



**Problem-Based Learning and Inquiry Method on Retention of Knowledge of Ecology  
Concepts among Secondary School Biology Student**

**Eseroghene Avwiri**

[eseroghene.avwiri@uniport.edu.ng](mailto:eseroghene.avwiri@uniport.edu.ng)

**Department of Science Education, University of Port Harcourt  
Rivers State, Nigeria.z**

&

**Bright Owubokirime Tamie**

[bright\\_tamie@uniport.edu.ng](mailto:bright_tamie@uniport.edu.ng)

**Department of Curriculum studies and Educational Technology,  
University of Port Harcourt, Nigeria**

**Abstract**

The study aims to examine the effect of instructional strategy (Problem-Based Learning, Inquiry Method and Lecture Method) on retention of the knowledge of the concept of Ecology among secondary school Biology students in Ikwerre Local Government Area, Rivers State. The design for the study was quasi-experimental. A sample of 143 Biology students were selected from a population of 3,217 comprising of 73 males and 70 females. These students were selected from three (3) different schools using purposive sampling technique. The two research questions were answered with mean and standard deviation. Analysis of Covariance was used to test the two hypotheses formulated at 0.05 level of significance. The research instrument titled Basic Ecology Retention Test was developed and deployed for the study. The instrument scored a reliability of 0.83 when subjected to Kuder-Richardson 21 formula. The study found out that the retention of knowledge of Ecology concepts was highest in students taught using Problem-Based Learning and was followed by those taught using Inquiry Method, the least retention of knowledge of Ecology concepts was those taught with lecture method. Also, there is no significant effect of gender on students' retention of knowledge of Ecology concept. Therefore, this study recommended that Biology teachers be encouraged to use Problem –Based –Learning and Inquiry Method to teach the concept of Ecology in schools.

**Key Words:** Problem-based learning, Inquiry method, Retention, Gender, Ecology.

**Introduction**

The word "retention" has its roots in Latin. Retention (noun) comes from: Retentio (Latin noun) meaning "a holding back" or "keeping"; Retinere (Latin verb) meaning "to hold back" or "to keep"; Prefix re- (Latin) meaning "back" or "again"; Tenere\* (Latin verb) meaning "to hold". (Meta AI, 2024).

Retention as Knowledge Recall, can be described as the ability to recall and retrieve learned information over time (Cepeda et al., 2020). Retention can also be seen as the persistence of learning over time, including the ability of one to apply learned concepts . (Ambrose et al., 2020). With retention, a student can easily transfer learned concepts to new situations and





Problem-Based Learning (PBL) and Inquiry method, could enhance students' engagement, motivation, and understanding, when retention is achieved. Strategies have been effective in improving science education outcomes globally. Adonye and Avwiri, (2025) on the effects of instructional strategy on Physics students' academic performance in secondary schools in Rivers State, found out that flex Instructional strategy used by the instructor had a significant effect on the mean performance of students in Physics. While Thus, the strategy used by teachers in the teaching and learning is very crucial.

Problem-Based Learning (PBL) strategy is student-centred educational strategy that involves students working in groups to explore real-world problems or scenarios, fostering critical thinking, creativity, and problem-solving skills (Salvin-Baden & Major, 2022). (PBL) is an instructional strategy that involves presenting students with real-world problems or scenarios, encouraging critical thinking, collaboration, and problem-solving. Students work in groups to identify, analyze, and propose solutions, thereby, developing essential skills in critical thinking, collaboration, communication, creativity and problem-solving.

Problem-Based Learning can be implemented by identifying learning objectives, designing a problem or scenario, forming student groups, providing necessary resources, guidance, and feedback. Problem-Based Learning could improve performance and retention by developing critical thinking and problem-solving skills, enhancing collaboration and teamwork (Yuan et al.,2008). By incorporating Problem-Based Learning strategies, educators can create engaging, challenging, and relevant learning experiences that could improve students' performance and retention.

Inquiry Method is a student-centred strategy that is carried out with a view of finding solutions and answers to educational problems. (Lunn Brownlee et al., 2022). Students formulate questions, design investigations, collect data, analyse results to develop deeper understanding and critical thinking.

Understanding the concept of male, female and gender in educational organizational is crucial, for promoting performance and retention. Gender is the degree of muscularity and femininity present in a human being. The male has the XY Chromosomes and dominance of testosterone while the female has the XX chromosomes and oestrogen/progesterone dominance (World Health Organization, 2024). However, this definition is evolving to accommodate diverse masculinities and gender identities. Similarly, female typically describes individuals' assigned









**Table 3: Summary of ANCOVA of Students' Retention of Knowledge Classified by Instructional Strategy Using Post-test Scores as a Covariate.**

Dependent Variable: Post post-test scores on application

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6956.097 <sup>a</sup>	3	2318.699	473.677	0.000	0.911
Intercept	71.720	1	71.720	14.651	0.000	0.095
Posttest	2803.652	1	2803.652	572.745	0.000	0.805
<b>Instructional Strategy</b>	<b>314.304</b>	<b>2</b>	<b>157.152</b>	<b>32.104</b>	<b>0.000</b>	<b>0.316</b>
Error	680.420	139	4.895			
Total	74666.000	143				
Corrected Total	7636.517	142				

a. R Squared = .911 (Adjusted R Squared = .909)

Table 3 shows that  $F_{2,139} = 32.104, p = 0.00 (p < 0.05)$ , therefore the null hypothesis is rejected. This indicates that there is significant effect of instructional strategy on students' retention of knowledge of Ecology concepts. A partial eta-squared value of 0.316 for instructional strategy indicates a very large effect of instructional strategy on students' retention on knowledge of Ecology concepts. Students taught Ecology using Problem-Based Learning, Inquiry Method and Lecture Method improved in retention of knowledge of Ecology concepts. To know the direction of the significance difference, a Post Hoc analysis is done using Bonferroni.

**Table 4: Post Hoc Analysis of Students' Retention of Knowledge Classified by Instructional Strategy Using Post-test as a Covariate.**

(I) Instructional Strategy for Difference <sup>b</sup>	(J) Instructional Strategy	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval	
					Lower Bound	Upper Bound
Problem Based Learning	Inquiry Method	<b>3.735*</b>	0.501	0.000	2.520	4.949
	Lecture Method	<b>4.049*</b>	0.589	0.000	2.622	5.476
Inquiry Method	Problem Based Learning	<b>-3.735*</b>	0.501	0.000	-4.949	-2.520



	Lecture Method	0.315	0.488	1.000	-0.869	1.498
Lecture Method	Problem Based Learning	-4.049*	0.589	0.000	-5.476	-2.622
	Inquiry Method	-0.315	0.488	1.000	-1.498	0.869

is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4 shows that Problem-Based Learning has the highest significant mean difference (I - J) when compared to Inquiry Method (3.735) and Lecture Method (4.049). This indicates that students taught Ecology using Problem-Based Learning, showed the highest gain in performance.

**Hypothesis 2:** There is no significant difference in retention between male and female students taught Ecology concepts.

**Table 5: Summary of ANCOVA of Students' Retention of Knowledge Classified by Gender Using Post-test Scores as a Covariate.**  
**Dependent Variable: Post post-test scores on application**

<b>Source</b>	<b>Type III Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>	<b>Partial Eta Squared</b>
Corrected Model	6642.600 <sup>a</sup>	2	3321.300	467.828	0.000	0.870
Intercept	4.108	1	4.108	0.579	0.448	0.004
Posttest	6582.027	1	6582.027	927.123	0.000	0.869
<b>Gender</b>	<b>0.807</b>	<b>1</b>	<b>0.807</b>	<b>0.114</b>	<b>0.737</b>	<b>0.001</b>
Error	993.917	140	7.099			
Total	74666.000	143				
Corrected Total	7636.517	142				

a. R Squared = .870 (Adjusted R Squared = .868)

Table 5 shows that  $F_{1,140} = 0.114, p = 0.737 (p > 0.05)$ , therefore the null hypothesis is retained. A partial eta-squared value of 0.001 for instructional strategy indicates a very small effect of instructional strategy on students' retention of knowledge of Ecology concept. This indicates that there is no significant difference between the male and female students' retention of the knowledge of Ecology concept.

### Discussion

The effect of instructional strategy (Problem-Based Learning, Inquiry Method and Lecture Method) on students' retention of the knowledge of Ecology concepts. The results of this study



indicated that students taught Basic Ecology Concepts using Problem-Based Learning had the highest mean score difference for retention of knowledge of concepts of Ecology. This could be that the nature of Problem-Based Learning involves more solution-oriented processes of analysis and synthesis. Inquiry Method had the second highest mean score difference for retention of knowledge of the concepts of Ecology also presumable due to the fact that it also embraces higher cognitive or mental processes of analysis and synthesis. While those taught with Lecture method had the lowest mean score difference. This could be that Lecture method do not deeply engage in higher cognitive or mental processes.

This indicates that students taught Ecology using Problem-Based Learning, showed the highest gain in performance. The finding of the study therefore revealed that the retention of knowledge of Ecology concepts was highest in students taught using Problem-Based Learning, followed by those taught using Inquiry Method, while those taught using Lecture Method had a mean lose in retention of knowledge of Ecology concepts and so they had the least retention of knowledge of Ecology concepts.



The present research is corroborated by the work of Usman et al (2023), who found out that STEM Problem-Based Learning (STEM-PBL) have a significant and favourable impact on students' Biology achievement and that students in the experimental group retained more

Biology information compared to the control group. This study also indicates that there is a significant effect of instructional strategy on students' retention of knowledge of Ecology concepts when the students taught Ecology using Problem-Based Learning

This indicates that students taught Ecology using Problem-Based Learning, showed the highest gain in retention. This agrees with the work of Akpan and Udofia (2020) Ogunyemi and Salami (2021) who found out that there is a significant improvement in students retention when taught with Problem Based Learning instruction.

Moreover, this study also indicated that female students taught Basic Ecology Concepts had a slightly higher mean difference than the male students. The work also agrees with Obasi and Olaniyan who found that the female students had a higher retention scores than the male students at an initial stage of learning. This could be that the female had more interest in the topic and also pays more attention in class. The finding of the study, therefore revealed that there is no significant difference between the male and female students in their retention of the knowledge of Ecology concept when taught using PBL.



### **Conclusion**

The study was able to establish the effect of Problem-Based Learning and Inquiry Method on the retention of knowledge on Ecology concepts in secondary school students in Ikwerre L.G.A. Rivers State.

This research shows that both PBL and IM can enhance retention, but with varying degrees of effectiveness. For Retention, the use of PBL as instructional strategy showed more significant retention of the concept of Ecology in the students.

In conclusion, both Problem-Based Learning and Inquiry Method are effective instructional strategies for promoting retention of knowledge of Ecology concepts among senior secondary school students, however, PBL enhanced retention more in the students.

### **Recommendations**

1. Science teachers should employ the Problem-Based Learning Method as much as possible in the teaching of scientific concepts in Ecology.
2. Teaching resources should be channel towards the effective of Problem-Based Learning.
3. The teacher should consider gender when using Problem based learning in order to carry all the students along during teaching and learning.

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