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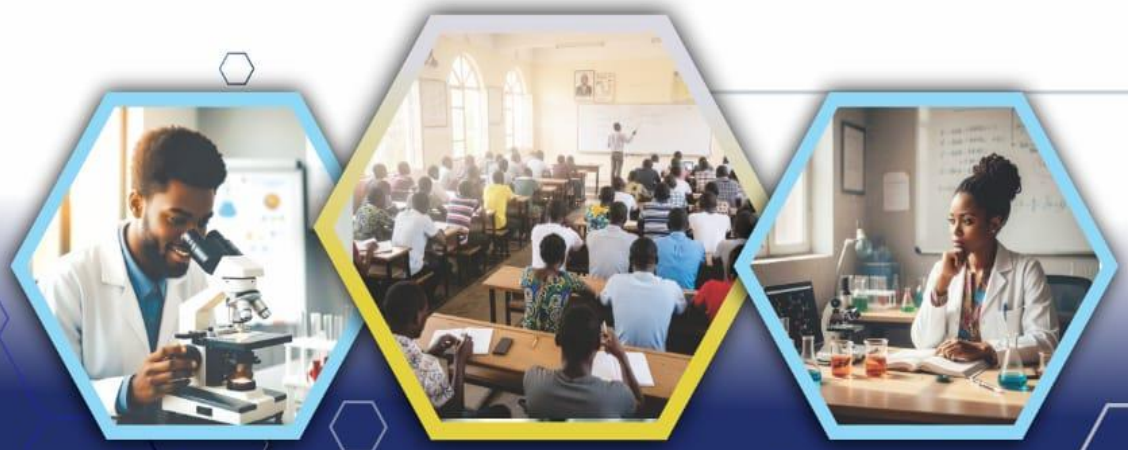

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EFFECT OF SIMULATION INSTRUCTIONAL PACKAGE ON STUDENTS' INTEREST AND ACHIEVEMENT IN ELECTROLYSIS IN NASARAWA-EGGON LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA

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Abstract

This study investigated the Effect of Simulation Instructional Package on Students Interest and Achievement in Electrolysis in Nasarawa-Eggon Local Government Area of Nasarawa State. The population of the study consists of 1,128 SS2 Chemistry students in public senior secondary schools in Nasarawa-Eggon Local Government Area of Nasarawa State. 719 of the total population are males, while 409 are females (NSME 2023/ 2024). The sample comprises two intact classes with 95 SS2 students. The design that was used is quasi-experimental of pre-test, and post-test non-equivalent control group design. Nine 9 research questions were raised in relation with nine objectives of the study and nine correspondent hypotheses were postulated to guide the study. A multi-stage random sampling technique was used for the study. The instruments that were used are Electrolysis Achievement Test (EAT), and Electrolysis Interest Rating Scale (EIRS). The validity indices were established at 0.73 for EAT. The reliability coefficient of the instruments were determined using Kuda-Richardson (KR-21) formula for EAT and Cronbach Alpha for EIRS. Their reliability indices were 0.79 for EAT and 0.90 for EIRS. Descriptive statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of ANCOVA was used to test the hypotheses at 0.05 level of significance. The findings of this study revealed that there was high significant difference between the mean interest and achievement scores of the experimental group (simulation instructional package) and control group (conventional instructional method), suggesting that students achieve better knowledge when using simulation instructional package than conventional instructional method. It was recommended that Chemistry teachers should be encouraged to adopt simulation instructional package in teaching electrolysis.

Keywords*:* Students, Interest, Achievement, Electrolysis, Simulation Instructional Package

Introduction

It is a truism that there is a rapid development in the world today and every nation strives to meet up with the requirements needed for development. Nations do so through the instrumentality of science and technology. Science and technology therefore, becomes the factory that produces technologists, technicians, craftsmen and skilled artisans who are required to change the economy and fortunes of any nation. Hence, scientific and technological skills acquisition is necessary for nations to cope with today's challenges (Toyin & Ojobola 2021). Therefore, the contributions of science and technology to overall development of all nations cannot be over-emphasized. This is the reason science holds an important position in the curriculum of Nigeria's educational system.

Chemistry occupies a vital position in Nigeria's educational curriculum because it deals with the study of matter and provides foundational knowledge for science, technology, and many professional fields such as medicine, engineering, and pharmacy. As a practical science, chemistry equips learners with essential scientific skills and has wide applications in everyday life, contributing significantly to technological advancement and improved quality of life. Because chemistry relates directly to the environment and daily human activities, it should be taught in a way that is practical and meaningful rather than abstract.

Despite its importance, students' achievement in chemistry has remained persistently low over the years, largely due to the continued use of conventional, teacher-centered teaching methods that are boring and ineffective. These traditional approaches emphasize rote learning, limit student participation, and reduce interest in the subject. In contrast, activity-based learning approaches such as Computer Assisted Instruction and simulation-based teaching promote active student engagement by replicating real-life situations. Simulation instruction, in particular, makes learning interactive and participatory, helping students better understand complex concepts and move chemistry away from abstraction.

Agu and Samuel (2018) observed that the use of simulation instructional strategies in science teaching yields positive learning outcomes over time by allowing learners to manipulate variables and observe the consequences of their actions. Simulation instruction emphasizes the reconstruction of realistic situations and promotes genuine learner interaction, making it effective for enhancing students' interest and understanding of electrolysis in chemistry (Davidson & Verhagen, 2017). Electrolysis, which is a core

concept in both physics and chemistry curricula, represents an important scientific development that introduces a new source of electric force through chemical reactions rather than mechanical means (Azaiza et al., 2016).

Electrolysis involves the chemical decomposition of an ionic compound through the passage of direct current in a molten state or aqueous solution, and it occurs in an electrolytic cell consisting of electrodes immersed in an electrolyte (Ojokuku, 2017). Because the process is visually observable, it can benefit significantly from simulation-based instructional packages. Conventional teaching methods often lead students to memorize scientific concepts without deep understanding, resulting in poor conceptualization and persistent misconceptions (Orinya et al., 2021). To address these challenges, computer-assisted instruction has been identified as an effective strategy for improving understanding and reducing misconceptions in science learning (Orinya et al., 2021; Chang, 2019). Hence, this study adopts a simulation instructional package to enhance students' understanding of electrolysis.

Interest is defined as a feeling of curiosity and attraction toward activities perceived as valuable and beneficial, which motivates learners to engage willingly in learning tasks (Okoye et al., 2015). It serves as a key motivational factor in the teaching–learning process and significantly influences students' achievement and retention in science education (Galle et al., 2022). Notably, interest promotes intrinsic motivation, which sustains students' engagement and participation in learning activities. Interest is described as a psychological state that accompanies and stimulates attention, involving feelings that direct an individual's focus toward a learning activity (Mohammed, 2017). From a psychological perspective, interest can be classified into individual interest, which is a stable personal disposition across situations, and situational interest, which arises from environmental factors (Egolum et al., 2022). Situational interest may be triggered or maintained depending on instructional conditions, and in educational measurement, interest is regarded as an important motivational construct (Okeke et al., 2016).

Students' interest in chemistry can be enhanced through the careful selection of appropriate teaching methods, as the conventional teaching approach commonly used in Nigerian secondary schools is often teacher-centered, monotonous, and discourages active student participation (Egolum, 2022). Such methods reduce students' engagement and interest in

chemistry, whereas learner-centered strategies are more likely to stimulate and sustain interest.

Achievement refers to the successful accomplishment of academic tasks through ability, effort, skill, and perseverance (Akani, 2017; Galle, 2021). It serves as a measure for determining students' level of learning and for evaluating the effectiveness of instructional methods (Akani, 2017; Kabutu et al., 2015). Achievement is also regarded as a key indicator of academic performance and educational effectiveness, reflecting the extent to which learners attain specific instructional goals within educational settings (Suhaini et al., 2020; Kabutu et al., 2015). Nevertheless, achievement is the knowledge acquired and skills developed in schools (Galle, 2022). It describes the scholastic standing of the student at any given time. The scholastic standing could be expressed in terms of scores obtained in test and examination whether internal or external. In his view, Hanushek et al (2015) see achievement as the level of attainment of a person in an examination, that is, how an individual is able to demonstrate his or her ability in an examination. On his part, Ejesi (2014) viewed achievement as the outcome of education to the extent to which a student, teacher or institution have attained their educational goal.

Objectives of the Study

The objective of this study was to investigate the effects of simulation instructional package on student's interest and achievement in electrolysis in Nasarawa State, Nigeria. The specific objectives of the study are to:

1. determine the effects of using simulation instructional package on interest of students in electrolysis.
2. determine the effects of using simulation instructional package in the interest of male and female students in electrolysis.
3. find out the effects of using simulation instructional package on achievement of the students in electrolysis.
4. ascertain the effects of using simulation instructional package on achievement of male and female students in electrolysis.

Research Questions

The following research questions guided the study:

1. What are the mean interest ratings of students taught electrolysis using simulation instructional package and those taught using the conventional instructional method?
2. What are the mean interest ratings of male and female students taught electrolysis using simulation instructional package and those taught using conventional instructional package?

3. What are the mean achievement scores of students taught electrolysis using simulation instructional package and those taught using conventional instructional method?
4. What are the mean achievement scores of male and female students taught electrolysis using simulation instructional package and those taught using conventional instructional method?

Statement of the Hypotheses

The following null hypotheses formulated were tested at 0.05 confidence level.

H_{01}: There is no significant difference in the mean interest ratings of students taught electrolysis using simulation instructional package and those taught using conventional instructional method.

H_{02}: There is no significant difference in the mean interest ratings of male and female students taught electrolysis using simulation instructional package and those taught using conventional instructional method.

H_{03}: There is no significant difference in the mean achievement scores of students taught electrolysis using simulation instructional package and those taught using conventional instructional method.

H_{04}: There is no significant difference in the mean achievement scores of male and female students taught electrolysis using simulation instructional package and those taught using conventional instructional method.

Research Methodology

The study adopted a quasi-experimental research design of pre-test, post-test and post-posttest control group. The target populations for this study comprised all 1128 SS2 Chemistry students in Public Senior Secondary Schools in Nasarawa-Eggon Local Government Area of Nasarawa State. 719 of the total population are males, while 409 are females. All the schools were co-educational Senior Secondary Schools in Nasarawa-Eggon Local Government Area of Nasarawa State for 2024/2025 academic session. A sample of 95 SS2 students (58 males and 37 females) was used for the study. Simple random sampling techniques was used to select schools for the study.

The Electrolysis Interest Rating Scale (EIRS): The EIRS comprised 20 items that was developed by the researcher. EIRS was designed to determine student's interest in electrolysis. EIRS was rated using a four-point scale. The options are Strongly Agreed (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points, Strongly Disagreed (SD) = 1 point.

Electrolysis Achievement Test (EAT): The academic achievement of SS2 students in electrolysis was measured using Electrolysis Achievement Test (EAT). It was adopted by the researcher from WAEC for the study.

The Electrolysis Interest Rating Scale (EIRS) and Electrolysis Achievement Test (EAT) were validated by three experts from the Department of Science, Technology, and Mathematics Education, Nasarawa State University, Keffi. Validation focused on the relevance, comprehensiveness, and adequacy of the instruments. Expert ratings for both instruments yielded indices of 0.88, 0.79, and 0.66, with an average validity index of 0.77, indicating suitability for data collection. Both instruments were trial-tested on 25 SS2 chemistry students from Government Secondary School, Aloce, Nasarawa-Eggon LGA, who were not part of the main study sample. Reliability was established using Cronbach's Alpha for EIRS (0.903) and KR-21 for EAT (0.79), with an internal consistency coefficient for ERT of 0.81. These values indicate acceptable reliability, confirming the instruments' appropriateness for the quasi-experimental study. The data collected from the study was analyzed using descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.

Results

Data collected from the study were analyzed and the results are as follows:

Research Question 1

What are the mean interest ratings of students taught electrolysis using simulation instructional package and those taught using the conventional instructional method?

The data analysis for answering this question is presented in Table 1

Table 1: Mean and Standard Deviation of Students Taught Electrolysis Using Simulation Instructional Package and Conventional Method

Group		PreInterest	PostInterest
Simulation	Mean	32.27	50.48
	N	48	48
	Std. Deviation	8.634	9.516
Conventional	Mean	37.21	48.64
	N	47	47
	Std. Deviation	11.373	7.511

Table 4.1 shows post mean interest rating scale scores of the experimental group (students taught electrolysis using simulation instructional package) is 50.48 with standard deviation of 9.516 and that of the control group (students taught electrolysis using conventional method) is 48.64 with standard deviation of 7.511. This means that the experimental group had more interest after being exposed to treatment.

Null Hypothesis 1

There is no significant difference in the mean interest ratings of students taught electrolysis using simulation instructional package and those taught using conventional method.

The null hypothesis (Ho1) tested the difference in the mean interest rating of students that were taught using simulation instructional package and those taught using conventional method. The testing was carried out using ANCOVA as shown in Table 2

Table 2: Result of ANCOVA on Interest Ratings of Students taught Electrolysis Using Simulation Instructional Package and Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1702.978[a]	2	851.489	14.983	0.000	0.246
Intercept	8947.688	1	8947.688	157.448	0.000	0.631
PreInterest	1622.503	1	1622.503	28.550	0.000	0.237
Group	**338.269**	**1**	**338.269**	**5.952**	**0.017**	**0.061**
Error	5228.327	92	56.830			
Total	240349.000	95				
Corrected Total	6931.305	94				

a. R Squared = .246 (Adjusted R Squared = 0.229)

Table 2 reveals that the noted differences between the mean interest ratings on electrolysis of the students taught using simulation instructional package and those taught using conventional method is significant at 0.05 alpha level. This is from the fact that F (1,92) = 5.952; P = 0.017 < α = 0.05; the null hypothesis is therefore rejected. This implies that, there was significant difference in the mean interest ratings.

Research Question 2

What are the mean interest ratings of male and female students taught electrolysis using simulation instructional package?

Data that was used to answer this research question is presented in Table 4.3.

Table 3: Mean and Standard Deviation of Mean Interest Ratings of Male and Female Students Taught Electrolysis Using Simulation Instructional Package

GenderSim		PreInterest	PostInterest
	Mean	33.20	51.10
Male	N	30	30
	Std. Deviation	8.907	9.636
	Mean	30.72	49.44
Female	N	18	18
	Std. Deviation	8.166	9.494

Table 3 Shows mean interest ratings of male and female students taught electrolysis using simulation instructional package. For the female students, the mean post interest rating is 49.44 with the standard deviation of 9.494, while the male has 51.10 post interest rating means with 9.636 standard deviation. From the results, male and female students taught electrolysis using simulation instructional package had higher interest rate than their female counterpart.

Hypothesis 2

There is no significant difference in the mean interest ratings of male and female students taught electrolysis using simulation instructional package.

The null hypothesis (Ho2) tested the differences in the mean interest ratings of male and female students that were taught electrolysis using simulation instructional package. The result of the test is shown in Table 4.

Table 4: Result of ANCOVA on Interest Ratings of Male and Female Students Taught Electrolysis Using Simulation Instructional Package

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	947.814[a]	2	473.907	6.446	0.003	0.223
Intercept	3564.942	1	3564.942	48.493	0.000	0.519
PreInterest	916.979	1	916.979	12.473	0.001	0.217
GenderSim	**1.553**	**1**	**1.553**	**0.021**	**0.885**	**0.000**
Error	3308.165	45	73.515			
Total	126567.000	48				
Corrected Total	4255.979	47				

a. R Squared = .223 (Adjusted R Squared = 0.188)

Table 4 shows the summary of ANCOVA test on mean interest ratings of male and female students in electrolysis when taught using simulation instructional package. The results reveals that the noted differences between the mean interest ratings of the male and female students taught electrolysis using simulation instructional package is not significant at 0.05 alpha level. This is from the fact that $F(1,45) = 0.021$, $P = 0.885 > \alpha = 0.05$, the null hypothesis was therefore not rejected. This means that there is no significant difference in the mean interest ratings when simulation instructional package was used to teach electrolysis to both male and female students.

Research Question 3

What are the mean achievement scores of students taught electrolysis using simulation instructional package and those taught using conventional instructional method?

Table 5: Mean and Standard Deviation of Students' Taught Electrolysis Using Simulation Instructional Package and Conventional Instructional Method

Group		Pretest	Posttest
Simulation	Mean	17.27	58.58
	N	48	48
	Std. Deviation	8.437	12.212
Conventional	Mean	20.45	52.91
	N	47	47
	Std. Deviation	9.306	9.029

Table 5 shows that the post-test achievement scores of the experimental group is 58.58 with standard deviation of 12.212 and that of the control group is 52.91 with standard deviation of 9.029, this means that the experimental group achieved higher than the control group after being exposed to treatment.

Hypothesis 3

There is no significant difference in the mean achievement scores of students taught electrolysis using simulation instructional package and those taught using conventional instructional method. The result of the test is shown in Table 5.

Table 6: Result of ANCOVA on Achievement Scores of Students Taught Electrolysis Using Simulation Instructional Package and Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6726.662[a]	2	3363.331	64.522	0.000	0.584
Intercept	25410.604	1	25410.604	487.474	0.000	0.841
Pretest	5963.630	1	5963.630	114.405	0.000	0.554
Group	**1674.500**	**1**	**1674.500**	**32.123**	**0.000**	**0.259**
Error	4795.696	92	52.127			
Total	307095.000	95				
Corrected Total	11522.358	94				

a. R Squared = .584 (Adjusted R Squared = 0.575)

Table 6 shows the summary of ANCOVA test on the mean achievement scores of students taught electrolysis using the simulation instructional package and those taught using conventional instructional method. The results revealed that, the noted differences between the mean achievement scores of students taught electrolysis using simulation instructional package and those taught using conventional instructional method is significant at 0.05 alpha level. This is from the fact that $F(1,92) = 32.123$, $P = 0.000 < \alpha\ 0.05$ level of significant significance, implying that there was significant difference in the mean scores of students achievement when simulation instructional package and conventional method were used, this is because the p-value 0.000 is less than alpha level 0.05, therefore the hypothesis is rejected**.**

Research Question 4

What are the mean achievement scores of male and female students taught electrolysis using simulation instructional package?

Table 7: Mean and Standard Deviation of Male and Female Students Taught Electrolysis Using Simulation Instructional Package

GenderSim		Pretest	Posttest
	Mean	18.17	61.03
Male	N	30	30
	Std. Deviation	9.225	13.197
	Mean	15.78	54.50
Female	N	18	18
	Std. Deviation	6.916	9.326

Table 7 shows the mean scores and standard deviation of male and female students taught electrolysis using simulation instructional package. The table reveals that the male students' had a mean score of 18.17 and 61.03 with the standard deviation of 9.225 and 13.197 in the pre-test and post- test respectively, while the female students had mean score of 15.78 and 54.50 with standard deviation of 6.916 and 9.326 in the pre-test and post-test respectively

Hypothesis 4

There is no significant difference in the mean achievement scores of male female students taught electrolysis using simulation package.

The result of the test is shown in Table 8.

Table 8: Result of ANCOVA on Achievement Scores of Male and Female Students' Pre-test Using Simulation Instructional Package

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6046.828[a]	2	3023.414	141.305	0.000	0.863
Intercept	11559.594	1	11559.594	540.258	0.000	0.923
Pretest	5566.628	1	5566.628	260.166	0.000	0.853
GenderSim	**129.197**	**1**	**129.197**	**6.038**	**0.018**	**0.118**
Error	962.839	45	21.396			
Total	171746.000	48				
Corrected Total	7009.667	47				

a. R Squared = .863 (Adjusted R Squared = 0.857)

Table 8 shows the summary of ANCOVA test on the influence of gender on student's achievement when taught electrolysis using simulation instructional package. The results revealed that the noted differences on the influence of gender on student's achievement when taught electrolysis using simulation instructional package is significant at 0.05 alpha level. This is from the fact that the $F(1,45) = 6.038$, $P = 0.018 < \alpha\ 0.05$, which implies that there is significant difference between the male and female students taught electrolysis using simulation instructional package. Since the p-value 0.018 is less than alpha level 0.05 the null hypothesis is rejected.

Discussion of Findings

The findings of this study revealed the effect of simulation instructional package on students' interest, and achievement in electrolysis.

Findings from this study revealed that there was significant difference in the mean interest ratings of students' taught electrolysis using simulation instructional package and those taught, using conventional instructional method. This finding is in agreement with the finding of Jeremiah and Aghogho (2019) who investigated the effect of computer simulation instructional strategy on senior secondary attitude and achievement in genetics, biology in Lagos, Nigeria. The result revealed that the instructional use of computer simulation of pedagogical tool significantly improved the achievement of students and bolstered their attitude.

The findings of this study also revealed that there was a significant difference in the mean achievement scores of students taught electrolysis using simulation instructional package and those taught using conventional instructional method. This finding is in agreement with Ezeudu etal (2017) who investigated the effect of simulation on students' achievement in senior secondary school chemistry in Enugu East, Local Government Area of Enugu state, Nigeria. The study revealed that simulation instructional package increased students' achievement in chemistry more than the conventional method and also, there was no significant difference in the achievement of both male and female students on the chemistry concepts.

Furthermore, the findings of this study revealed that there was significant difference in the mean achievement scores of male and female taught electrolysis using simulation instructional package and those taught using conventional instructional method. The result of this study is not in line with the finding of Emmanuel, et al, (2017) who determined the effects of computer simulation on Secondary School Students' Academic Achievement of Students in Chemistry in Anambra state. The result revealed that computer simulation was more effective in enhancing student's achievement in chemistry than lecture method. There was no significant difference on students achievement due to gender.

The findings of this study also showed that there was significant difference in the mean achievement scores of students taught electrolysis using simulation and those using conventional instructional method. The findings is in agreement with the finding of Orinya, E etal (2021) who investigated the effect of computer simulation instructional package on physics students in electrolysis. The result showed that there was a significant

difference in academic achievement between male and female students taught electrolysis in physics with computer simulation instructional package and those taught with lecture method based on ability level. The findings is also in line with the finding of Agu and Samuel (2018) which investigated the effect of simulation instructional package on achievement and retention of basic science and technology students.

Conclusion

The study concludes that the simulation instructional package is an effective instructional strategy for enhancing students' interest and achievement in the learning of electrolysis. The findings further indicate that the strategy is gender-neutral, as it does not favor either male or female students, thereby making it suitable for inclusive classroom instruction. Evidence from the study shows that replacing conventional teaching methods with innovative approaches such as simulation-based instruction significantly improves students' engagement and academic performance in chemistry. The use of simulation instructional packages helps to reduce psychological barriers associated with gender stereotypes and anxiety, particularly among female students. The strategy also supports slow learners by making lessons more interactive, enjoyable, and meaningful, while simplifying abstract chemistry concepts and correcting misconceptions. Overall, the adoption of simulation-based instructional packages offers a practical and effective approach for improving chemistry teaching and learning at the senior secondary school level.

Recommendations

The following recommendations are made based on the findings of the study.

1. Chemistry teachers should be encouraged to adopt simulation instructional package in teaching electrolysis.
2. Students should be encouraged on the use of simulation instructional package in male and female groups to help reduce gender gap.
3. Chemistry teachers should be trained on how to develop and employ the use of simulation instructional package.
4. Seminars, conferences and workshops should be organized for chemistry teachers to update their knowledge on the use of simulation instructional package.

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