

Effects of Computer-Simulation, Field-Trip and Expository Strategies on Gender and Retention of Basic Science Students using, the Concept of Environmental-Pollution in Owerri

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Abstract

This study investigated Effects of Computer-Simulation, Field-Trip and Expository Strategies on gender and Retention of Basic Science students taught the concept of Environmental-Pollution in Owerri, Imo State. A research question and hypothesis guided the study. Quasi-experimental; non-equivalent Control group precisely, Pre-test, Post-test Control group design was used. Population was 3000 JSS1 students of 2020/2021 academic year. Purposive sampling technique was used to select a sample size of 450 JSS1 students from nine schools out of 15 coeducational schools. Researcher developed instrument entitled Basic Science Achievement Test on Environmental-Pollution (BSAT) was validated with reliability Coefficient of 0.72 determined using Kuder-Richardson Formula 12(K-R 21) was used for data collection. Intact classes in the selected schools were assigned as Experimental groups using Computer-Simulation, Field-Trip strategy and Control group using Expository strategy, respectively. Mean and Standard Deviation were used to answer research question while Analysis of Covariance was used to test the hypothesis at 0.05 F level. Results showed that, mean scores of female students taught Environmental-Pollution using Computer-Simulation, Field-Trip and Expository strategy was greater than that of male students taught using the same strategy. There was significant difference between the mean retention scores of male and female Basic Science students taught Environmental-Pollution using the same strategy. The significant difference was in favour of male students taught using Expository strategy. Based on these findings recommendations were made among others that, Field-Trip, Computer-Simulation and Expository strategies should be used to teach the concept of Environmental-pollution. Female participation in Basic Science lessons should be encouraged in Owerri Education zone, the strategies show significant to gender difference in students' retention in the zone.

Keywords: Basic. Environmental -Pollution, Gender, Instructional Strategies, Retention

Introduction

Basic Science and Technology is one of the subjects that made up the 10 subjects of junior secondary school curriculum, in pursuance of the objectives of Basic Education in Nigeria (National Policy on Education, 2014). One of the objectives of this education is to lay a sound basis for scientific, critical and reflective thinking. Consequently, Basic Science and Technology was introduced to lay a foundation for scientific literacy for all citizens. Scientific literacy is crucial for making informed decisions about policies that affect the environment ranging from climate change and environmental protection to public health and energy policy (Lemmon *et al*, 2023). Despite the importance of scientific literacy, a high percentage of students fail to achieve credit level in Basic Science indicating a low level of scientific literacy among students (Ozoji *et al*, 2022).

However, one major theme among the four themes in Basic Science and Technology is Basic Science, having the Sub-theme “Learning about your Environment”. This aspect of the subject provides Environmental-Pollution awareness to citizens. Petal and Singh (2021) defines pollution as the unwarranted disposal of mass or energy into earth’s natural resources pool such as water, land or air. That result in long-or short term detriment to the atmosphere and its ecological health which negatively impact living beings and their lives, both quantitatively and qualitatively.

Environmental -Pollution, as listed among topics in junior secondary school one’s Basic Science theme seems not to have been well understood by students. The Chief Examiner’s report for Junior Secondary Certificate Examination (JSCE) in 2010-2021 showed that students were unable to properly relate and explain the causes of pollution in their environment and that most students could not actually differentiate between pollution and pollutants (Ikwueze and Tafi, 2021). This indicates that students perceived the concept as being difficult. This could be due to inappropriate teaching strategies used to teach students. Ihekwoaba (2023) reported that, most teachers do not use recommended teaching strategies for effective implementation of Basic Science teaching in south East Nigeria, including Imo State. The recommended instructional strategies for teaching Basic Science include; Field-Trip, Expository, Demonstration, project, laboratory, co-operation, and inquiry (Siambano, 2022).

Instructional strategy refers to the technique teacher use to deliver lesson, it encompasses any active type of teaching technique teacher uses to help students learn in other to have better achievement and retention of a concept (Persaud, 2023). One of such active strategies is using Computer- Simulation. This is a process of running computer model to simulate students about a real world situation, in other to reduce the abstract nature of air and water pollution. Computer -Simulation can be used to demonstrate the process of how air and water pollution occurs. Another active based strategy is the use of Field-Trips or field-observation strategy during teaching. Field-Trips are defined as visits to an outside area of the normal classroom made by teacher and students for the purpose of firsthand observation (Stephen, 2019). Field-Trip provides opportunity for self-experience, observations and self-long-lasting learning (Brian and Linda, 2021).

Despite many active strategies available in science teaching some teachers commonly use Non-active strategy such as Lecture and Expository strategy to teach science (Wahyudin, 2020). Expository strategy is a teacher-centered strategy that focuses on the delivery of facts, ideas and important information to students sourced from textbook, references, or personal experiences using lecture strategy (Wahyudin, 2020). Expository strategy make science lesson boring and some students find it difficult to grasp scientific concept, skills and principles which are abstract in nature. This may affect students' retention.

Retention is the ability to have information stored in a long term memory in such a way that, it can be readily retrieved despite the interval of time between the learnt materials. kristina (2022) asserted that, students that were actively involved in extracurricular activities tend to experience better retention rate than their counterpart that do not involved in extracurricular activities. Another factor that is capable of affecting students' retention could be students' gender. Gender sensitivity has been observed as one of the factors that could affect students in Basic Science (Ani *et al*, 2021). Research often show low science literacy among female students, although some methods, such as outdoor laboratory strategy show no significant gender difference in performance (Oziji *et al*, 2022).

Tukura *et al* (2020) investigated gender effect of Computer-Simulation strategy on Basic Science students' retention, in Minna, Niger State. Finding showed that, there was no significant difference between male and female students' retention using Computer-Simulation and Expository instructional strategy. Egbodo *et al* (2022) investigated gender effect on Basic Science and Technology students' retention using Computer-Simulation in Benue State. Finding shows that students' gender has no significant effect on retention using Computer- Simulation strategy. The question of whether these instructional strategies narrow or widen the gender gap in science achievement remains highly debated. Some studies suggest that male students outperform females in hand-on environments, while others indicate that interactive strategies bridge the gender disparity entirely.

It is against this back drop that this study is designed to investigate the effects of Computer-Simulation, Field-Trip, and Expository Instructional strategies on gender and retention of Basic Science students in Owerri Education Zone.

Statement of Problem

The Chief Examiner's report for Junior Secondary Certificate Examination (JSCE) in 2010-2021 showed that students were unable to properly relate and explain the causes of pollution in their environment and that most students could not actually differentiate between pollution and pollutants. This indicates that students perceived the concept as being difficult. This could be due to inappropriate teaching strategies used to teach students. Research often show low science literacy among female students. This is probably because the strategy used in the teaching could not enhance students' retention and students' gender differences in Basic Science. It is against this back drop that this study seems to determine the effects of

Computer-Simulation, Field-Trip and Expository strategies on retention of Basic Science students taught the concept of Environmental- Pollution in Owerri, Imo State.

Research Question

What difference exists between the mean retention score of male and female Basic Science students taught the concept Environmental-pollution using Computer-Simulation, Field-Trip and Expository Strategies, respectively?

Research Hypothesis

There is no significant difference between the mean retention scores of male and female Basic Science Students taught the concept of Environmental-Pollution using Computer-Simulation, Field-Trip and Expository Strategies, respectively.

Methodology

This study employed Quasi-experimental; non-equivalent Controlled group design, precisely Pre-test, Post-test, Control group design. The population comprised of all the junior secondary school one Basic Science students consisting of 3000 students in all the 15 out of 86 public co-educational secondary schools of 2020/2021 academic year (Zonal Educational Management Board Owerri, 2019). Purposive sampling technique was used to select nine schools base on criteria such as; school with integrated science specialist, schools with sick bay, pond and garden. The sample size was 450 students. A shuffled 50 objectives question of Basic Science Achievement Test on Environmental- Pollution entitled BSAT was used as retention test for this study. Each correct answer was scored 1mrk while incorrect answer was scored zero mark. The instrument was subjected to face, content and table of specification validity by five experts from university of Uyo. The instrument was subjected to Kuder-Richandson 21 (KR-21) formula, to obtain the reliability coefficient of 0.72 index value. This study incorporated four lessons, in the concept of Environmental-Pollution; they are; air and water pollution, sources of air and water pollution, health and ecological effects of air and water pollution, and remediation/control of air and water Pollution.

Method of Data collection

Data for this study was collected by administering BSAT on Environmental-Pollution to 450 students in JSS1 of 2020/2021 academic year to obtain the students' Pretest score before applying the three instructional strategies of four lessons on Environmental- Pollution. Thereafter the same instrument was administered to the same students to obtain students achievement scored. Within three weeks of Posttest, retention test was administered to the same students using the same BSAT to obtain students' retention scores. The research question was answered using Mean and Standard Deviation, the hypothesis was tested using Analysis of Covariance at 0.05 Probability level. If $p \leq 0.05$ reject hypothesis but if $p \geq 0.05$ retain hypothesis.

Result

Research Question1: What difference exists between the mean retention score of male and female Basic Science students taught the concept of Environmental-Pollution using Computer-Simulation, Field-Trip and Expository strategies, respectively?

Table1: Summary of Mean and Standard Deviation of Posttest and Post-Posttest Retention Scores of Male and Female Students Taught Environmental-Pollution using Computer-Simulation, Field-Trip and Expository Strategy Respectively.

Strategies/ Gender	N	Posttest		Retention		Mean Difference
		mean	S.D	mean	SD	
SIMULATION						
Male	60	36.96	6.16	28.43	6.16	8.53
Female	90	36.91	6.27	29.66	7.31	7.25
FIELD-TRIP						
Male	63	37.30	5.17	27.50	6.64	9.80
Female	87	40.52	5.67	31.28	8.60	9.24
EXPOSITORY						
Male	69	31.17	6.31	25.47	7.75	5.70
Female	81	35.69	6.94	30.01	7.67	5.68
Total	450					

Source: Researchers

Table 1 shows that, the retention means scores of female students taught using Field-Trip, Expository, and Computer-Simulation were greater than those of male students taught using same strategies. Female students taught using Field-Trip had the highest retention scores, 31.28. Also, S.D score 6.16, of male students taught using Computer-Simulation indicated that they have the most homogenous retention scores. Moreover, male students taught using Field-Trip had the highest mean difference 9.80. This implies that, the students had the highest decay of retention score.

Research Hypothesis 1: There is no significant difference between the mean retention scores of male and female Basic Science students taught the concept of Environmental- Pollution using Computer-Simulation, Field-Trip and Expository strategies.

Table 2: ANCOVA Summary of Students' Retention Scores Classified by Strategies and Gender with Post-Test Scores as Covariates

Tests of Between-Subjects Effects							
Dependent Variable: RETENTION							
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared 0.05	Decision p <
Corrected Model	2138.529 ^a	6	356.422	6.477	.000	.081	Significant
Intercept	36187.719	1	36187.719	657.654	.000	.598	Significant
POSTTEST	795.531	1	795.531	14.457	.000	.032	Significant
STRATEGIES	141.225	2	70.612	1.283	.278	.006	Not Significant
GENDER	395.344	1	395.344	7.185	.008	.016	Significant
STRATEGIES* GENDER	659.805	2	329.902	5.995	.003	.026	Significant
Error	24376.291	443	55.025				
Total	405487.000	450					
Corrected Total	26514.820	449					

a. R Squared = .081 (Adjusted R Squared = .068) **Source:** Researchers

Table 2 shows that, the mean effect was Not significant on strategies $F = 1.283$; $P (.278) > 0.05$, the mean effect was significant on Gender $F = 7.185$; $P (.008) < 0.05$. The mean interaction effect was significant on Strategies and Gender $F = 5.995$; $P (.003) < 0.05$. Reject hypothesis, a post hoc test of significance was done using Scheffe's multiple comparison statistics to determine the direction of significant, shown in Table 3

Table 3: Scheffe's Test Analysis of the Significant Difference among mean Retention Score of Male and Female Students taught Environmental-Pollution using Simulation, Field-Trip and Expository Strategies

Pair wise Comparisons						
Dependent Variable: RETENTION						
(I) STRATEGIES	(J) GENDER	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
EXPOSITORY	MALE	-1.315	.889	.140	Lower Bound	Upper Bound
	FEMALE	-1.118	.872	.200	-3.063	.433
SIMULATION	MALE	1.315	.889	.140	-4.33	3.063
	FEMALE	.197	.873	.821	-1.518	1.913
FIELD TRIP	MALE	1.118	.872	.200	-5.95	2.831
	FEMALE	-.197	.873	.821	-1.913	1.518

a. Adjustment for multiple comparisons: Least Significant Difference, equivalent to no adjustments).

Source: Researchers

Table 3 shows that, significant mean difference existed in the strategies. The highest significant mean different was between male students taught using Expository and male students taught using Simulation.

Findings

- i. Mean retention score of female students taught using Field –Trip, Computer-Simulation and Expository strategy was greater than the male and female students taught using same strategies. Female students taught using Field-Trip had the highest retention score.
- ii. There was significant difference between the mean retention scores of male and female Basic Science students taught the concept of Environmental-Pollution using Computer-Simulation, Field-Trip and Expository strategies but the significant different was in favour of male students taught using Expository strategy.

Discussion of Findings

Difference in the Mean Retention Score of Male and Female Basic Science Students taught the Concept of Environmental-Pollution Using Computer-Simulation, Field-Trip and Expository Strategies.

In Owerri Education Zone, this study finding showed that, female students' retention taught the concept Environmental-Pollution using Field-Trip was greater than that of the male students taught using the same strategy. This could be that the female students actively involved in all the lessons activities by taken careful observation and participation than the male students taught the concept using Field-Trip, including Simulation and Expository strategies. This study is not in line with Egbodo *et al* (2022) that, there was no significant difference between male and female students mean retention scores taught Basic Science using Computer-Simulation and Expository strategies. Also, this study finding is not in line with Ogar *et al*. (2021) that, there was no significant difference between the mean retention scores of male and female students taught Basic Science using Field- Trip and Expository strategies.

Recommendations

1. Field-Trip strategies should be used to teach Environmental - Pollution
2. Female students should be encourage to participate in Field-Trip activity
3. School administrators and other relevant authority should help newly posted teachers in their schools to connect with the school community and environment by introducing such teacher to resource persons that could help facilitate curriculum deliver in Basic science.

Conclusion

In view of the persistent low retention and poor academic performance of Basic Science students in Owerri Education Zone, alongside unresolved debates regarding gender performance gap in science. The strategies show significant to gender difference in students' retention. The strategies foster long-term memory retention and active engagement of male students in Basic science. This implies that, Classroom is a limited environment to teach Basic Science in Junior Secondary School.

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