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Role-Play, Peer Tutoring and Expository Method of Teaching Ecological Management and Biology Students' Academic Performance in Uyo, Akwa Ibom State, Nigeria

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Abstract

The study conducts an empirical examination of the effectiveness of role-play, peer tutoring, and the expository method in teaching ecological management, focusing on the academic performance of biology students in Uyo, Akwa Ibom State, Nigeria. Three research questions and three null hypotheses guided the study. The design of the study was quasi-experimental with a non-randomised pretest, posttest control group. The sample size of 183 (92 males and 91 females) Senior Secondary Two (SS 2) students in three intact classes of three co-educational secondary schools in Uyo Local Government Area, Nigeria, was selected using the purposive sampling technique. The Biology Performance Test (BPT) was used for data collection. The Biology Performance Test (BPT) had forty (40) multiple-choice questions. The test measured students' pretest and posttest performance in the concept. The reliability of BPT was determined using Kuder-Richardson 21 (KR-21) with

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reliability indices of 0.87. Mean and standard deviation were used to answer the research questions, while analysis of covariance (ANCOVA) was used to test the null hypotheses at the 0.05 level of significance. The results indicated significant differences in the mean performance scores of biology students taught ecological management through role-play, peer tutoring, and expository methods, with the role-play and peer tutoring methods yielding better outcomes than the expository method. Additionally, there were no significant differences in the mean performance scores between male and female biology students taught ecological management using role-play, peer tutoring, and expository methods, respectively. It was also found that there are no significant interaction effects of teaching methods and gender on biology students' performance on ecological management. It was concluded that role-play and peer tutoring teaching methods were more effective than expository in facilitating students' performance in ecological management in biology. Based on the findings, it was recommended, among others, that biology teachers should make effective use of role-play and peer tutoring in teaching the concept of ecological management in biology.

Keywords: Role-play, Peer Tutoring, Expository, Academic Performance, Ecological Management

Introduction

Biology is a branch of science which studies various forms of life. It is also a branch of natural sciences that focuses on living organisms, including their physical structure, chemical processes, molecule interactions, physiological mechanisms, development and evolution (Nwuba *et al.*, 2023). Biology is a fascinating study that ranges from microscopic cellular molecules to the biosphere, encompassing the earth's surface and its living organisms (Sarojini, 2018). Biology, as the study of living organisms, utilises the scientific method and classifies and describes organisms and their functions. Also, how species come into existence and the interactions they have with each other and with

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the natural environment. It is a science subject which aims at equipping students with appropriate scientific attitudes, competences and abilities to apply scientific knowledge to challenges of life. The study of biology enables man to understand the diversity of life forms, conservation and sustainable use of natural resources (Niesenbaum, 2019). Biology as a subject occupies a central position in the senior secondary school science curriculum (Federal Republic of Nigeria, FRN, 2020). The study of biology equips students with useful concepts, principles, theories and safety that enable them to face the challenges around them before and after graduation. It also equips students in the area of environmental science, such as biodiversity, conservation, climate change, renewable energy, natural resource management and ecological management (Goji, 2018).

Ecological management is the process of combining human activities with the need to protect and repair ecosystems and also ensure their long-term health and viability. Understanding and regulating the complex interactions between living creatures and their environment is required to maintain the preservation of biodiversity, natural processes, and overall ecosystem health (Bodin, 2017). Ecological management refers to the process of protecting organisms and their interactions with the environment. It focuses on the management of biological components, their interactions with the physical environment, and the consequences for the planet. Long et al. (2017) classify ecological management into four primary categories: association (biological associations), tolerance, adaptations (plant and animal), and pollution. However, this study focuses on animal adaptations.

Animal adaptation is the process by which animals develop certain features, behaviours and body structures that help the animals survive and reproduce in their specific environments. It is how animals adjust to their surroundings to meet their needs for food, shelter, protection and reproduction. Animal adaptations are the result of evolutionary processes that enhance an organism's ability to survive and reproduce in specific environments. It is the special features or behaviours that help animals survive and reproduce in their specific environments (Akunwa and Obidiwe, 2018). These adaptations develop over a long period of time through the process of evolution. It is the change or development of features that helps animals live successfully in their environment. Without these adaptations, animals would find it difficult to survive changes in their surroundings. Thus, a clear and engaging understanding of animal adaptation enhances students' scientific reasoning, motivation and interest in biology, which in turn leads to improved academic achievement. Students' poor performance has

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been attributed to non-utilisation of appropriate teaching methods. Effective instructional teaching methods such as role-play, peer tutoring and exposition could be employed to reduce the failure rate of the students in biology.

Role-play is a teaching and learning method where students act out roles or situations to explore particular concepts, develop understanding and practise real-life scenarios. It is a group activity that involves more than one person who assumes different roles in a given situation to acquire learning experiences (Harneel *et al.*, 2018). Role-playing is an active learning technique that involves a high level of participation from students. Learning in role-play is facilitated by observing as well as acting out the series of events happening in the respective situation. It is an example of learning by doing (Kilgour *et al.*, 2016). Role-play is the practice of having students take on specific roles and act them out in a case-based scenario for the purpose of learning course content or understanding complex concepts (Puyate and Eniekenemi, 2017). Nwachukwu and Bello (2024) stated that role-play is the changing of one's behaviour to fulfil a social role. The term is used to refer to the playing of roles generally, such as in a theatre or educational setting, taking the role of an existing character or person and acting it out with a partner taking someone else's role, often involving different genres of practice. When students take the skills they have learnt in theory and put them into practice, this creates a deeper cognitive link to the material, making it easier for students to learn (Ibok *et al.*, 2024). Role-play can be combined with other teaching methods, such as peer tutoring, to improve students' performance in biology.

Peer tutoring refers to a teaching method that allows a teacher, after teaching the topic, to group learners to ensure that the brighter students teach their counterparts who may be slow in learning. It is an active teaching method that fosters student inclusion while enabling students to learn from each other (Cockerill *et al.*, 2018). In using the peer-tutoring method, students are allowed to teach themselves in an organised setting where one student acts as the tutor and others as the tutees. The more intelligent students are asked to act as the tutors, while the less intelligent ones learn as the tutees. Through interactions among themselves, both sets of students can learn from each other by playing, talking and sharing ideas and sometimes through quarrelling. Peer tutoring is a method of instruction during which students help one another comprehend the material and in turn learn by teaching (Longjohn and Osila, 2022). It refers to an individual with the same status as the individual being tutored, which in most cases is not the teacher. Peer tutoring is an instructional method that consists of pairing students together to learn

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or practise an academic task. The pairs of students can be of the same or differing ability. It is the process by which a student, with guidance from a teacher, helps in teaching one or more classmates to learn a concept. This means that this approach focuses on peers to solve a problem and is most effective in fostering creativity, experimentation, problem-solving skills and the learning of deep concepts (Negedu *et al.*, 2024). Thus, in peer tutoring, students take partial responsibility for teaching and learning from each other rather than merely telling students what they need to know (expository).

The expository teaching strategy aims to directly instruct students, presenting information in a clear and organised manner. This method is effective when introducing new concepts, explaining complex ideas and delivering factual content which involves lectures, presentations and instructional materials to help students gain a solid understanding of the subject (Lutfi, 2020). However, expository teaching can present a rich body of highly related facts, concepts and principles which the students can learn and transfer. It is efficient and useful for the presentation of facts or ideas in a relatively short time. It is one-way classroom interaction where the student only listens to the teacher without participating in the discussion aspect of the lesson (Husnul, 2019). Here, the student is expected to listen, accept, memorise and give feedback as expected. The teacher is in front of the class lecturing, and students are taking down notes. However, expository instruction goes beyond just presenting students with facts. It involves presenting clear and concise information in a purposeful way that allows students to easily make connections from one concept to the next by incorporating visual elements like charts, graphs and slides to enhance understanding (Nmaji-Uba *et al.*, 2019). Expository teaching strategy involves direct presentation of information by the teacher, which can impact students, irrespective of gender.

Gender encompasses a broad spectrum of biological, behavioural, physical, and psychological characteristics that distinguish males from females (Okeke, 2020). It also reflects the roles, responsibilities, opportunities, and constraints associated with being male or female within different social contexts (Lyne, 2023). Furthermore, gender represents the socially and culturally defined attributes and moral expectations that align with the values of a given community. However, Irungu *et al.* (2019), Obijiofor and Obumneke, and Oladejo *et al.* (2021), as well as Enebechi (2023), found that gender has no significant difference on students' performance. Also, Mwhia (2020), Taiye (2021), and Ani *et al.* (2022) posited that male and female students, when presented with equal opportunities, perform the same. These conflicting results and the inconsistency

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existing in literature on gender pose a need to check if gender affects the academic performance of students taught the concept of ecological management based on the three teaching methods – role-play, peer tutoring and expository teaching methods – used in the study.

Statement of the Problem

One of the problems facing the Nigerian educational sector today is the persistent poor performance of students in external examinations, especially in the sciences. Biology is no exception, particularly ecological management. The WAEC Chief Examiners report of 2023 and other research reports have shown that a high percentage of secondary school students continue to perform poorly in biology during external examinations. Students' low performance in biology may be linked to inadequate teaching methods used by teachers in the classroom. In biology education, scholars have consistently explored more effective teaching strategies to connect abstract and complex concepts with practical understanding, while addressing the challenge of students memorising numerous facts and terminologies, such as those related to ecological management. Poor teaching methods adopted by teachers do not only lead to poor understanding of the concepts but are also capable of hindering students' ability to understand and apply information. Some teaching methods identified by studies for effectively conveying such concepts include role-play, peer tutoring, blended learning, and activity-based approaches, particularly when contrasted with the expository method. Consequently, this study aims to investigate the effects of role-play, peer tutoring, and the expository method on the academic performance of biology students studying ecological management in Uyo, Akwa Ibom State, Nigeria.

Purpose of the Study

The purpose of the study was to examine the effectiveness of role-play, peer tutoring, and expository teaching methods in enhancing the academic performance of biology students in ecological management in Uyo, Akwa Ibom State, Nigeria. The study aimed to:

- i. Determine the differences in the mean academic performance scores of biology students taught ecological management using each of the three methods: role-play, peer tutoring, and expository.
- ii. Identify the differences in mean academic performance scores between male

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and female biology students taught ecological management through these methods.

- iii. Investigate the interaction effects of teaching methods (role-play, peer tutoring, and expository) and gender on the students' mean academic performance scores in ecological management.

Research Questions

- i. What are the differences in the mean academic performance scores of biology students taught ecological management using role-play, peer tutoring, and expository methods, respectively?
- ii. What are the differences in the mean academic performance scores between male and female biology students taught ecological management through role-play, peer tutoring, and expository methods, respectively?
- iii. What are the interaction effects of teaching methods (role-play, peer tutoring, and expository) and gender on the mean academic performance scores of biology students in ecological management?.

Methodology

The study employed a quasi-experimental design with a non-randomised pretest-posttest control group. The study was conducted in three co-educational public secondary schools in Uyo Local Government Area, Akwa Ibom State, Nigeria. The population comprised all 2,335 Senior Secondary Two students studying biology across 15 public secondary schools in the Uyo Local Government Area, Akwa Ibom State. From this population, a sample of 183 Senior Secondary Two students was selected for the study. The sample was drawn from three co-educational secondary schools using the purposive sampling technique. The selected schools met the criteria of having qualified biology teachers and schools that have registered candidates for the West African Senior School Certificate Examination and National Examinations Council for the past 15 years. The Biology Achievement Test (BAT) was used for data collection. BAT was designed to measure the students' performance on the concept of ecological management. The test consisted of fifty (50) multiple-choice items, each with four options labelled A to D. Only one option was correct, while the other three served as distractors. The questions were based on the concept of forest conservation. The

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instruments were face validated by two experts: an experienced biology teacher with 10 years of teaching experience and a biology lecturer specialising in biology education at the University of Uyo. Kuder-Richardson 21 (KR-21) was used in determining the reliability index of the Biology Achievement Test. The choice of this reliability test is due to its ability to measure a single reliability coefficient that reflects the consistency of responses across different items in the test. With a reliability index of 0.87, this indicates that the reliability is good.

Experimental Procedure

The biology teachers in the sampled schools were used as research assistants with students in intact classes. Each of the classes was assigned to experimental group one, two and the control group, respectively. To qualify as research assistants, the three biology teachers were trained for one week. Well-prepared lesson packages were used by the research assistants in teaching animal adaptation in their respective groups for four weeks. Experimental group one was taught animal adaptation using the role-play teaching method. The research assistant divides the class into small groups. Assigns each group an animal to represent fish, camel, frog, bat, chameleon and polar bear. Explains the concept of adaptation and describes types of adaptations. Students perform their role-play before the class. The research assistant observes and guides performances. Experimental group two was taught animal adaptation using the peer-tutoring teaching method. The research assistant divides the class into peer tutoring groups (6-8 students). Each group gets one type of adaptation to study. The teacher selects a peer tutor in each group. Peer tutors guide their group members in reading and discussing their assigned adaptation type using materials provided. Students learn collaboratively and support each other. The research assistant moves around the class, supervising group discussions and clarifying difficult points. Each peer tutor leads group members in discussing examples and the importance of their adaptation type. In the control group, animal adaptations were taught using the expository method.

The data obtained from the performance test were analysed using mean, standard deviation and analysis of covariance (ANCOVA). Mean and standard deviation were used to answer research questions, while ANCOVA was used to test the null hypotheses at the 0.05 level of significance.

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Results and Discussions

Research Question 1: What are the differences in the mean academic performance scores of biology students taught ecological management using role-play, peer tutoring, and expository methods, respectively?

Table 1: Descriptive statistics showing the differences in the mean academic performance scores of biology students taught ecological management using role-play, peer tutoring and expository methods

Methods	Pretest			Post test		
	N	\bar{X}	SD	\bar{X}	SD	Mean Diff
Role-play	58	22.16	3.30	45.82	2.72	23.66
Peer-tutoring	61	21.21	3.68	42.02	3.25	20.81
Expository	64	21.68	3.60	34.18	2.89	12.50

Data in Table 1 presents the mean performance scores of biology students taught ecological management using role-play, peer tutoring, and expository methods, respectively. The results show mean scores of 23.66, 20.81, and 12.50 for students taught by role-play, peer tutoring, and expository methods. This indicates that students taught with role-play and peer tutoring performed better than those taught using the expository method. Therefore, there are differences in the mean performance scores, favouring students taught through role-play and peer tutoring.

Research Question 2: What are the differences in the mean academic performance scores between male and female biology students taught ecological management using role-play, peer tutoring, and expository methods, respectively?



Table 2: Descriptive statistics showing the differences in the mean academic performance scores between male and female biology students taught ecological management using role-play, peer-tutoring and expository methods

Methods	Gender	N	Pretest		Posttest		Mean Diff
			\bar{X}	SD	\bar{X}	SD	
Role-play	Male	27	21.65	2.64	45.52	2.57	23.87
	Female	31	22.59	3.76	46.07	2.85	23.48
Peer-tutoring	Male	31	21.19	3.61	42.07	3.02	20.88
	Female	30	21.23	3.67	41.96	2.81	20.73
Expository	Male	34	21.67	3.25	33.73	2.70	12.06
	Female	30	21.70	4.33	34.85	3.91	13.15

Data in Table 2 shows the differences in the mean performance scores between male and female biology students taught ecological management using role-play, peer tutoring and expository methods, respectively. The results show that male biology students gained higher mean performance scores in biology than their female counterparts when taught using role-play (23.87 versus 23.48) and peer tutoring (20.88 versus 20.73), respectively. However, as for the expository method, the reverse was the case, as the female biology students scored a higher mean gain in performance than the male biology students (13.15 versus 12.06), respectively. These results indicate that both role-play and peer-tutoring methods favour the male students, while the expository method favours female biology students.

Research Question 3: How do teaching methods (role-play, peer tutoring, and expository) and gender interact to affect the mean academic performance scores of biology students in ecological management?

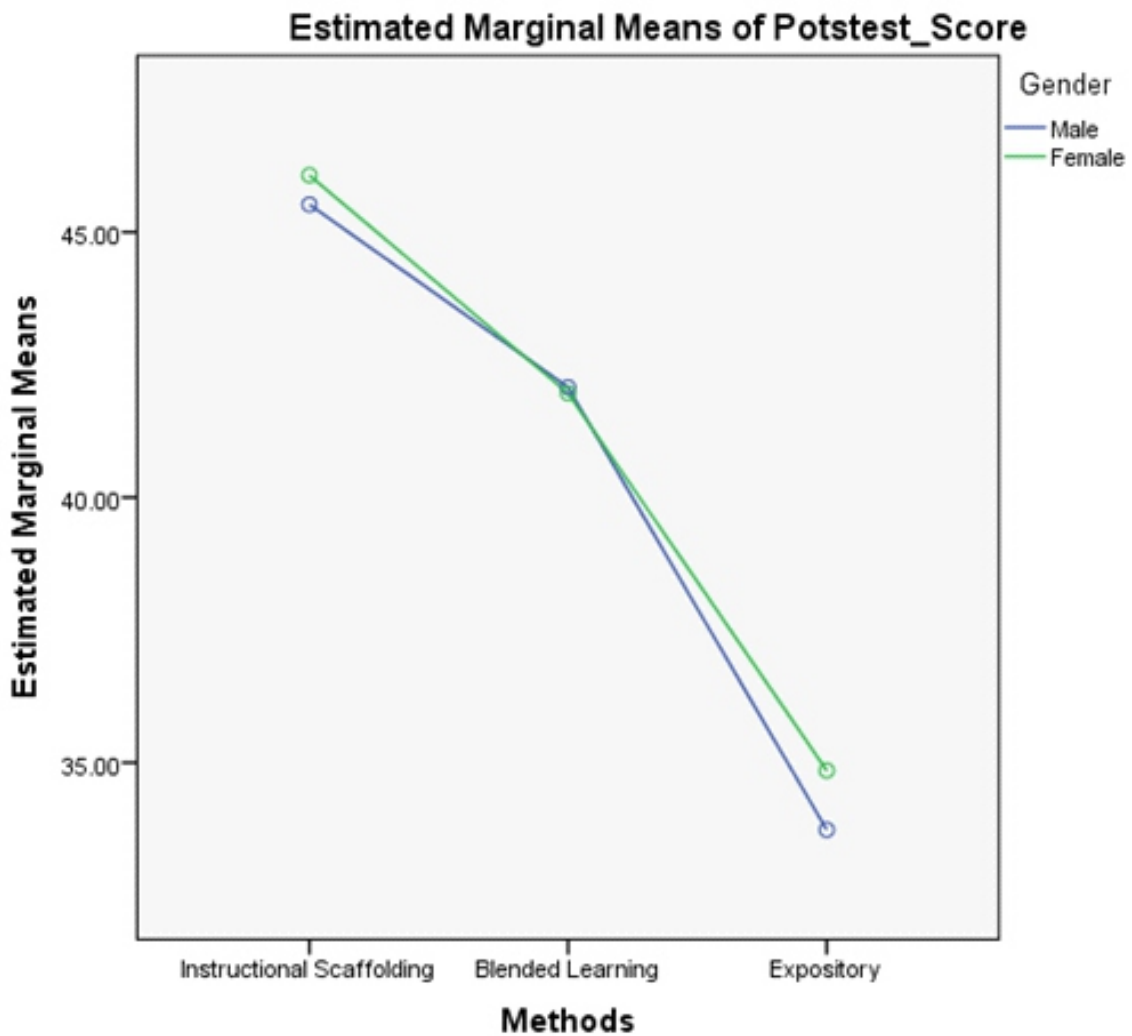


Fig 1: Plot for the interaction effects of teaching methods and gender on biology students' performance on ecological management.

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Figure 1 is the plot for the interaction effects of teaching methods and gender on biology students' performance on ecological management. The plot shows that female biology students taught using the role-play method gained a higher performance mean score of 46.07 than female biology students taught using peer tutoring (41.96) and the expository method (34.85). The result also shows that males taught using the role-play method secured higher mean performance scores of 45.52 than their counterparts taught using peer tutoring (42.07) and the expository method (33.73). This indicates that both male and female biology students taught using role-play and peer tutoring performed better than those taught using the expository method. This implies that there are no significant interaction effects of teaching methods (role-play, peer tutoring and expository) and gender on biology students' academic performance mean scores on ecological management.

Testing of Hypotheses

Hypothesis 1: There is no significant difference in the mean academic performance scores of biology students taught ecological management using role-play, peer tutoring, and expository methods, respectively.

Table 3a: Summary of ANCOVA for differences in the mean performance scores of biology students taught ecological management using role-play, peer-tutoring and expository methods

Source	Type III Sum of Squares	Df	Mean Square	F-value	P-value	Decision at $p < 0.05$
Corrected Model	3570.681	3	1190.227	139.477	0.000	*Sig
Intercept	5427.607	1	5427.607	636.036	0.000	
Pretest	42.252	1	42.252	4.951	0.028	
Methods	3498.008	2	1749.004	204.958	0.000	
Error	1271.489	149	8.533			
Total	258277.000	153				
Corrected Total	4842.170	152				

*Sig = Significant at $p < 0.05$

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Data in Table 3a presents the summary of the Analysis of Covariance (ANCOVA) for the posttest performance of biology students taught using role-play, peer tutoring, and expository methods, respectively. The calculated F-value for the main effect of instructional methods at 2, 152 is 204.958, while its corresponding calculated level of significance is 0.000 alpha. This level of significance is less than 0.05, on which the decision is based. The null hypothesis is rejected, indicating significant differences in the mean performance scores of biology students taught plastic waste management using ecological management, role-play, peer tutoring, and expository methods, respectively. Since the hypothesis was significant, further analysis was conducted to identify the direction of these differences and the performance trends. The result of the post hoc test using Duncan's test is presented in Table 3b.

Table 3b: Summary result of Duncan's test for differences in the mean performance scores based on the teaching strategies

Strategies	N	Subset		
		1	2	3
Expository	60	34.180		
Peer-tutoring	63		42.019	
Role-play	60			45.820
Sig.		1.00	1.00	1.00

Data in Table 3b shows that biology students taught using the role-play method achieved higher mean performance scores than those taught with peer tutoring and the expository methods, respectively. Students taught with peer tutoring also scored higher than those taught with the expository method. The differences among all three teaching methods were statistically significant, with $p < .05$.

Hypothesis 2: There is no significant difference in the mean academic performance scores between male and female biology students taught ecological management using role-play, peer tutoring, and expository methods, respectively.

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Table 4: Summary of ANCOVA testing differences among the performance mean scores of male and female biology students taught ecological management using role-play, peer-tutoring and expository methods

Source	Type III Sum of Squares	Df	Mean Square	F-value	ie	P- Decision at p<0.05
Corrected Model	161.752	2	80.876	2.592	0.078	*Not Sig
Intercept	5281.496	1	5281.496	169.264	0.000	
Pretest	64.434	1	64.434	2.065	0.153	
Methods	1584.042	2	792.412	1.979	0.067	
Gender	89.079	1	89.079	2.855	0.093	
Error	4680.418	150	31.203			
Total	258277.000	153				
Corrected Total	4842.170	152				

*Not Sig = Not Significant at $p > 0.05$

Data in Table 4 presents the summary of the Analysis of Covariance (ANCOVA) examining differences in the mean performance scores of male and female biology students taught ecological management using role-play, peer-tutoring, and expository methods. The calculated F-value for the main effect of instructional methods at 1, 152 is 2.855, while its corresponding P-value level of significance is 0.093 alpha. This level of significance is greater than 0.05. The null hypothesis is retained, indicating no significant differences in the mean performance scores between male and female students across the teaching methods.

Hypothesis 3: There are no significant interaction effects between teaching methods (role-play, peer tutoring, and expository) and gender on the mean academic performance scores of biology students in ecological management.

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Table 5: Summary of ANCOVA testing the interaction effects of teaching methods (role-play, peer-tutoring and expository) and gender on biology students'

Source	Type Sum of Squares	Df	Mean Square	F-value	P-value	Decision at p<0.05
Corrected Model	3587.811	6	597.968	69.600	0.000	*Not Sig
Intercept	5426.097	1	5426.097	631.566	0.000	
Pretest	40.462	1	40.462	4.710	0.032	
Methods	3327.080	2	1663.540	193.626	0.000	
Gender	8.241	1	8.241	0.959	0.329	
Methods * Gender	9.563	2	4.782	0.557	0.574	
Error	1254.359	146	8.591			
Total	258277.000	153				
Corrected Total	4842.170	152				

*Not Sig = Not Significant at $p > 0.05$

Data in Table 5 presents the summary of the Analysis of Covariance (ANCOVA) examining the interaction effects of teaching methods and gender on the mean academic performance scores of biology students in ecological management. The calculated F-value for the main effect of instructional methods at 2, 152 is 0.557, while its corresponding P-value level of significance is 0.574 alpha. This level of significance is greater than 0.05, on which the decision is based. The null hypothesis is retained, indicating that there are no significant interaction effects between teaching methods (role-play, peer tutoring, and expository) and gender on the mean academic performance scores of biology students in ecological management.

Discussion of Findings

The findings revealed a significant difference in the mean academic achievement scores of biology students taught ecological management using role-play, peer tutoring, and expository methods. The study's findings revealed significant differences in the mean

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performance scores of biology students taught ecological management using role-play, peer-tutoring, and expository methods, with role-play and peer-tutoring showing superior results. The significant differences might be due to the fact that role-play and peer-tutoring methods enable students to be actively involved in the teaching/learning process, thus facilitating their understanding of the subject matter taught. The result aligns with the findings of Ikwuka et al. (2021) and Longjohn and Osila (2022), which also reported significant differences among science students taught using role-play, peer tutoring, and expository methods, favouring role-play and peer tutoring.

The findings indicate no significant difference in the academic performance of male and female biology students taught ecological management using role-play, peer tutoring, and expository methods. Findings of the study show that there are no significant differences among the mean performance scores of male and female biology students taught ecological management using role-play, peer tutoring and expository methods, respectively. These results indicate that both role-play and peer-tutoring methods favour the male students, while the expository method favours female biology students. Therefore, there are no significant differences among the mean performance scores of male and female biology students taught ecological management using role-play, peer tutoring and expository methods, respectively. This might be due to the fact that the three teaching methods are student-friendly. This study is in line with the findings of Obijiofor and Obumneke-Okeke (2020) as well as Enebechi (2023), who found that gender has no significant difference on students' performance. However, this study is contrary to the studies of Taiye (2021) as well as Ani *et al.* (2022), who found that both male and female had a significant effect on students' performance in sciences.

Findings on interaction effects of teaching methods (role-play, peer tutoring and expository) and gender showed no significant difference. The results show no significant interaction effects of teaching methods (role-play, peer tutoring and expository) and gender on biology students' performance on ecological management. From the results, female biology students taught using role-play gained a higher performance mean score than female biology students taught using peer tutoring and expository methods. Results also show that males taught using the role-play method secured higher mean performance scores than their counterparts taught using peer tutoring and exposition. This indicates that both male and female biology students taught using peer tutoring performed better than those taught using the expository method. The result also shows that males taught using role-play and peer-tutoring methods performed better than female counterparts in the expository method. This suggests that there is no evidence of interaction between the three methods and gender as it affects their academic performance. Therefore, the null was retained. This implies

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that gender did not combine with the three teaching methods to affect the students' performance in the concept of ecological management. The finding of the study is in line with that of Irungu *et al.* (2019) as well as Oladejo *et al.* (2021), who found that there is no statistically significant relationship between gender interactions and academic achievement of learners in sciences. However, this finding is contrary to the studies of Mwhia (2020), who found that there are significant interaction effects of teaching strategies and gender on students' academic performance.

Conclusion

Based on the study's findings, it was concluded that among the three teaching methods investigated, role-play and peer tutoring were more effective than the expository method in improving students' performance in ecological management. Additionally, students' gender had no significant impact on their performance, and there were no significant interaction effects between teaching methods and gender.

Recommendations

1. Students should make use of role-play and peer-tutoring teaching methods in learning the concept of ecological management to improve their academic performance in biology.
2. Biology teachers should be dynamic in imparting knowledge and skills to students so as to improve male and female students' academic performance in biology.
3. Biology teachers should deploy role-play and peer-tutoring methods in teaching ecological management so as to improve students' academic performance in biology.

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