International Journal of Innovative Education Research 10(1):108-115, Jan.-Mar., 2022

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Effectiveness of Simulation Instructional Strategy And Teacher-Demonstration Method On Students' Retention Of Electrolysis in Obio-Akpor Local Government Area of Rivers State

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ABSTRACT
The study compared the effectiveness of Simulation instructional strategy and Teacher-demonstration method on students' retention of the concept of Electrolysis in Obio-Akpor Local Government Area of Rivers State. Three research questions and three hypotheses guided the study. Purposive sampling technique was used to select two of the schools who have well equipped computer laboratories, from which a sample of 84 science students in their intact classes were selected for the study. The research instruments were validated tests named 'Electrolysis Performance Test' and 'Electrolysis Retention Test, while Kuder Richardson-21 (KR-21) formula was used to obtain a reliability coefficient of 0.75. The Research questions were analysed using mean and percentage while the Hypotheses were tested at 0.05 level of significance using Analysis of Covariance. The study found that the students taught using Simulation instructional strategy retained more of the concept of Electrolysis than those taught using Teacher-demonstration method. Also, the female students retained more of the concept than male students though the difference between them in their retention of the concept was not significant, just as the joint effect of gender and group was also not significant. The study thus recommend that Simulation instructional strategy should be used in teaching scientific concepts.
Keywords: Simulation instructional strategy, Teacher-demonstration method, Retention, Electrolysis.

INTRODUCTION

Retention refers to the keeping of information in one's memory for a long time. Retention enables one to remember a knowledge after a long time. Retention of knowledge of concepts learnt in science lessons is very important because the retained knowledge is needed for further studies and application needed for technological advancement of Nigeria. As stipulated in FRN (2014), it is expected that after going through science lessons in Nigerian schools, students should be able to use the knowledge for technological application. It is therefore expedient that teachers teach scientific concepts, not only for understanding but also for retention. This can only be realized when science teachers employ methods and

strategies that will enable not only the understanding of concepts in students, but will also enable retention towards the much needed application of such knowledge.

Electrolysis is a process in which a chemical substance is broken down by the passage of electricity through the substance. The knowledge of Electrolysis is applied in everyday situation for many technologies such as electroplating of tin or iron to produce tin cans used in storage and preservation of food, chrome plating of metals to prevent corrosion, production of chemicals, extraction of metals from their ores and purification of metals. Despite the necessity of the knowledge and application of electrolysis, the concept has been identified to be a difficult concept by students as indicated in the studies conducted by Obomanu and Onuoha (2012) and Akram, Surif and Ali (2014).

Simulation is a process in which the properties of a real life situation or a scientific concept is replicated or imitated. Simulation comes in handy when the experiment or situation is volatile, dangerous, expensive or the materials are not available. For example, simulation of an accident or war scene, in order to teach concepts such as application of first aid. Computer Simulation allows students to interact with the concept in a virtual manner using the computer. Simulation is very useful in teaching abstract scientific concepts.

Olorukooba et al. (2016) found that Computer Simulation enhanced retention in students taught Qualitative Analysis. Similarly, Ayuba (2017) found that Computer-Based Instruction enhanced retention in students taught Algebraic word problems. In the same vein, Ezeaghasi & Obochi (2018) found a significant difference in retention between NCE I students taught cell division concept using Simulation games and those taught using Lecture method, in favour of those taught using Simulation games.

Some other strategies have been found to enhance retention of concepts in students. Fatokun, et al. (2016) found the students taught Periodicity using Games teaching approach retained the knowledge better than those taught using conventional method. Usman et al. (2016) also found a significant difference in retention between pre-service teachers taught Geometry using Van Hiele's Phase-based teaching strategy and those taught using Conventional method, in favour of those taught using Van Hiele's Phase-based teaching strategy. Similarly, Onyema & Olele (2020) found that Blended learning enhanced retention in students. Nwankwo & Okigbo (2021) in the same vein, found a significant difference in retention between students taught electrolysis using Jigsaw teaching strategy and those taught using Conventional method, in favour of those taught using Jigsaw teaching strategy.

Concerning the influence of gender on retention, Eze, et al. (2016) and Fatokun, et al. (2016) found no significant difference in retention between male and female students. Usman et al. (2016) found no significant difference in retention between male and female pre-service teachers. Similarly, Onyema & Olele (2020) and Ibeneme and Akinlabi (2021) found that gender did not influence retention in students. Concerning the joint effect of strategy and gender on retention, Usman et al. (2016) found no significant joint effect of strategy and gender on the retention of pre-service teachers while Ibeneme and Akinlabi (2021) found a significant joint effect of strategy and gender on the retention of students.

Statement of problem

Nigeria is yet to be self-sufficient in terms of technological development. Many technologies used in everyday life are still being imported from foreign countries into Nigeria. Could this situation be due to the inability of students to retain the knowledge of scientific concepts that could lead to their application? In the past years such as 2017 to 2019, West Africa Examination Council Chief Examiner's reports have consistently reported a poor understanding of scientific concepts by students. How will the students retain what they did not understand? What teaching method /strategy can enable the retention of scientific concepts in students? This study therefore seeks to compare the effectiveness of Simulation instructional strategy and Teacher-demonstration method on students' retention of the concept of Electrolysis.

Aim and objectives of the study

The study is aimed at comparing the effectiveness of Simulation instructional strategy and Teacher-demonstration method on students' retention of the concept of Electrolysis in Obio-Akpor Local Government Area of Rivers State. The specific objectives of the study are to:

1. Investigate the effect of Instructional strategy (Simulation instructional strategy and Teacher-demonstration method) on students' retention of the concept of Electrolysis.

2. Determine the influence of students' gender on their retention of the concept of Electrolysis.
3. Determine the joint effect of instructional strategy (Simulation instructional strategy and Teacher-demonstration method) and gender on students' retention of the concept of Electrolysis.

Research Questions

1. What is the effect of Instructional strategy (Simulation instructional strategy and Teacher-demonstration method) on students' retention of the concept of Electrolysis?
2. How does students' gender influence the retention of the concept of Electrolysis?
3. What is the joint effect of instructional strategy (Simulation instructional strategy and Teacher-demonstration method) and gender on students' retention of the concept of Electrolysis?

Hypotheses

H_{01}: There is no significant difference between students taught using Simulation instructional strategy and those taught with Teacher-demonstration method in their retention of the concept of Electrolysis.

Ho_2: There is no significant difference between male and female students in their retention of the concept of Electrolysis.

H_{03}: There is no significant joint effect of instructional strategy (Simulation instructional strategy and Teacher-demonstration method) and gender on students' retention of the concept of Electrolysis.

METHODOLOGY

The study had Quasi-experimental pre-test post-test design. In the study, the dependent variable is students' retention of the concept of Electrolysis, the independent variable is Instructional strategy while the moderating variable is gender. The population of the study consisted of 652 Senior Secondary School 2 (SS2) science students from private secondary schools which have well equipped computer laboratories in Obio-Akpor Local Government Area of Rivers State. Purposive sampling technique was used to select two of the schools which have well equipped computer laboratories, from which a sample of 84 science students in their intact classes were selected for the study. The first school which had 52 students in an intact class constituted the Experimental group while the second school which had 32 in an intact class constituted the Control group. The research instruments were validated tests named 'Electrolysis Performance Test' (EPT) and 'Electrolysis Retention Test' (ERT). EPT was used to gather data on the students' performance while ERT (which was a reshuffled version of EPT) was used to gather data on retention. EPT contained 25 multiple choice questions, with five options of A-E. Each question was scored 4 marks giving a total of 100%. Kuder Richardson - 21 (KR-21) formula was used to obtain a reliability coefficient of 0.75 for the instrument.

Electrolysis Performance Test (EPT) was administered to each group as Pre-test. The Experimental group was then taught the concept of Electrolysis of Copper II Tetraoxosulphate VI ($CuSO_4$) using Simulation instructional strategy while the control group was taught the concept of Electrolysis using Teacher-demonstration method. Thereafter, EPT was administered to each group as Post-test and after two weeks, ERT was administered to them as Retention test. The Research questions were answered using mean and percentage while the Hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA).

RESULTS AND FINDINGS

Research Question 1: *What is the effect of Simulation instructional strategy on students' retention of the concept of Electrolysis?*

Table 1: Mean and mean difference of students' retention scores in experimental and control groups.

Group/Strategy	n	Post-test Mean	Retention test Mean	Mean Difference
Experimental (Simulation)	52	84.35	81.69	-2.66
Control (Teacher – demonstration)	32	69.94	65.75	-4.19

Table 1 shows that the students in the experimental group had a mean difference of -2.66 while the students in the control group had a mean difference of -4.19. This indicates that the students in the experimental group retained more of the concept of Electrolysis than the students in the control group. In other words, the use of Simulation instructional strategy enables higher retention in students.

Hypothesis 1: There is no significant difference between students taught using Simulation instructional strategy and those taught with Teacher-demonstration method in their retention of the concept of Electrolysis.

Table 2: Summary of ANCOVA of students' retention classified by instructional strategies using post-test as a covariate.

Tests of Between-Subjects Effects

Dependent Variable: Retention test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6691.382[a]	2	3345.691	52.111	0.000
Intercept	1561.319	1	1561.319	24.319	0.000
Post-test	1656.649	1	1656.649	25.803	0.000
Group	1011.662	1	1011.662	15.757	0.000
Error	5200.428	81	64.203		
Total	492224.000	84			
Corrected Total	11891.810	83			

a. R Squared = 0.563 (Adjusted R Squared = 0.552)

Table 2 revealed a significant value of $F_{(1,81)} = 15.757$, $p = 0.000$ ($p < 0.05$), the null hypothesis is thus rejected. Hence a significant difference exists between students taught using Simulation instructional strategy and those taught with Teacher demonstration method in their retention of the concept of Electrolysis.

Table 3: Post hoc analysis of students' retention classified by instructional strategies.

Pairwise Comparisons

Dependent Variable: Retention test

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Experimental	Control	8.981*	2.263	0.000	4.479	13.483
Control	Experimental	-8.981*	2.263	0.000	-13.483	-4.479

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

The post hoc analysis shown on Table 3 reveals that the students in the experimental group contributed more to the significant difference the two groups in their retention of Electrolysis.

Research Question 2: How does students' gender influence the retention of the concept of Electrolysis?

Table 4: Mean and mean difference of male and female students' retention scores.

Gender	n	Post-test Mean	Retention test Mean	Mean Difference
Male	53	80.45	76.08	-4.37
Female	31	76.13	74.84	-1.29

Table 4 shows that the male students had a mean difference of -4.37 while the female students had a mean difference of -1.29. This indicates that the female students retained more of the concept of Electrolysis than the male students.

Hypothesis 2: There is no significant difference between male and female students in their retention of the concept of Electrolysis.

Table 5: Summary of ANCOVA of students' retention classified by gender using post-test as a covariate.

Tests of Between-Subjects Effects

Dependent Variable: Retention test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5748.240[a]	2	2874.120	37.894	0.000
Intercept	598.944	1	598.944	7.897	0.006
Post-test	5718.322	1	5718.322	75.393	0.000
Gender	68.520	1	68.520	0.903	0.345
Error	6143.569	81	75.847		
Total	492224.000	84			
Corrected Total	11891.810	83			

a. R Squared = 0.483 (Adjusted R Squared = 0.471)

As shown on Table 5, $F_{(1,81)} = 0.903$, $p = 0.345$ ($p > 0.05$), the null hypothesis is thus retained. Hence there is no significant difference between male and female in their retention of the concept of Electrolysis.

Research Question 2: *What is the joint effect of instructional strategy (Simulation instructional strategy and Teacher-demonstration method) and gender on students' retention of the concept of Electrolysis?*

Table 6: Mean and mean difference of students' retention scores in experimental and control groups classified by gender.

Group	Gender	n	Post-test Mean	Retention test Mean	Mean Difference
Experimental (Simulation)	Male	35	85.43	81.94	-3.49
	Female	17	82.12	81.18	-0.94
Control (Teacher – demonstration)	Male	18	70.78	64.67	-6.11
	Female	14	68.86	67.14	-1.72

Table 6 shows that the female students in the experimental group with a mean difference of -0.94 retained most, followed by the female students in the control group with a mean difference of -1.72. The male students in the experimental group with a mean difference of -3.49 however retained more than the male students in the control group with a mean difference of -6.11.

Hypothesis 2: There is no significant joint effect of instructional strategy (Simulation instructional strategy and Teacher-demonstration method) and gender on students' retention of the concept of Electrolysis.

Table 7: Summary of ANCOVA of interaction of gender and instructional strategies on students' retention using post-test as a covariate.

Tests of Between-Subjects Effects

Dependent Variable: Retention test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6791.573[a]	4	1697.893	26.299	0.000
Intercept	1478.153	1	1478.153	22.896	0.000
Post-test	1701.834	1	1701.834	26.361	0.000
Group	936.815	1	936.815	14.511	0.000
Gender	84.687	1	84.687	1.312	0.256
Group * Gender	30.394	1	30.394	0.471	0.495
Error	5100.237	79	64.560		
Total	492224.000	84			
Corrected Total	11891.810	83			

a. R Squared = 0.571 (Adjusted R Squared = 0.549)

Table 7 shows the interaction of gender and group/instructional strategy on students' retention. It reveals that at $F_{(1,79)} = 14.511$, $p = 0.00$ ($p < 0.05$), group/strategy is significant, at $F_{(1,79)} = 1.312$, $p = 0.256$ ($p > 0.05$), gender is not significant and at $F_{(1,79)} = 0.471$, $p = 0.495$ ($p > 0.05$), the interaction of group and gender is not significant. The null hypothesis is thus retained that there is no significant joint effect of gender and group on the retention of the concept of Electrolysis by the students.

Table 8: Post hoc analysis of students' retention classified by instructional strategies

Pairwise Comparisons

Dependent Variable: Retention test

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Experimental	Control	8.746*	2.296	0.000	4.176	13.315
Control	Experimental	-8.746*	2.296	0.000	-13.315	-4.176

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

The post hoc analysis shown on Table 8 reveals that the students in the experimental group contributed more to the significant difference the two groups in their retention of Electrolysis.

DISCUSSION OF FINDINGS

The students in the experimental group (those taught using Simulation instructional strategy) retained more of the concept of Electrolysis than the students in the control group (those taught using Teacher-demonstration method). This is supported by the significant difference found between students taught using Simulation instructional strategy and those taught with Teacher-demonstration method in their retention of the concept of Electrolysis. This is in favour of students taught using Simulation instructional strategy. This finding may be because Simulation instructional strategy enabled the students to virtually interact with the components of the concept of electrolysis which may have only been imagined because of the abstract nature of the concept. This finding agrees with the finding of Olorunkooba et al. (2016) that Computer Simulation enhanced retention in students taught Qualitative Analysis. The finding also agrees with Ayuba (2017) who found that Computer-Based Instruction enhanced retention in students

taught Algebraic word problems. The finding also agrees with that of Ezeaghasi & Obochi (2018) who found a significant difference in retention between NCE I students taught cell division concept using Simulation games and those taught using Lecture method, in favour of those taught using Simulation games.

The female students retained more of the concept of Electrolysis than the male students. The difference between the male and female in their retention of the concept of Electrolysis was however not significant. This finding agrees with the finding of Eze, et al. (2016) and Fatokun, et al. (2016) who found no significant difference in retention between male and female students. This finding also agrees with that of Usman et al. (2016) who found no significant difference in retention between male and female pre-service teachers. This finding similarly agrees with the finding of Similarly, Onyema and Olele (2020) and Ibeneme and Akinlabi (2021) that gender did not influence retention in students.

The female students in the experimental group retained most, followed by the female students in the control group. The male students in the experimental group also retained more than the male students in the control group. However, the joint effect of gender and group on the retention of the concept of Electrolysis by the students was found not significant. This finding agrees with the finding of Usman et. al. (2016) who found no significant joint effect of strategy and gender on the retention of pre-service teachers. The finding however contradicts the finding of Ibeneme and Akinlabi (2021) who found a significant joint effect of strategy and gender on the retention of students.

CONCLUSION

This study has revealed that the use of Simulation instructional strategy enables higher retention of concepts in students. It has also shown that Simulation instructional strategy enabled female students to retain the knowledge of Electrolysis. This is therefore a wake-up call for Science teachers to incorporate Simulation instructional strategy into the teaching of scientific concepts.

RECOMMENDATIONS

Based on the findings of the study, it is recommended that

1. Simulation instructional strategy should be used in teaching scientific concepts.
2. Simulation instructional strategy should be included as a teaching strategy in the Curricula of Science subjects.

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