

Effect of Classroom Interaction Patterns on Secondary School Students Cognitive Achievement in Biology

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Abstract

The study examined the effect of classroom interaction patterns on secondary school students' cognitive achievement in Biology in Edo State, Nigeria. Two research questions and two null hypotheses guided the study. The design of the study was a quasi-experimental, pre-test, post-test, non-equivalent control group design. A sample of 270 SSI biology students randomly drawn from six public co-educational secondary schools in Ikpoba Okha Education zone of Edo state were used for the study. An instrument known as Biology Achievement Test (BAT) was used for the study. The instrument was validated, and the reliability coefficient was established using Kuder Richardson K-R 20 and was found 0.87. The data collected were analysed using mean and standard deviation. Analysis of covariance (ANCOVA) was used to test the hypotheses at .05 level of significance. The results revealed that students taught with classroom interaction patterns perform better than those taught with conventional method, also gender has no significant difference in the mean cognitive achievement scores in biology due to application of classroom interaction patterns. Based on the findings, recommendations were made.

1. Introduction

Science and technology have proved significantly useful in man's daily struggle to control his environment and the world around him. Most developing nations as a result of visible role of science and technology now make frantic efforts to improve on the study of science and other allied subjects in their schools. Included among the basic science subjects is biology.

Biology occupies a unique position in the secondary school education curriculum because of its importance as science of life. In Nigeria, the secondary school biology curriculum is designed to promote students' investigation into natural phenomena, to deepen students' understanding and interest in biological sciences and also to encourage students' ability to apply scientific knowledge to everyday life in matters of personal, community, health and agriculture among others (Federal Ministry of Education, 2009). It is a prerequisite subject for many fields of learning, and that

contributes immensely to the technological growth of the nation. Biology is introduced to students at senior secondary school level as a preparatory ground for human development, where career abilities are groomed, potentials and talents are discovered and energized (Federal Republic of Nigeria, 2015). Biology has a very high enrollment of Students in Senior Secondary Certificate Examination (SSCE) than physics and chemistry. This clearly manifested itself in the Senior Secondary School Certificate taken every year [20]. Therefore, the quality and quantity of biology education like science education received by the Secondary school students would be focused towards the development of future scientist. As Amosa, Akawo, Eli and Queen (2014) noted that biology would help to develop future scientist, technologist, engineers and other related professions. A sound knowledge of biology is a prerequisite factor for entrance into such professions like medicine, pharmacy, nursing, agriculture, forestry, biotechnology, nanotechnology and so on [8]. This clearly shows that biology is very important to any growing economy.

Despite the importance of biology as one of a key subject in realizing any nation's scientific and technological aspirations, evidence of low achievement in the subject by Nigerian students abound (Chief Examiners' Report, 2010 - 2015) See fig. 1. The implication of this is that Nigeria may have shortages of manpower in the area of science and technology, which may affect Nigeria's achievement of vision 2010 to become one of the 20 industrialized nations in the world.

Year	Enrolled Students	Distinction/ Credit (%)	Pass/Failure (%)
2010	1,203,028	466,155 (38.75)	736913 (61.25)
2011	1,374,050	492,422 (35.84)	881628 (64.16)
2012	5,135,288	488,302 (9.51)	4646986 (90.49)
2013	609,026	96,202 (15.79)	512824 (84.20)
2014	841,863	36,348 (4.32)	805515 (95.68)
2015	1,036,520	322,310 (31.10)	714210 (68.90)

Source: West African Examination Council 2010 – 2015 Annual Report [19]

Figure 1. Statistics of students' enrollment and performance in Biology in May/June WASCE (2010 – 2015)

From Figure 1 result, it shows that in 2012, only 9.51 percent scored distinction and credit and 90.49 percent had pass and fail grades. None of the results from 2010 to 2015 recorded up to 40 percent distinction/credit. This was attributed to poor instructional strategy and subsequently poor cognitive achievement.

Achievement, according to Aniaku [3] is the quantity and quality of knowledge and skill an individual or groups acquired about a specific area of course and how that knowledge can be made use of in solving societal problems. It is however, the accomplishment of academic goals, the educational outcomes of students, the extent a student, a teacher or an instructor has achieved the stated objectives [3]. There is however no doubt that students' achievement is influenced by the teachers' teaching methods. This was observed by Okoyefi and Nzewi [15] who noted that teachers' teaching methods increased students' cognitive achievement in science subjects. Similarly, Opara [17] noted that teachers' method of teaching influenced students' cognitive achievement in science. Students vary in their academic abilities and this tends to be reflected in the extent to which they are affected by a particular teaching method. Various teaching methods are used by teachers in the teaching of biology aimed at bringing about meaningful learning. These include conventional method, lecture method, demonstration method, project among others. According to Awotua-Efeby [5], the conventional method is mainly teacher centered with student being consistently passive and content are taught as absolute knowledge. Unfortunately, evidence from literature showed that most science teachers in Nigeria secondary schools predominantly use conventional method in teaching science due to poor knowledge and no exposure to other learner centered method leading to poor cognitive achievement [2], [16]. Hence, there is need for an improved instructional strategy like application of classroom interaction patterns.

The issue of gender and biology achievement has attracted attention of some researchers [11]. The arbitrary assigning roles and the expectations to different sex (male and female) within the society has given rise to such misconception of perceiving science as masculine and male domain only. The problem is even compounded by the fact that most science educators give masculine outlook to science subjects such as physics and chemistry, encouraging females to go rather for biology, agriculture science and home economics which they consider to be more female-friendly science subjects. Some other researchers Okoyefi and Nzewi [15] are of the opinion that gender has no influence on students rather, student achieved equally when given equal opportunity. Hence, the researchers considered it necessary to explore the influence of gender on

cognitive achievement of biology students when exposed to integrative application of interaction patterns.

Integrative application of all the plausible classroom interaction patterns is what is called whole-class interactive teaching [13]. Also, Ogbu [13] noted that the predominant way in which classroom interaction occurs is called interaction pattern. Interaction pattern is a way in which messages are transmitted successfully between teachers and students to achieve instructional objective in the classroom [18], [9]. Whole classroom interactive teaching using interaction patterns is an instructional strategy whereby the teacher consciously and skillfully plans and executes every of his lesson so that the interaction patterns are plausibly and effectively applied per instant in each of lesson delivery. Classroom interaction is the sum total of activities taking place in the classroom between the teacher, the learner and the learning materials during the teaching process [6]. Classroom interaction pattern when applied properly is mainly student-centered, with students consistently very active and the teacher a facilitator. Mackey [6] also asserts that 'through the process of repetition, segmentation and rewarding, interaction can serve to draw learners' attention to form meaningful relationship and provide them with additional time to focus on encoding meaning'. According to Nurmasita [12] analysis of classroom interaction may be seen as an instrument which is designed to record categories of interaction during, or from, recorded teaching or learning session. It can be used for studying the chain of classroom events in such a fashion that each event is taken into consideration.

The four major classification of classroom interaction patterns according to Ogbu [13] are thus:

- Teacher-student interaction pattern: an interaction between the teacher and individual students or group of students.
- Students-students interaction pattern: that is where students reacts to each others actions attitude and opinions during class session, it is further classified as co-operative, competitive and individualistic interaction pattern.
- Teacher-material interaction pattern: that is when the teacher is manipulating instructional materials, machines and equipments for the purpose of skill learning or in other to stress a point or clarify some issues for the students.
- Students-material interaction pattern: when students look on instructional materials, machines and equipment solve practical problems or experiment with specimen or models.

Classroom interaction pattern is an instructional strategy whereby the teacher ensures that the above interaction patterns are effectively applied in each lesson delivery. By this strategy, the teacher ensures that only the advantages of each classroom

interaction are fully tapped, skillfully skipping their disadvantages. The question now is: can integrative application of classroom interaction patterns serve as an improved and more effective instructional strategy that can lead to students improved cognitive achievement in biology?

2. Purpose of the Study

The main purpose of this study was to find out the effect of classroom of interaction patterns on secondary school students' cognitive achievement in biology. Specifically, the study will:

1. Determine the effect of application of classroom interaction patterns and conventional method on students' cognitive achievement in biology.
2. Ascertain the effect of application of classroom interaction pattern of male and female students on cognitive achievement in biology.

3. Research Questions

The following research questions were formulated to guide the study:

1. What is the effect of classroom interaction patterns and conventional method on students' mean cognitive achievement in biology?
2. What are the mean cognitive achievement scores of male and female students exposed to different classroom interaction patterns?

4. Hypotheses

The following null hypotheses were formulated to guide this study:

1. The mean cognitive achievement scores of students taught with classroom interaction pattern will not differ significantly from those taught with conventional methods.
2. There is no significant difference in the mean cognitive achievement scores of male and female students in biology due to application of classroom interaction patterns.

5. Method

The study adopted the quasi experimental design. Specifically, the pre-test, post-test, non-equivalent control group design. The study was conducted within the Ikpoba Okha Education zone of Edo State. The sample for the study comprised of two hundred and seventy (270) SSI biology students drawn from six public co-educational secondary schools in the zone. The six co-educational secondary schools were drawn through a stratified random sampling. In each school, one intact-class was drawn for the study through simple random sampling. Out of the six co-educational schools, three schools were assigned to

the treatment group while the remaining three were assigned to the control group. The assignment of the schools to the treatment and control groups was done through a stratified random sampling. For the experimental group a total of one hundred and twenty-seven (127) students were used (58 males and 69 females), then for the control group one hundred and forty-three (143) students were used (83 female and 63 male).

The instrument used for data collection was the Biology Achievement Test (BAT) which has 20 items developed by the researchers, based on the biology topic "Unit of Life" which was from SSI biology curriculum. Face and content validity of the instrument were established by three experts from science education and measurement and evaluation from Chukwuemeka Odumegwu Ojukwu University, Nigeria. The internal consistency reliability coefficient was established using Kuder Richardson K – R 20 and was found .87.

6. Experimental Procedure

The regular biology class teachers were used for the study. Training was giving to biology teachers who took the experimental group on the application of various classroom interaction pattern while the biology teachers who took the control group used the conventional method. Since intact classes were used. The experimental stream teachers were given notes of lesson prepared by the researchers while the researchers vetted the lesson plan prepared by the biology teachers in the control group to ensure that the teachers did not deviate from the procedures of instructions commonly used by the biology teachers. Biology Achievement Test was used for both pre-test and post-test. Before the onset of the experiment, subjects in both treatment and control groups were given the pre-test.

The treatment consists of teaching the biology concept: 'unit of life' using classroom interaction patterns. Four major approaches of classroom interaction patterns were employed namely: teacher-students interaction pattern, student-student interaction pattern, teacher-material interaction pattern and student-material interaction pattern.

In teacher-student interaction pattern, the teacher introduces the topic and move into interaction section with the students either individually or as a group, here, the teacher do more of explaining while she listens to the students. The students are more active while the teacher is passive.

In students-students interaction pattern, the students reacts to each others action, attitude and opinion as the class proceeds. Here the teacher gives the students tasks to perform as a group and then later individually. The students were allowed to communicate their ideas and findings as members of

the group. The teacher went around supervising what they are doing, acting as a guide.

In teacher-material interaction pattern, the teacher presents to the students an instructional material as regards to the topic of discussion for the purpose of skill learning or in other to stress a point or to clarify some issues for the students.

In students-material interaction pattern, the students are allowed to work on the instructional materials provided by the teacher. The teacher divides the students into five groups, shares the instructional materials among the groups and ask the students to solve practical problems or experiment with it. The students were advised to consult their teachers when any difficulty relating to the concept under study arises but not teaching them.

For the control group, the conventional method was used in teaching the subjects in the sample schools. In this method, the teacher verbalized the relevant concept and principles during the lesson. The student watched and listened attentively, taking down relevant notes. The teaching of both experimental and control group was done during the normal school biology periods following the normal timetable of the school.

At the end of 6 weeks, the teacher administered the post-test (after reshuffling of the items) to the subjects. The scripts from both pre-test and post-test of the two groups were marked and scored using the marking guide. The data collected from pre-test and post-test were analysed using mean and standard deviation for answering the research questions, analysis of covariance (ANCOVA) for testing the hypotheses at 0.05% of confidence.

7. Results

Research question 1

What is the effect of classroom interaction patterns and conventional method on students' mean cognitive achievement in biology?

Table 1. Mean and Standard deviation for the experimental and control groups

Groups	N	Pretest		Post test		Mean achievement Gain
		Mean	SD	Mean	SD	
Treatment	127	21.3671	8.2356	59.2718	7.48	37.9047
Control	143	19.1687	6.7432	40.2116	10.51	21.0429

According to Table 1, results reveal that students taught by teachers who employed classroom interaction patterns (experimental group) perform better than those taught by teachers who employed conventional methods of teaching as shown by post test scores of 59.2718 and 40.2116 with achievement gain of 37.9047 and 21.0429.

Research Question 2

What are the mean cognitive achievement scores of male and female students exposed to different interaction patterns?

Table 2. Mean and Standard Deviation (SD) for the Experimental group across the sex

Groups	Sex	N	Pretest		Post test		Mean achievement Gain
			Mean	SD	Mean	SD	
Treatment	Male	58	20.2781	8.5816	54.4416	8.3215	34.1635
	Female	69	21.1568	7.4507	60.0226	6.6423	38.8658

Table 2 result revealed the pretest mean scores and SD scores for the experimental male and female are 20.2781 and 8.5156; 21.1568 and 7.4507 respectively. Similarly, the post-test mean scores and SD scores for the experimental male and female are 54.4416 and 8.3215; 60.0226 and 6.6423. The mean achievement gain for male and female in the treatment group are 34.1635 and 38.8658 respectively.

Table 3. Summary of ANCOVA Table by method and gender

Sources of Variation	Sum of Squares	df	Mean Squares	F	F _{cv}
Covariance	699.331	1	699.331	3.237	
Main Effects	54408.711	2	27204.355	125.927	
Gender	650.486	1	650.486	3.011	3.84
T. method	49284.172	1	49284.172	228	3.84
2-way interaction (Gender & T. method)	715.725	1	715.725	3.313	3.84
Explained	55823.767	4	13955.942	64.601	
Residual	51415.863	268	216.033		
Total	107239.630	270			

From the hypothesis result across method, the ANCOVA table shows that F-cal (228) is greater than the critical value (3.84) at an alpha level of 0.05. Therefore, since the calculated value is greater than the critical value, the null hypothesis was rejected. Hence, there is a significant difference in the mean achievement scores of students taught biology using classroom interaction pattern and those taught using the conventional method. The experimental group performed better than the control group.

For hypothesis result on difference across gender, Table 3 result reveal that F-cal (3.011) is less than F_{cv} (3.84) at an alpha level of 0.05. Since the calculated value is less than the critical value at the given alpha; the null hypothesis is not rejected. Therefore, there is no significant difference in the mean cognitive achievement scores of male and female students in biology due to application of classroom interaction patterns.

8. Discussion

The findings of this study showed that the treatment group obtained a higher mean cognitive achievement score as a result of their teacher

application of classroom interaction patterns compared to their control group counterparts. The superiority of the treatment group over the control group is in agreement with the findings of researchers who had an innovative experimental treatment in their study (Aniekwe, 2002; [13].

In the case of gender, the findings of this study revealed that female students scored slightly higher than their male counterparts in BAT. That was further confirmed by the ANCOVA result in table 3 which revealed that gender was not a significant factor on students achievement in science. This result agrees with the findings of Okoyefi & Nzewi [15]; Nnorom [10]; Ogunleye & Babajide [14], who found no significant difference in the achievement of male and female students in science subjects.

9. Conclusion

The findings of this study have shown that application of classroom interaction patterns is a practically efficacious instructional strategy in enhancing students' cognitive achievement scores in mainstream classrooms. Hence, application of classroom interaction pattern is a better instructional strategy than the conventional teaching methods. Also, it was concluded that although with the application of classroom interaction pattern female students score slightly higher than their male counterparts. The difference in the mean achievement scores of male and female taught biology using application of classroom interaction pattern is not statistically significant.

10. Recommendations

The following recommendations were made:

- The federal and state government should organized incentive laden in-service training programme for all serving science teachers, especially biology to impact knowledge of the theories of classroom interaction patterns on the teachers for dynamic and improved teaching.
- Science curriculum should be reviewed in terms of the basic instructional approach to incorporate integrative application of interaction pattern.

11. References

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