

## Effects of Classroom Interaction Patterns on Secondary School Students' Achievement in Ecology

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### Abstract

This study investigated the effects of classroom interaction patterns on senior secondary school students' achievement in ecology. A quasi-experiment of the pre-test, post-test non-equivalent control group design was adopted. Three groups were involved in the study. The first group was subjected to competitive interaction; the second group was subjected to cooperative interaction while the third group was subjected to individualistic interaction method. A total of ninety-three students (50 males and 43 females) from three intact classes were used for the study. The Ecology Achievement Test (EAT) was utilized as the data collection tool, with a reliability coefficient of 0.96. Research questions were answered using mean and standard deviation while the hypotheses were tested using analysis of Co-variance (ANCOVA) at a 95% confidence level. Findings revealed that students taught ecology in a cooperative classroom had higher mean achievement scores than those taught in individualistic and competitive classrooms interaction patterns. Furthermore, it was discovered that cooperative classroom interaction patterns had a significant effect on students' mean achievement scores in ecology. It was recommended that biology teachers prioritize the use of cooperative classroom interaction to facilitate biology instruction because of its proven efficacy in advancing students' achievement in ecology.

**Keywords:** Classroom Interaction Patterns, Biology, Ecology, Achievement in Ecology

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### Introduction

Education is a critical instrument for human and national development. It is in realization of this that development-craving nations are investing heavily in education in order to be part of the global partners for sustainable development. Science and technology have proven useful in man's struggle to control his environment and build a sustainable world. Specifically, Onanuga and Saka (2020) assert that effects of education on national development emanate basically from the areas of science and technology. In recent times, most developing nations are making frantic efforts to improve on the study of science and other related subjects in their schools. In Nigeria for example, the National Policy on Education stipulates that admission into the nation's tertiary institutions should be based on 60:40 ratio for science and arts related courses respectively (Federal Republic of Nigeria – FRN, 2013). Furthermore, the 9-3-4 system of education in Nigeria which focuses on self-reliance and sustainable national development is built around science and technology. At the secondary level of education in Nigeria, one of the science subjects projected to help develop individuals who will contribute in scientific and technological breakthrough of the nation is biology.

Biology to a lay man is conceptualized as the study of life, living things and their environment. It is one of the basic sciences like chemistry and physics that is essentially needed for a nation's technological breakthrough (Nnorom & Erhabor, 2019). It has a number of branches including ecology. Ecology is the scientific study of the relationships between organisms including humans, and their physical environment (Ibe & Abamuche, 2019). It seeks to understand the vital connections between plants and animals and the world around them (Umar, Fugu & Aliyu, 2018). The study of ecology is important because it enriches our world and is crucial for human well-being and prosperity (Salau, 2017). Furthermore, it provides new knowledge of the interdependence between people and nature that is vital for food production, maintaining clean air and water, and sustaining biodiversity in a changing climate (Maduabum, 2014). It therefore, portends that to develop a sound basis for modern technology the study of biology which enhances understanding of nature is imperative. Without sound knowledge and wholesome attention towards the study of biology, the much needed and craved technological breakthrough may not be actualized. This is because, the knowledge of biology plays significant role in the manufacturing and processing industries, medicine, pharmaceuticals, food stuffs, insecticides, among others (Adimonyemma, Akachukwu & Igboabuchi, 2018; Umar et al, 2018).

Unfortunately, research reports (Onu, Anyaegbunam & Uzoigwe, 2020; Onanuga & Saka, 2020; Ibe & Abamuche, 2019; Nnorom & Erhabor, 2019; Adimonyemma et al, 2018; Okoye, 2018; Salau, 2017; Umoh, 2016; Ugo & Kpoghol, 2016) show that students achieve academically poor in biology. Reports of the WAEC Chief Examiners Report in Biology reveal clearly that students' poor achievement in biology is traceable to their weakness in ecology which incidentally forms the bulk of the questions in all biology papers (WAEC Chief

Examiners Reports 2017, 2018 & 2019). According to the Chief Examiners reports the students' weaknesses were manifested in their inability to attempt most questions in ecology and poor illustrations in questions drawn from ecology. Incidentally ecology is a dominant theme in biology which encompasses basic ecological concepts, functional ecosystem, ecological management, aquatic habitats, terrestrial habitats and ecology of populations.

As postulated by Oviawe (2020), Nnorom and Erhabor (2019), interaction between teachers and students, students and their co-students are essential part of the teaching-learning process. Umar et al. (2018) defines classroom interaction as the sum total of all the teaching-learning activities taking place in the classroom between the teacher, the learners and the learning materials. The authors further argued that interaction between the teacher and students and between students to students during the teaching-learning process modifies behaviour, helps the students to socialize, develop desirable attitude and interest, help in identification of problems and creates an atmosphere to develop problem-solving skills. They identified classroom interaction to include co-operative, competitive and individualistic interaction patterns.

Co-operative social (learning) situation according to Oviawe (2020), Nnorom and Erhabor (2019), is one in which the goal attainment of an individual is positively correlated to the goal attainment of the members of the group. That is, the individual's rewards are directly proportional to the quality of the group work (Achor, Danjuma & Orji, 2019; Adimonyemma et al, 2018). The individuals work in group of four to five members, having common goals and seeking help and clarifications from other members rather than from the teacher; with the teacher praising and rewarding the group as a whole. In this case, the teacher acts as performance (positive behaviour) re-enforcer. Within the co-operative learning situation, achievement is measured by group performance and not based on individual performance of members (Salau, 2017) and all the component groups' work towards a common goal and a common reward. It is important to note that in this pattern inter-group synergy is emphasized. The competitive learning situation on the other hand, is one in which the goals of separate individuals or groups are negatively correlated (Adewale et al, 2016; Bolarinwa & Okolocha, 2016). Under competitive learning situation, the focus is to provide environment for interpersonal or inter-group competition where reward is based on the ability of an individual or group to outperform the others. In this pattern inter-group synergy is a taboo. In the individualistic pattern students work individually without emphasis on cooperation or competition and rewards are based on individual performance without reference to any group or synergy between individuals or groups in the classroom (Umoh, 2016; Sakiyo & Badau, 2015).

Furthermore, in individualistic classroom interaction pattern, there is no correlation among the goal attainment of the learners (Owodunni, 2015; Aderini et al, 2013). That is, whether a student accomplished his/her goal has no effect on whether other students achieve their own goal (Fatokun & Omenesa, 2015; Adodo & Oyeniyi, 2013). In each patterns of interaction gender is equally considered to be an important factor in students leaning of ecology because of the interplay of masculinity and femininity in different aspects of units which ranges from field trips, observations and real life interactions (Umoh, 2016; Emmanuel & Samuel, 2016). Gender differences in academic achievement in some fields of sciences have been attributed to interactions between physical, psychological and physiological attributes of the learners (Oviawe, 2020; Nnorom and Erhabor, 2019).

Although interaction pattern has been widely advocated and applied in arts and social sciences, its workability in ecology classroom has not been subjected to empirical verifications irrespective of the various claims and counterclaims by researchers in the fields of biology concerning the technique. As such the workability or otherwise, of these approaches in the teaching and learning of ecology in secondary schools in Nigeria, need to be empirically examined.

### **Research Questions**

1. What is the effect of classroom interaction patterns on the mean achievement scores of students in ecology?
2. What is the effect of classroom interaction patterns on the mean achievement scores of male and female students in ecology?

### **Hypotheses**

**H<sub>01</sub>:** There is no significant effect of classroom interaction patterns on the mean achievement scores of students in ecology.

**H<sub>02</sub>:** There is no significant difference in the mean achievement scores of male and female students in ecology due to classroom interaction patterns.

### **Methodology**

The Quasi experiment of the pre-test post-test non-equivalent control group design was adopted to examine the differential effects of classroom interaction patterns on SS II students achievement in ecology. Three groups were involved in the study. The first group was subjected to competitive interaction; the second group was subjected to cooperative interaction while the third group was subjected to individualistic interaction method.

Although the individualistic approach seems to be the conventional approach in schools, each procedure served as a control to each other. The study was carried out in Abakaliki Education Zone of Ebonyi State, Nigeria. Three co-educational secondary schools were drawn from the secondary schools in Ebonyi State through simple balloting. The schools were assigned to the three interaction categories (individualistic, Co-operative and Competitive) respectively through simple random sampling by balloting. Ecology Achievement Test (EAT) was used for data collection. The EAT was a multiple choice objective test containing 60 questions derived from the contents: basic ecological concepts, biomass, ecology population, soil and population studies with reliability coefficient of 0.96 using Kuder-Richardson Formula 20 (K-R 20). The first group was taught in a competitive interactive classroom environment, the second group in a cooperative interactive classroom environment while the third group was taught in individualistic classroom environment. Before the onset of the experiment, subjects in three groups were given pre-test. After the pre-test the regular Biology teachers started the experiment in their respective schools adhering strictly to the interaction patterns that were developed during the pre-experimental conference. The experiment was conducted during the normal school periods, following the normal timetable of the schools. To minimize errors which might arise as a result of teacher differences, the researcher organized a pre-experimental training for the biology teachers that were used for the study. Separate trainings were organized for teachers in the three groups. Manuals containing the specifications for the interaction patterns were made available to the teachers that participated in the experiment. Furthermore, intact classes were used for this study. Because it was impossible to achieve initial equivalence for subjects in the three groups, the researchers used the analysis of co-variance (ANCOVA) for data analysis so as to eliminate the errors of non-equivalence arising from the non-randomization of the individual subjects. Equally, to ensure that instructional situation were the same for all the three schools, the researchers provided concise instructional guides to the teachers in each group. All the students in the class (stream) were involved in the study. Research questions were answered using adjusted mean and standard deviation while the null hypotheses were tested at 95% confidence level using the Analysis of Co-Variance (ANCOVA).

## Findings

### Research Question 1

*What is the effect of classroom interaction patterns on the mean achievement scores of students in ecology?*

Data obtained for this research question with the ecology achievement test (EAT) for the three different interaction groups were used to answer this research question. Mean for pretest and posttest scores were adjusted statistically in the analysis to take care of the initial equivalence of the research subjects. This implies that the residual score was the basis for judgment. Summary of result of data analysis is presented in table 2.

**Table 1:** Mean Achievement Scores and Standard Deviation of Students in Ecology in different Classroom Interaction Patterns

Group	N	Adjusted Mean	Standard Deviation
Individualistic	25	29.00	5.58
Cooperative	40	56.70	9.40
Competitive	28	34.82	4.49

Summary of result presented in Table1 indicates that students taught ecology in individualistic classroom setting had an adjusted mean achievement score of 29.00, those in the cooperative group had mean achievement score of 56.70 while the students taught in a competitive group had mean achievement score of 34.82. The result indicates clearly that the students taught in a cooperative group had the highest mean achievement score thus, implying that cooperative classroom interaction pattern facilitated students' achievement in ecology more than in an individualistic or competitive classroom interaction patterns.

### Research Question 2

*What is the effect of classroom interaction patterns on the mean achievement scores of male and female students in biology?*

The pretest and posttest achievement scores of male and female students taught ecology in the three different classroom interaction patterns were adjusted in the analysis. The adjustment ensured that the residual score was the determinant of the judgment for the three groups. Summary of result is presented in table 2.

**Table 2:** Mean Achievement and Standard Deviation Scores of Male and Female Students in Biology in Different Classroom Interaction Patterns

Group	Male	N	Female	N
Individualistic	29.17	12	28.83	13
Cooperative	50.48	23	65.12	17
Competitive	36.87	15	32.46	13

Summary of result presented in Table2 showed that male students in the cooperative classroom interaction pattern had the highest mean achievement score (50.48) followed by those in the competitive group (36.87)

while those in the individualistic group had the least mean achievement score of 29.17. Similarly, female students in the cooperative group had the highest mean achievement score of 65.12, followed by those in the cooperative group (32.46) while those in the individualistic group had a mean achievement score of 28.83. This implies that at the two levels of gender (male and female), cooperative classroom interaction pattern facilitated male and female students' achievement in ecology more than the competitive and individualistic classroom interaction patterns.

### Hypotheses

**HO<sub>1</sub>:** There is no significant effect of classroom interaction patterns on the mean achievement scores of students in ecology.

**Table 3:** Analysis of Co-variance for Students Overall Ecology Achievement Score Based on Different Classroom Interaction Patterns

Source of variation	Sum of squares	Df	Mean square	F	F.sig.
Covariates	1534.625	1	1534.625	52.812	0.000
Main Effects	13302.371	3	4434.124	152.595	0.000
Interaction	13226.305	2	6613.152	227.584	0.000
Gender	462.208	1	462.208	15.906	0.000
2-Way Interactions (Patterns & Gender)	1666.676	2	833.338	28.678	0.000
Explained	16503.672	6	2750.612	94.659	0.000
Residual	2498.995	86	29.058		
Total	19002.667	92	206.551		

Summary of result on Table4 indicates that the alpha level (0.05) is greater than the F.Significant value (0.000). Based on the decision rule the researcher rejects the null hypothesis and concludes that there is a significant effect of classroom interaction patterns on the mean achievement scores of students in ecology.

**Ho<sub>2</sub>:** There is no significant difference in the mean achievement scores of male and female students in ecology due to classroom interaction patterns.

**Table 4a:** Analysis of Co-variance for students overall ecology achievement score in individualistic classroom interaction Pattern based on gender

Source of variation	Sum of squares	Df	Mean square	F	F.sig.
Covariates	234.427	1	234.427	15.298	0.001
Main Effects (Gender)	31.074	1	31.074	2.028	0.168
Explained	265.501	2	132.751	8.663	0.002
Residual	337.139	22	15.324		
Total	602.640	24	25.110		

As shown on Table 4a the alpha level (0.05) is less than the F.probability value of 0.168. Based on the decision rule the researcher upholds the null hypothesis with respect to individualistic pattern and conclude that there is no significant difference in the mean achievement scores of male and female students in ecology due to individualistic interaction patterns

**Table 4b:** Analysis of Co-variance for Students Overall Ecology Achievement Scores in Cooperative Classroom Interaction Pattern Based on Gender

Source of variation	Sum of squares	Df	Mean square	F	F.sig.
Covariates	259.319	1	259.319	7.199	0.011
Main Effects (Gender)	1850.320	1	1850.320	51.368	0.000
Explained	2109.639	2	1054.819	29.284	0.000
Residual	1332.761	37	36.021		
Total	3442.400	39	88.267		

Summary of result on Table 4b indicates that the alpha level (0.05) is greater than the f.probability value of 0.000. Based on the decision rule the researcher rejects the null hypothesis with respect to cooperative pattern and conclude that there is significant difference in the mean achievement scores of male and female students in ecology due to cooperative interaction patterns.

**Table 4c:** Analysis of Co-variance for Students Overall Ecology Achievement Scores in Competitive Classroom Interaction Pattern Based on Gender

Source of variation	Sum of squares	Df	Mean square	F	F.sig.
Covariates	0.001	1	0.001	0.000	0.993
Main Effects (Gender)	135.124	1	135.124	8.260	0.008
Explained	135.144	2	67.572	4.131	0.028
Residual	408.963	25	16.359		
Total	544.107	27	20.152		

As shown on Table 4c the alpha level (0.05) is greater than the F.probability value of 0.008. Based on the decision rule the researcher rejects the null hypothesis with respect to competitive pattern and conclude that there is significant difference in the mean achievement scores of male and female students in ecology due to competitive interaction patterns.

### Discussion of Results

Summary of result presented in Table1 indicated that there is a significant effect of classroom interaction patterns on the mean achievement scores of students in biology. The relative effectiveness of classroom interaction patterns in enhancing students' achievements could be due to the unique characteristics in the cooperative interaction pattern that allows students to interact freely among themselves while the teacher guides and directs the classroom talk towards a specific target (Viiri and Sari, 2006). The teacher in playing the guidance role moderates students' effort such that where there is a mistake or a digression, the teacher puts the students' right, so that students can make meaningful contributions. This result is in line with the findings of Ovia (2020), that cooperative mode of interaction is a more efficient means of facilitating students' achievement in science and basic technology as well as in attaining high levels of reasoning and higher level of scientific reasoning.

The cooperative interaction pattern encourages students' active participation and is democratic in nature because the teacher allows the students to participate actively in the lesson; while at the same time the teacher gives the students' praises and encouragement when they make correct attempts. In addition, the teacher entertains questions and free interaction exists among the students in their respective groups and between the teacher and the students (Nnorom & Erhabor, 2019); which encourages students to contribute freely on what they know or discovered during the learning process. The cooperative teaching-learning setting is synonymous to a learner-centred approach in teaching and learning which is no doubt an essential ingredient in students' optimal academic achievement and good classroom climate (Onimisi 2006). Promoting good classroom interaction therefore lies with the teacher that provides the enabling social and psychosocial atmosphere through democratic leadership style during lessons and day-day interactions with the learners (Onimisi, 2006).

The findings are in tandem with that of Nnorom and Erhabor (2019), Okoye and Onwuachu (2018), Owodunni (2015), who observed that cooperative classroom interaction patterns significantly, enhanced the achievement of male and female students alike in sciences. Specifically, the cooperative and competitive classroom interaction patterns were found to be more significantly effective in improving students (male and female) academic achievement in ecology.

### Conclusion

Based on the findings of this study the researchers conclude that cooperative classroom interaction patterns significantly improved students' achievement in ecology. Statistically, there was no significant effect of individualistic classroom interaction pattern on male and female students mean achievement scores in biology while a significant effect was noted on the mean achievement scores of male and females in cooperative and competitive classroom interactions.

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