

# Effect of Simulation Instructional Method on Undergraduate Chemistry Education Student's Academic Performance in Sodium Reactions

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## Abstract

The purpose of this study is to investigate the effect of simulation methods of teaching on the academic performance of Undergraduate Chemistry Education students of University of Calabar. A sample of 80 students (40 control, 40 experimental) who studied in the Department of Science Education (Chemistry unit) of the University of Calabar was used for the study. Students who were admitted during the 2017-2018 academic year participated in the research. Quasi experimental pretest posttest design was used for the research. The Chemistry achievement test (Cat) was the instruments used for collection of data. Kuder Richardson formula was used for reliability test. The calculated reliability coefficient was 0.86. Statistical results of the data obtained after the research showed that students of the experimental group who were taught using simulations had higher academic achievement than the control group who were taught using the traditional approach.

**Keywords:** Sodium reaction, potassium reaction, Science education, simulation-based education, group 1.

## Introduction

Sodium reactions are some of the vital chemical reactions considered key topic in Chemistry education. Due to sodium violent reactions, experiments with sodium are almost if not totally not carried out in school's laboratory. The importance of Sodium in blood pressure effect is increasing daily without students being able to carry out experiments on the reactivity of sodium.

Sodium is a highly reactive chemical element that belong to group 1 of the periodic Table of elements. Its valence electrons are in the s orbitals and are therefore referred to as s block elements. Sodium forms a wide variety of chemical compounds that are very useful. Sodium is highly reactive. It readily reacts with oxygen and water. When a tiny piece of sodium is added to water, it shows a highly explosive reaction (Madhusha, 2018). This chemical element is highly reactive in nature. For this reason, it is always found in nature only in the form of compounds and not in any free elemental state (<https://sciencestruck.com/sodium-element>, 2019).

In as much as experiments are needed for a Chemistry class to be interesting, it should not be that which can endanger the lives of students. Since sodium metal is very reactive, how then can

students perform experiments with sodium metal and be safe? The concept of simulation come into play. Simulations are instructional out line where students are placed in a "world" prepared by the teacher. This shows a reality within which students interact. The teacher is in charge of the parameters of this "world" and uses it to achieve the desired instructional results. Students experience the reality of the scenario and gather meaning from it (UNSW TEACHING SYDNEY 2019)

Simulation can be said to be the imitation of real-world activities and processes in a safe environment. The purpose of simulations is to present an experience that is close to the 'real thing' as possible. The approach is frequently used in disciplines where students need to develop skills and experience, but safety issues considerations prevent this happening in the real-world. For example, students performing experiments with sodium metal (2014)

Computer simulations is a widely acceptable tool for teaching and learning which combines visual and interactive learning experiences to promotes application of knowledge and provides a simplified representation of real world systems (Eskrootchi & Oskrochi, 2010). Engagement of students in active learning by means of computer simulation leads to enhanced performance and retention of concepts (West & Veenstra, 2012).

Computer simulations can significantly affect and improve attitude of students towards Biology and be effectively used as instructional method in Biology classroom. (Nireti, Morenike, & Joyce, 2014). Computer simulations brings about students' interest and involvement in the learning process, foster retention of information and offers opportunities for affective and behavioral learning (Guy & Lownes-Jackson, 2015).

Sulaiman, Mustapha & Ibrahim (2016) study on the "Effect of Simulation Techniques and Lecture Method on Students' Academic Performance" reported a significant effect of performances of student taught with simulation games technique. Simulation games technique has significant positive impact on students' academic performance at JSS Secondary school level in Mafoni, Maiduguri. In the same vein, other studies by, Dauda (2015) , Adoke (2015), on the effect of simulation games technique on students' academic performance found that simulation games technique was more effective in comparison to other teaching techniques of teaching especially the teacher-centre approaches.

In a simulation-based nursing educational interventions study, the results obtained revealed that simulation was effective with large effects in the psychomotor domain (Junghee, Jin and Sujin, 2016). Devasagayam & Hyat (2007) found evidence that supported the use of computer simulations as a pedagogical device in a cross disciplinary study of finance and marketing courses. Foster et al. (2004) and Helliard et al. (2000) found more specific evidence that a market-share game can improve student learning in undergraduate finance courses.

Moffit, Stull & McKinney (2010) found out that students benefited from simulation, as grades in the post-exams are significantly higher than in the pre-exams, which suggests an increased understanding of fundamental financial knowledge. Olorukooba, Sanda & Suleiman (2016) study on "The Impact of Computer Simulations on Performance and Retention of Students" reported that students taught with computer simulation performed better than those taught using lecture method and was gender friendly.

Previous researches reviewed presented that simulation has positive effect on students' academic performance. The effect of simulation on the teaching of sodium and its' reaction on the academic performance of students among science education undergraduates students in University of Calabar prompted the researcher to investigate the relationship existing among these variables Recognizing s the effect of simulation teaching method towards the teaching of sodium and its' reactions will enable the University to design and implement educational interventions with the goal of enhancing their academic performance and the quality of their learning experiences.

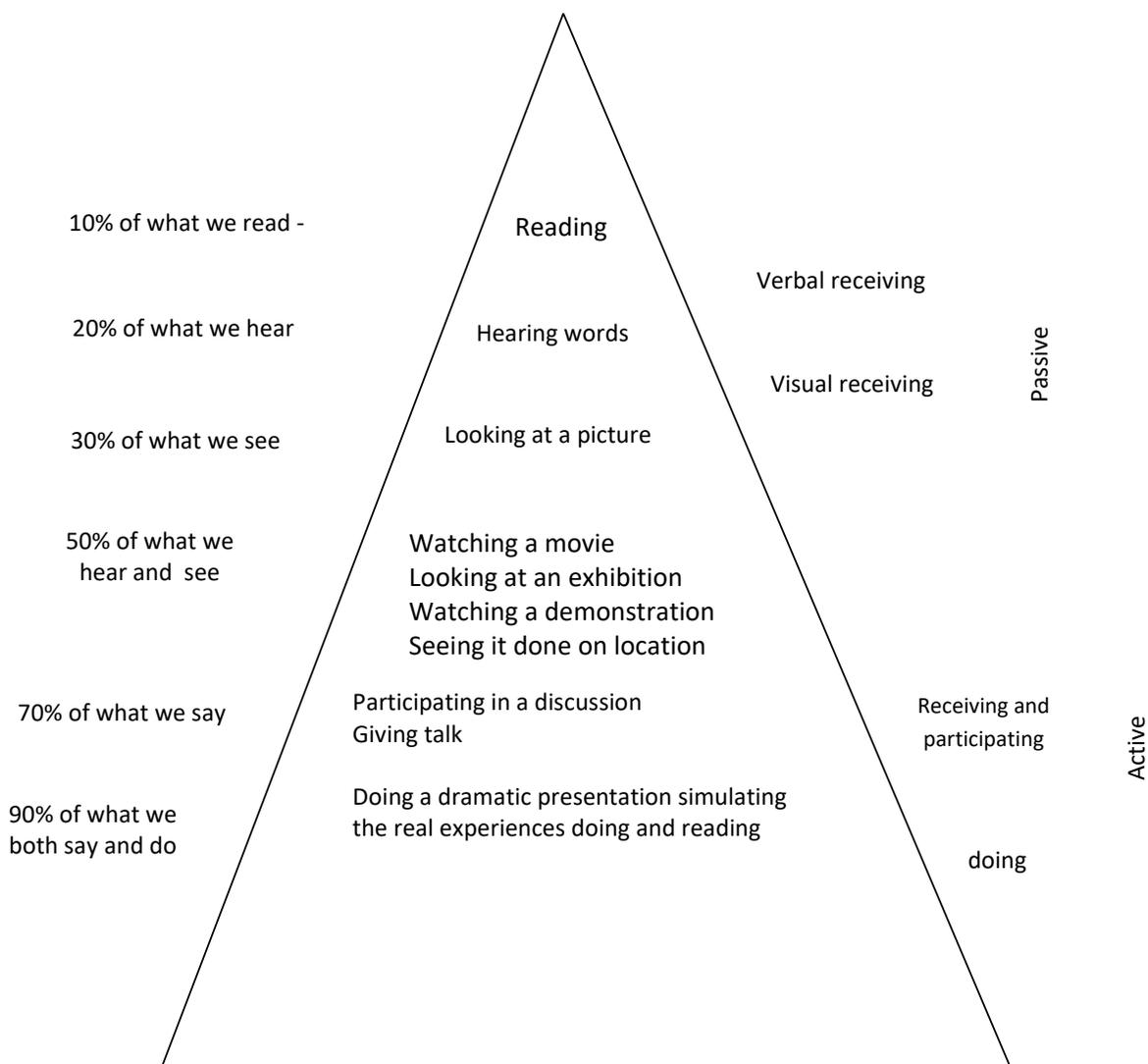
Rogers (1969) argues that "much significant learning, is acquired by doing" and that learning is facilitated when the student is a responsible participant. Vygotsky states that learning takes place in a social context and that interaction is with others (Palinscar, 2005).

Active learning offers a paradigm for students learning that differs from the traditional lecture method based, model (Johnson, Roger & Karl, 2006) Difference in provision learning and amount of learning is obvious from (Edgar, 1969) cone of learning.

The student/teacher interaction, student/student interaction, small group interaction and entire group interaction are essential in teaching and learning. Students are therefore encouraged to say and do when simulation teaching method is used. Teachers who are concerned with students' emotional, social and academic needs have been found to encourage more students' involvement in lessons.

The cone of learning shows that learners only remember 10% of what they read, 20% of what they hear, 30% of what they see 50% of what they hear and see, 70% of what they say and 90% of what they say and do.

**Figure 1:** Audio–visual methods in teaching (after Edgar)



### Statement of Problem

Sodium is an important and fundamental element in Chemistry in education. The study of sodium offers insights into the way the sodium dissolves in the blood and plays a key role in **maintaining blood pressure**. Sodium helps control blood pressure and regulates the function of muscles and nerves, which is why sodium concentrations are carefully controlled by the body. However, most people consume far more sodium than their bodies need. As important as it is, it is also one of the most

difficult topics. Various research studies have identified different difficulties associated with teaching and learning of sodium. One of the problems is the abstract nature of the topic because of its reactivity, experiments cannot be carried out in the laboratory by students. Therefore, many students have difficulties in visualizing the concept because the processes involved are not physically observable. It has been observed that teachers in Nigeria constantly used conventional method in teaching the concept and avoid simulations, there by ignoring the use of media technology to improve students' learning. In pedagogy, visualization aids student understanding of complex processes because it enables students to convert imaginary concept into a visual object that can be mentally manipulated. This study therefore sought to investigate the effect of simulation instructional method on the academic achievement of undergraduate Chemistry students in the concept sodium.

### Purpose of Study

The purpose of this study was to investigate the effect of simulation instructional method on the academic performance of undergraduate Chemistry students in the concept sodium. One null hypothesis was formulated to guide the study. It stated thus: There is no significant difference in the academic performance of chemistry students taught sodium with and without simulation instructional method.

### Methodology

The research design was pretest-posttest control group quasi-experimental design. The research was carried out in the Department of Science Education (Chemistry unit) of the University of Calabar Education. The students who were admitted in the 2017-2018 academic year participated in the research. A total of 80 students (40 experimental and 40 control) were selected using the stratified random and purposive sampling methods. The experimental groups were taught using simulation instructional method while the control group was taught using conventional teaching method without simulation. A 60-item five-response option objective test (Chemistry achievement test, CAT) developed by the researchers was used as the pretest and posttest. The reliability of CAT was estimated to be 0.81. Treatment lasted for a period of six weeks. Both the experimental group and the control groups were taught by their lecturers. The data collected using CAT were analyzed using Analysis of covariance ANCOVA with pretest as covariate.

**Table 1:** Mean, standard deviation and summary of analysis of covariance of influence of treatment on undergraduate Chemistry students' performance in Sodium

Treatment group	N	$\bar{x}$	SD
Experimental	40	47.67	9.19
Control	40	16.83	6.40
<b>Total</b>	<b>80</b>	<b>32.25</b>	<b>17.35</b>

Source of variation	Sum of squares	df	Mean squares	F	Sig level	Partial Eta square
Corrected Model	48325.314	2	28552.405	546.711	.000*	.723
Intercept	27238.353	1	27238.353	537.777	.000*	.688
Pretest	2173.743	1	2173.743	41.669	.000*	.143
Treatment	54686.541	1	54686.541	1132.341	.000*	.712
Error	11422.352	112	43.223			
<b>Total</b>	<b>321566.000</b>	<b>80</b>				
<b>Corrected total</b>	<b>71951.000</b>	<b>79</b>				

R-Squared = .723 (adjusted R=.720) F-critical = 3.86 \* P<.05

The result of the analysis displayed on Table 1 showed that students taught sodium using simulation instructional method had higher mean performance ( $x = 47.67$ ) in comparison to those taught without simulation which had mean of  $x = 16.833$ . The result of the analysis as displayed in Table 1 revealed a high significant F-ratio of 1132.341 for treatment (simulation).

The null hypothesis which speculated that there is no significant difference between the academic performance of undergraduate Chemistry Education students taught sodium with simulation instructional method and those taught without was rejected and the alternate hypothesis accepted. This was because the F-ratio 1132.341 was found to be greater than the critical F-ratio of 3.86 needed to reject the null at .05 alpha levels with 1 and 73 degrees of freedom.

## Discussion of Findings

The hypothesis sought to find out if there was any significant difference in the effect of simulation instructional method and normal science teaching on Undergraduate Chemistry Education students' performances in sodium. The result of the analysis displayed in Table 1 earlier revealed that students taught sodium using simulation teaching method had higher mean performance of  $x=47.67$  in comparison to those taught sodium without simulation instructional method who had a mean score of  $x=16.833$ . When the means were subjected to Analysis of Covariance, there was a significant difference in the result as the calculated F-value of 1132.341 was higher than the critical F-value of 3.86. This highly significant difference between the groups is probably due to the treatment main effect (simulation instructional method) rather than the effect of random fluctuation.

This study showed the importance and significant role played by simulation instructional method on students' achievement, especially in Chemistry. They have positive influence in achievement in Chemistry. This explains why a subject like Chemistry will require activities/experiment that can convert topics that seem imaginary to concrete for students' understanding. It made students to use their intellectual ability during the learning and teaching process. This finding agreed with that Sulaiman, Mustapha & Ibrahim (2016) that discovered that student taught with simulation games technique had a significant positive impact on students' academic performance. Earlier studies by Dauda (2015), Adoke (2015), on the effect of simulation games technique on students' academic performance also found that simulation games technique was more effective in comparison to other teaching techniques of teaching especially the teacher-centre approaches.

This study also collaborated work done by (Junghee, Jin and Sujin, 2016), Devasagayam & Hyat (2007), Foster et al. (2004) and Helliari et al. (2000) whose works found a positive between simulation and academic performance. This study is also in agreement with the findings of Moffit, Stull & McKinney (2010), Olorukooba, Sanda & Suleiman (2016) that reported that students taught with computer simulation performed better than those taught using lecture method.

This work is a bit at variance with that Steven & Mark (2011) study on "The Influence of Simulation Performance on Student Interest" which found out that simulation performance has no significant influence on the students' feelings about their knowledge attainment or their level of interest in the discipline.

## Conclusion

The study showed the importance and significant role played by simulation instructional method on students' achievement, especially in Chemistry. They have positive influence in achievement in Chemistry. This explains why a subject like Chemistry will require activities/experiment that can convert topics that seem imaginary to concrete for students' understanding. It made students to use their intellectual ability during the learning and teaching process. It encouraged creativity, bringing learning homewards and often improved and enhanced students' achievement.

Students in the control groups forgot what they learnt than students in the experimental group.

### **The Implication for Basic Science and Mathematics Teaching**

The teaching of Basic Science and Mathematics can be more effective if teachers get students/pupils to be actively engaged in student-student or instructor-student conversations. The learning effectiveness of instructional simulation rests on actively engaging students in problem solving, transferring knowledge to new problems and situations. It brings about understanding and refining students' thought processes. Seeing social processes and social interactions in action.

### **Recommendations**

Based on the findings of this research, it was recommended that:

1. Teachers use simulation instruction method to teach chemistry.
2. Education stakeholders should provide simulation garget in schools.
3. Teacher should be trained on how to use simulation instructional method.

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