



Field-Trip, Computer Simulation and Expository Strategies on Science Students' Academic Achievement in Ecological Pyramids in Benin Municipality, Edo State

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Abstract

The study investigated Field trip, Computer Simulation and Expository Instructional Strategies on science students' academic achievement on ecological pyramids in secondary schools in Benin Municipality. Three research questions and three null hypotheses gave direction to the study. The population of the study comprised all the 1,655 senior secondary two science students' in Benin Municipality Area, Edo State. The sample comprises 174 students' selected using simple random sampling technique. Science Achievement Test (SAT) on ecological pyramid was the instrument for data collection with reliability of 0.79 determined using Kuder- Richardson Formula -21. The face validity of SAT was done by two experienced school secondary science teachers and a lecturer in test, measurement and evaluation in the Department of Science Education. Mean and standard deviation was used to answer research questions while Analysis of Covariance (ANCOVA) was used to test the hypothesis at .05 level of significance. Findings of the study showed that science students' taught Ecological pyramids using field trip and computer simulation performed significantly better than those taught using expository strategies. Gender was found not to be a significant factor affecting students' achievement in the study.

Keywords: Science, Ecological Pyramid, Field trip, Computer Simulation, gender,

Introduction

The teaching and learning of Science in the 21st century by Teachers and students' required intellectual skills and practical activities. In today's classroom teaching, many science students find certain topics abstract in nature and thereby making it difficult to comprehend. Example is ecological pyramid. Ecological pyramid is an interesting concept, but many science teachers are unable to adequately capture learners interest in the concept. This lead to poor performance of science students in external examinations. If there should be improvement on the performance of science students on ecological pyramid, then there is need to combine various instructional strategies to make learning of ecological pyramid and other topics in sciences more meaningful to students. Science is the intellectual and practical activity encompassing the systematic study of the

structure and behavior of the physical and natural world through observation and experience. Science has given new breath to making learning more effective through human interaction with information technology that has advanced the knowledge and progression of mankind. Science teaching may involve science trips that expose learners to different science process skills. This can be achieved through the use of instructional strategies.

Instructional strategies allow teachers to specify class activities, to ease the assessment of students' conceptual understanding (Mukuka *et al.* 2020). Teaching of the topic Ecological pyramid, cannot be done effectively without appropriate strategies in promoting higher academic achievement. Tinapay, et al (2023) asserted that lack of activities that



stimulates students' interest in the sciences, such as field trips are not effectively incorporated into teaching concepts that are unfamiliar in their environments. The need to learn outside the classroom setting has proven to be impactful on students gaining new knowledge, greater curiosity and learning in real-life. This calls for Field trip.

Field trip is an important instructional strategy used in understanding scientific concepts from their abstract nature. Singh (2022) asserts that field trip can be both exciting and educational for students. This is because students gain a variety of experiences through field trips that are not available in a classroom setting. Field visits make schoolwork more tangible and memorable by connecting with the outside world. A field trip sparks questions and ideas at the start and end of a lesson. Paige (2022) stated that field trip Promote interactive learning and engage students' physical participation in an activity, which goes beyond reading about it in a textbook. Visits of science students to field promote real-life learning in ecological pyramid since fauna, floral, in their biomass, are seen in real life from their abstract forms in the classroom. Field trip strategy complements Computer simulation.

Computer simulation is an enriching technological device with pictures, sound and motion processes synchronized and projected for effective teaching and learning. It captures the essence of remote learning into dynamic and interesting real -life situations. Onah (2023) opined that the use of computer simulation improved the achievement of students in sciences. A study by the National institute of multi-media education in Japan (2020), showed a noticeable rise in education with integrating technology to the curriculum, with monumental influence on students' achievement. Sanina *et al.* (2020), opined that computer simulation-based education improves learners' logical reasoning, critical thinking, strategic and problem-solving skills by allowing them integrate their understanding with real-life scenarios. Computer simulations can be used in the classroom to help students' gain additional insight into Ecological pyramids.

Ecological pyramids as a concept is taught in most schools through verbal expository and students' find it in an abstract form. Computer simulation simplifies and breaks down complex topics like ecological pyramids for easy communication. A learning tool that maximizes benefits for knowledge achievement, development of learners' interest and reducing gaps in workload. Kruger, Hoffler and

Parchmann (2022) opined that computer simulation explains and predicts scientific phenomena with more valid scientific ideas for conceptual understanding. Cognitive and experiential learning is improved with the use of computer simulation to create a dynamic and engaging environment for learning ecological pyramids. Computer simulation employs visual picture of the lesson topic that promote interest, curiosity and effective knowledge creation to the students from its abstract nature. These strategies demystify the concept of ecological pyramids. This underscores the importance of leveraging Computer Simulation to make the teaching and learning of science an interesting one. Expository strategy is also used to complement science teaching.

Expository instructional strategy is verbal teaching used in secondary schools in Nigeria. Expository instructional strategy involves direct instruction relying on illustrations from textbooks, study prints, charts, newspapers, magazines and bulletins. Learners hardly participate in knowledge and skills construction as students are restricted from active participation unless permitted by the teacher, so may not learn optimally. Ado, Isah and Idris (2024) stated that expository instructional strategy caused the students to studied inactively. Students only become the object not subject in learning. The learning atmosphere becomes tedious, and unattractive. Therefore, a good science teacher should be able to guide the students accurately using several educational innovating instructional strategies, to promote excellent academic achievement.

Teachers lack of exposure and inadequate use of these innovative strategies has led to students' abysmal performance in the sciences. Ukor and Abdulbajar (2019) asserted that, lack of activities that stimulate students' interest in the sciences, such as Field-trips are not effectively incorporated into teaching students' concepts they are not familiar with in their environments. Tinapay *et al.* (2023) also attested to the fact that secondary school science students perform abysmally poor due to a lack of comprehensive grasp of the topics covered in Science in the absence of field trip exposure. Ineffective strategy that stimulate students' interest pose challenges in the classroom. This leads to students' under-achievement in secondary school Science in Benin City. Male and female students are taught together in public schools and complement one another in classroom settings.

Gender has been a controversial issue in determining students' Academic Achievement. These



show that there is controversy over students' achievement in science in terms of gender. Gender is a condition of being male or female. Sanchez (2021) stated that gender relates with the roles and patterns of behaviors on everyone within a specific society. Gender in relationship to achievement is perceived differently by the scientific community. Nweze (2021) posited that, there is an acknowledged problem of female under-achievement in the sciences when compared with their male counterparts. In essence, the challenge of female students' under-achievement in science appears to be more pronounced. Current boosting of women in terms of the gender gap, could improve female achievement in the sciences (Akhigbe and Ogufere, 2020). Omeodu and Abara (2020) posited that field trip encourages interest in learning to both male and female students. Apparently, under equivalent conditions, male and female students can achieve equally. Hence, there is need to also examine gender as a variable on students' academic achievement on Ecological pyramids using Field trip, Computer simulation and expository instructional strategies in Benin Area of Edo State, Nigeria.

Ecological pyramid is a concept in the senior secondary school curriculum and its relevance to knowledge cannot be over-emphasized. Ecological pyramid represents relationships between different organisms in an ecosystem. It is a graphical representation showing relationships between different organisms in a pyramid and a life support system. It shows the flow of energy at different trophic levels in an ecosystem. Aikens and Mckenzie, (2021) stated that Ecological pyramid is a large system of several elements circulated in relation to one another. Ecological pyramids show the relative amounts of various parameters including as number of organisms, energy and biomass across trophic levels. Ecological pyramid shows the distribution of biomass and energy within a pyramid. Chu (2020) also stated that Ecological pyramids are based on the fundamental idea that everything in the environment has a hierarchy of importance. In this context, trophic levels and energy pyramids are effective for expressing the relationship of science components, which help to develop a systematic approach between pyramid of numbers, energy and biomass. Ecological pyramids are called trophic pyramids or energy pyramids. Thus; three types of ecological pyramid exist. They are: Pyramid of Numbers, Pyramid of Biomass and pyramid of Energy.

Research Questions

1. What is the achievement mean scores among students taught ecological pyramid using Field-trip, Computer simulation and expository instructional strategies respectively?
2. What difference exists between the achievement mean scores of male and female students on ecological pyramid taught using Field trip, Computer simulation and expository strategies respectively?
3. What is achievement mean scores of the interaction effect of instructional strategies on Male and Female students' taught Ecological Pyramid using Field trip, Computer simulation and Expository strategies?

Research Hypotheses

The following hypotheses guided the study and were tested at .05 level of significance.

1. There is no significant difference in the achievement mean scores among Science students taught ecological pyramid using Field-trip, Computer simulation and expository instructional strategies
2. There is no significant difference exists between the achievement mean scores of male and female Science students' taught ecological pyramid using Field-trip, Computer simulation and expository instructional strategies.
3. There is no significant difference in the interaction effect of instructional strategies, on Male and Female Science Students' Achievement mean scores on Ecological Pyramid.

Research Methods

The research design adopted for this study was a quasi- experimental design with three groups, two experimental groups and a control group. Experimental group one was taught the concept of ecological pyramid using Field trip, experimental group two was taught the same concept using Computer simulation and group three was the control group taught same concept using expository strategy. The study was carried out in Benin Municipality Area of Edo State. The population was 1,655 Science students. Simple random sampling technique was used to select a sample size of 174 Biology students for the



study. The instrument for data collection was Science Achievement Test (SAT) on Ecological pyramids. SAT consisted of 30 multiple-choice-items with four (4) options A-D, with only one correct answer. This gave a total of thirty (30) marks. The content validity of the Science Achievement Test (SAT) on Ecological Pyramids was ascertained using test blue print. The test was used to gather pretest and posttest scores of students on ecological pyramids taught using Field

trip, computer simulation and expository instructional strategies. Mean and standard deviation was used to analyze data and provide answers to research questions. Analysis of Covariance (ANCOVA) was used to test the hypotheses formulated for the study at .05 level of significance. ANCOVA was considered suitable for this study due to use of pre-test scores as Covariate to control for the effects of non-equivalent groups.

Results:

Table 1: Mean, Standard deviation and mean Gain scores of students’ pretest and post-test taught Ecological pyramids using Field trip, Computer simulation and expository instructional strategies.

Strategies	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Field-trip	63	6.57	2.08	18.65	1.69	12.08
Computer Simulation	57	7.42	2.27	17.58	1.59	10.16
Expository	54	6.33	1.88	11.21	1.05	4.88

Data in Table 1 shows that students taught Ecological Pyramid using Field-trip, Computer Simulation and Expository strategies had mean scores of 6.57, 7.42 and 6.33 respectively in their pretest while they had mean scores of 18.65, 17.58 and 11.21 respectively in their posttest. The table also shows mean gain scores of 12.08, 10.16 and 4.88 respectively for students

taught Ecological Pyramid using Field-trip, Computer Simulation and Expository strategies. The result indicate that students taught Ecological Pyramid using Field-trip, and Computer Simulation strategies had the highest mean gain score, while those taught using Expository strategy had the least facilitative effect.

Table 2: Mean, Standard Deviation and mean Gain Scores of Male and Female Students’ Pretest and Posttest Taught Ecological Pyramid Using Field-trip, Computer Simulation and Expository Strategies

Strategies	Gender	N	Pretest		Posttest		Mean Gain
			Mean	SD	Mean	SD	
Field-trip	Male	33	6.93	2.47	19.11	1.53	12.18
	Female	29	6.22	1.54	18.19	1.74	11.97
Computer Simulation	Male	30	7.73	2.50	17.61	1.48	9.88
	Female	27	6.96	1.84	17.54	1.77	10.58
Expository	Male	26	6.55	1.58	11.23	1.06	4.68
	Female	29	6.08	2.16	11.19	1.04	5.11



Data in Table 2 shows the mean gain of male students taught Ecological Pyramid using Field-trip, Computer Simulation and Expository strategies as 12.18, 9.88 and 4.68 respectively, while those of their female counterparts are 11.97, 10.58 and 5.11 respectively. These results indicate that male students mean gain score taught Ecological Pyramid using Field-trip

strategy is higher than those of their female counterparts. Female students mean gain scores taught Ecological Pyramid using Computer Simulation strategy is higher than those of their male counterparts; while female students mean gain score taught Ecological Pyramid using Expository strategy is slightly higher than that of their male counterparts.

Table 3: Mean, Standard Deviation and Mean Gain Scores of Students' Pretest and Posttest Taught Ecological Pyramid Using Field-trip, Computer Simulation and Expository strategies

Strategies	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Field-trip	108	6.57	2.08	18.65	1.69	12.08
Computer Simulation	69	7.42	2.27	17.58	1.59	10.16
Expository	137	6.33	1.88	11.21	1.05	4.88

Results in Table 3; shows that students taught Ecological Pyramid using Field-trip, Computer Simulation and Expository methods had a mean score of 6.57, 7.42 and 6.33 respectively in their pretest while they had a mean score of 18.65, 17.58 and 11.21 respectively in their posttest. The table also shows a mean gain score of 12.08, 10.16 and 4.88 respectively

for students taught Ecological Pyramid using Field-trip, Computer Simulation and Expository strategies. The result indicates that students taught Ecological Pyramid using Field-trip and Computer Simulation strategies had the highest mean gain score, while those taught using Expository strategy had least.

Table 4: Analysis of Covariance (ANCOVA) on difference in the achievement mean score of science students taught ecological pyramid using Field trip, Computer simulation and Expository Strategies.

Source of Variation		Sum of Squares	df	Mean Square	F	Sig. at P<.05
Covariates	Pretest	147.04	1	147.04	75.27	.00
Main Effects	Resources	3729.45	2	1864.72	954.58	.00
Residual		605.57	310	1.95		
Total		4482.05	313	14.32		

In Table 4, the calculated Probability value (P-value) .00 of the main effects (Methods) is less than the significance level (.05). Therefore, the null hypothesis is rejected. This implies that at $P < .05$, there exist significant difference among the achievement mean scores of students taught ecological pyramid using

Field-trip compared with those taught using Computer simulation and expository strategy. In order to determine the direction of significance, the Least Square Difference (LSD) posthoc pairwise comparison test was done and the results are summarized in Table 4.

Table 5: LSD Posthoc Pairwise Comparison Test of Students’ Posttest Scores Classified by Instructional Strategies with Pretest Scores as Covariate

(I) Resources	(J) Resources	Mean Difference (I-J)	Std. Error	Sign at P < .05
Field-trip	Computer Simulation	1.18*	.22	.00
Computer Simulation	Expository	7.40*	.18	.00
	Field-trip	-1.18*	.22	.00
Expository	Expository	6.22*	.21	.00
	Field-trip	-7.40*	.18	.00
	Computer Simulation	-6.22*	.21	.00

Table 5: Shows a mean difference (1.18) between students taught ecological pyramid using Field-trip and Computer simulation; 7.40 between students taught ecological pyramid using Field-trip and expository strategy; and 6.22 between students taught ecological pyramid using Computer simulation and expository strategy. It can be inferred from the result that Field-trip is the most facilitating, followed by Computer simulation and Expository strategy is the least.

Table 6: Analysis of Covariance (ANCOVA) of Male and Female Students’ Posttest Scores Taught Using the Different instructional strategies with Pretest as covariate

Source of Variation		Sum of Squares	df	Mean Square	F	Sig. at P<.05
Covariates	Pretest	137.04	1	157.04	76.95	.00
Main Effects	Strategies	3418.45	2	1864.72	875.84	.00
	Gender	6.04	1	6.04	3.18	.07
2-Way Interactions	Strategies * Gender	11.86	2	6.44	3.37	.04
Residual		586.65	308	1.91		
Total		4582.05	312	13.32		

In Table 6, the calculated Probability value (P-value) .08 of the main effects of Gender is greater than the significance level (.05). Therefore, the null hypothesis cannot be rejected. This implies that at P < .05, there exists no significant difference between the achievement mean scores of male and female students taught ecological pyramid using Field-trip compared with those taught using Computer simulation and expository strategy.

Table 7: LSD Posthoc Pairwise Comparison Test of Students’ Posttest Scores Classified by Instructional Strategies with Pretest Scores as Covariate

(I) Strategies	(I) Gender	(J) Gender	Mean Difference (I-J)	Std. Error	Sign at P < .05
Field-trip	Male	Female	1.18*	.22	.00
	Female	Male	7.40*	.18	.00
Computer Simulation	Male	Female	-1.18*	.22	.00
	Female	Male	6.22*	.21	.00
Expository	Male	Female	-7.40*	.18	.00
	Female	Male	-6.22*	.21	.00

Table 7; shows a mean difference (1.18) between students taught ecological pyramid using Field-trip and Computer simulation; 7.40 between students taught ecological pyramid using Field-trip and expository strategy; and 6.22 between students taught

ecological pyramid using Computer simulation and expository strategy. It can be inferred from the result that Field-trip and Computer Simulation is the most facilitating, while Expository strategy is the least.

Table 8; Analysis of Covariance (ANCOVA) of Male and Female Students’ Achievement Mean Scores Taught Using the Different instructional strategies with Posttest as covariate

Source of Variation		Sum of Squares	df	Mean Square	F	Sig. at P<.05
Covariates	Pretest	3744.65	1	3744.65	3215.43	.00
Main Effects	Strategies	133.92	2	66.96	57.50	.00
	Gender	1.57	1	1.57	1.34	.25
2-Way Interactions	Strategies * Gender	0.98	2	0.49	0.42	.66
Residual		357.53	307	1.17		
Total		4238.65	313	13.54		



In Table 8 above, the calculated Probability value (P-value) .25 of the main effects of Gender is greater than the significance level (.05). Therefore, the null hypothesis cannot be rejected. This implies that at $P < .05$, there exists no significant difference among the mean achievement scores of male and female students in ecological pyramid when taught using Field-trip, Computer simulation compared with those taught using expository strategy.

Discussion of Findings

The findings in the mean achievement scores of Students on ecological pyramid using Field trip, and Computer simulation indicated a significant difference. Students taught Ecological pyramid using Field trip and Computer simulation achieved higher than those taught using Expository instructional strategy. The findings of the study are in line with Oka and Samuel (2020) that Field trip instructional strategy significantly improved students' achievement in practical Science. While use of computer simulation agreed with that of Onah (2023) who opined that the use of computer simulation improved the achievement of students in sciences. The findings in the achievement mean scores of male and female Science students on ecological pyramid using Field trip, Computer simulation showed a significant achievement. This agreed with Omeodu and Abara (2020) and Akhigbe and Ogufere (2020) who stated respectively that field trip and computer simulation encourages interest in learning to both male and female students. Male and female Students taught with expository instructional strategy performed least. This is in agreement with, Ado, Isah and Idris (2024) stated that expository instructional strategy caused the students to studied inactively.

Conclusion

Based on the findings of the study, it was concluded that students taught the concept of Ecological pyramid with Field trip and computer simulation achieved significantly better than students' taught using Expository instructional strategy. High achievement in science is possible if innovative instructional strategies such as Field trip and Computer simulation is adopted by science teachers for teaching Science concepts. Gender is a contributory factor to learning science.

Recommendations: Based on the findings, it was recommended that:

1. Students should be encouraged to explore outdoor knowledge through Field trip so as to see natural environment as it is related to ecological pyramids, so as to become interested and learn science phenomena in real-life to improve academic performance.
2. Science teachers should endeavour to use Field trip, Computer simulation as instructional strategies to promote knowledge in the teaching and learning of Ecological pyramids in schools.
3. The use of Field trip and Computer simulation as an instructional strategy in teaching Science should be encouraged by school administrators and also equipping laboratories with technologically driven resources to widen knowledge bank.

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