits among technical drawing students and encouraged parents to equip their children with the required materials they need for effective learning of technical drawing. Furthermore, students perceived their teachers effective in preparing and organizing lesson notes adequately as such applied facts and principles to problem-solving.

The finding from the analysis of the research question two shows that the performance of students also declined after some period of time and if the teachers of chemistry will be trained on how to utilize computer packages in teaching and learning there will be high retention ability by the students, this is in consonant with the

recommendation made by Gachi (2024), recommended that federal and State governments should adequately train Chemistry teachers on using Computer-Assisted Instruction in teaching chemistry among others.

CONCLUSION

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

1. Computer Drill-and-Practice also have positive effect on chemistry students' academic performance in chemical reaction Therefore, academic performance is enhanced significantly by using Computer Drill-and-Practice
2. Using computer Drill-and-Practice improve students' retention ability of learnt concept of chemical reaction other words, better retention of learnt concept is achieved by using computer drill-and-practice

RECOMMENDATIONS

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

1. Chemistry teachers should use Computer Drill-and-Practice instructional strategy in teaching chemical reaction concept of chemistry so as to improve the performance of students;
2. Government should encourage teaching using Computer Drill-and-Practice instructional strategy by providing necessary Solar Powered ICT facilities needed for its effective implementation and by sponsoring teachers by organizing seminars, conferences and workshops on learning how to teach using computer drill-and-practice instructional Strategy.

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