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EFFECTS OF COOPERATIVE, COMPETITIVE AND INDIVIDUALISTIC CLASSROOM INTERACTION PATTERNS ON STUDENTS' ACADEMIC PERFORMANCE IN PHYSICS IN OGUN STATE, NIGERIA

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Abstract:
The study determined the effects of cooperative, competitive and individualistic classroom interaction patterns on the performance of secondary school students in Physics. It also examined the moderating effect of gender on dependent measure. The study adopted the pretest, posttest, control group quasi experimental design. The sample consisted of 214 senior secondary school I students (104 males and 110 females) from four intact classes randomly selected in two local government areas of Ogun State using the cluster sampling technique. The classes were randomly assigned to one control group and three experimental groups. The experimental groups were Cooperative Interaction Pattern (COIP), Competitive Interaction Pattern (CMIP), and Individualistic Interaction Pattern (IDIP) while the Conventional Method of Teaching (CVMT) served as the control group. The instrument titled "Physics Achievement Test (PAT)" was used to collect data for the study. Data collected were analysed using t-test and F-statistics. The results showed that the academic performance of secondary school students in Physics was significantly influenced by each of the classroom interaction patterns of Cooperative ($t= 23.04$, $p< 0.05$); Competitive ($t= 18.18$, $p< 0.05$) and Individualistic ($t= 16.10$, $p< 0.05$). The results also showed that there was no significant difference between the performance of male and female students taught using each of the interaction patterns of Cooperative ($t= -0.531$, $p>0.05$); Competitive ($t= -0.278$, $p>0.05$), and Individualistic ($t=0.523$, $p>0.05$). The results further showed that there was

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significant effect of COIP ($t=6.77$, $p<0.05$) and IDIP (4.02, $p<0.05$) on students' retention ability but there was no significant effect of CMIP ($t=0.98$, $p>0.05$) and CVMT ($t=1.23$, $p>0.05$) on the retention ability of the students. The study concluded that the cooperative classroom interaction pattern should be used in Physics classroom as it could improve students' learning in Physics.

Keywords: interaction patterns, academic performance, physics, senior secondary schools

1. Introduction

The importance of Physics made its inclusion in the Nigerian senior secondary school curriculum imperative. For solid technological foundation and development, Physics education needs to be given serious attention and priority in a nation's educational system. In spite of the importance of Physics as a requirement for many specialized science and engineering courses at the tertiary educational institutions, students' performance at the secondary school level in Nigeria has not been encouraging. Several research reports spanning over a decade, (Okoli, 2001, Nwagbo, 2001, Omotayo and Yusuf 2002, Okoli 2005 and Nweke 2015) are consistent that students achieve poorly in Secondary School Science subjects. Similarly, statistics from the West African Examination Council (WAEC) reports (2013, 2014 and 2015), and the National examination Council (NECO, June/July, 2013, 2014 and 2015) on students performances in the sciences, (Biology, Chemistry, Physics And Mathematics) converge on the fact that students record very poor performance in the Senior Secondary School Certificate Examination (Omiko, 2015).

Researchers have identified causes of students' poor performance in science subjects; particularly Physics, to include poor teaching methods, lack of qualified teachers, poor infrastructure and inadequate laboratory facilities, teacher-centered instruction, and non-availability and non-utilization of instructional materials (Bajah, 2000; Gambari, 2010; Olorukooba, 2007). Some science teaching strategies have been established to be effective and efficient in promoting and maximizing science learning outcomes. Such strategies include cooperative learning (Hanze & Berger, 2007; Doymus, 2008); computer-assisted instruction (Tekos & Solomonidou, 2009; Yusuf & Afolabi, 2010), guided discovery, concept mapping, field trip, demonstration method, among others. In spite of the proofed efficiency of these strategies, they are rarely used in Nigerian science classrooms. In a much broader sense, the divergent teaching techniques that have been adopted by pedagogues in order to support students'

performance in Physics ranges from some teacher-centred techniques to other learner-centred methods. However, in this part of the world, the commonest type of teaching technique seems to be the teacher-centred whole-classroom teaching which is referred to as teacher expository method. This method requires that the learners sit and listen to the teacher as he/she presents the content of the day's lesson, with students asking few questions when necessary and supplying responses when asked to do so by the teacher.

In classroom practices nowadays, a close appraisal of the current trend shows that the dominant strategy is teacher-centered which tends to emphasize rote learning rather than meaningful learning (Ifamuyiwa and Akinsola, 2005). This method of teaching has failed to promote genuine Physics understanding. The persistent poor performance of student seems to have been partly ascribed to the foregoing traditional teaching and instructional method adopted by science and Physics teachers. Similarly, persistent use of traditional mode of instruction seems to have been identified as one of the major problems affecting learning and higher achievement in science and Physics.

In order to change this paradigm, classroom interaction needs to be improved upon; appropriate teaching/learning strategies need to be employed as teaching/learning situation may demand. Most of the Physics students might acquire science concepts much easier by interacting with one another in the company of their teachers who are more matured or expert users of mathematical language and concepts. One of the major problems of teaching and learning nowadays is the idiosyncrasy of classroom interaction which in parts is traceable to insufficient interaction among the students. Hence, for efficient classroom interactions, a classroom teacher has the choice of structuring his or her lessons cooperatively, competitively or individualistically as present educational system is not rigid upon a particular interaction.

2. Statement of the Problem

The persistent poor performance of students in Physics in public examinations has called for research efforts to explain the causes of such poor performance. Many studies have thus been conducted with a major focus on teachers and students' characteristics. However, only a few have focused on the classroom interaction patterns and the influence on students' performance and retention in Physics. It is generally the case that teachers employed in schools serve the purpose of promoting desired learning in their students. To this end, the teachers' skill in managing classroom interactions will determine to a large extent his/her effectiveness, which in turn can be rated by the degree to which he/she causes students to learn what they are supposed to learn.

In physics lessons, students can work together to achieve learning objectives and goals by cooperating and collaborating with their peers. They can also work competitively and on their own. Studies have revealed that these classroom interaction patterns have significant influence on students' performance. However, few studies have empirically established the comparative effects of the three interaction patterns on students' performance and retention ability in physics. Thus, this study was concerned with comparing the effectiveness of cooperative, competitive and individualistic classroom interaction patterns on the performance of secondary school students taught Physics. It also assessed the effect of the different classroom interaction patterns on students' retention ability in Physics.

3. Hypotheses

The following null hypotheses were tested at 0.05 level.

i. There is no significant difference in the performance of students taught Physics using cooperative, competitive, individualistic interaction patterns and conventional method of teaching.
ii. There is no significant difference in the performance of male and female students taught Physics using cooperative, competitive, individualistic interaction patterns and conventional method of teaching.
iii. There is no significant difference in retention ability of students taught Physics using cooperative, competitive, individualistic interaction patterns and conventional method of teaching.

4. Methodology

The population for this study comprised all senior secondary school class one students in public schools in Ogun State, while the sample consisted of 214 senior secondary school I students from four intact classes randomly selected from two local government areas in Ogun State using the cluster sampling technique. The schools form Ijebu Ode Local Government were Adeola Odutola College and Christ Church Secondary School while Ipara Remo Secondary School and Sapade Grammar School were selected form Remo North Local Government.

Two research instruments were used for data collection. The first instrument was teaching guides for the identified interaction patterns that would take place in the experimental classes. Each of the participating teachers were taken through the teaching guide on the nature of the interaction pattern they were to use and how they were to be

adapted for use in the teaching and learning process. The second instrument was titled Physics Achievement Test (PAT). It was developed by the researcher to test students' performance in Physics before and after exposure to the treatments. The test was based on the Ogun State Ministry of Education approved scheme of work for SS1. The test consisted of two sections A and B. Section (A) sought personal information on the students with respect to name, school, students' gender and class while Section (B) was made up of twenty five (25) multiple choice objective test items from which the students were asked to choose the correct option from alternatives given. The instrument was used to collect pretest and posttest data. The content of the test covered all the topics that were taught during the experiment. The questions were standardized and validated. The reliability coefficient was 0.86 using split-half reliability test.

The data collection procedure involves three main stages, which are: the pre-treatment stage, treatment stage and post treatment stage. The study lasted eight weeks. During the first week which is the pre-treatment stage, all the participating students in both experimental and control group were first given a test (pre-test). The treatment stage which lasted for 4 weeks covered three topics in Physics which are: Fundamental and Derived Units, Motion and Work. Throughout the course of these weeks the researcher monitored each class in order to make sure desirable treatment guides were strictly followed interaction patterns took place at each lesson. The teachers used the teaching guide developed by researcher as a directive.

The experimental groups were Cooperative Interaction Pattern (COIP), Competitive Interaction Pattern (CMIP), and Individualistic Interaction Pattern (IDIP) while the Conventional Method of Teaching (CVMT) served as the control group. In the cooperative interaction pattern, students worked together in small clusters or groups and every member of the group was held accountable for the group's achievement. In the competitive interaction pattern group, students were ranked from highest to lowest in achievement through collaborative learning. In individualistic interaction pattern, students worked alone and were not expected to be interrupted by other students. In the conventional teaching method, students mastered knowledge through drill and practice. During the 6^{th} week which was the post-treatment stage, the PAT was administered on the students as posttest so as to determine their level of performance after their exposure to the different interaction patterns. Lastly, the test was administered on the students two weeks after the post-test to determine the retention ability of the students. The students' scripts were collected and graded as appropriate. The data collected were analyzed using t-test and F-test statistics.

5. Results

5.1 Hypothesis One

Hypothesis one states that there is no significant difference in the performance of students taught Physics using cooperative, competitive, individualistic interaction patterns and conventional method of teaching. The overall effect of the interaction patterns on the posttest scores of the students was determined. This was done via the subjection of the post-test scores to the Analysis of Covariance (ANCOVA) using their pretest scores as covariates. The result obtained is presented in the Table 1.

Table 1: Analysis of Covariance of differences in the Performance of Students taught using the Cooperative, Competitive, Individualistic and Conventional Interaction Patterns

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	131.710[a]	4	32.928	4.209	.003	.075
Intercept	2677.852	1	2677.852	342.287	.000	.621
Pre-test scores	54.159	1	54.159	6.923	.009	.032
Group	75.507	3	25.169	3.217	.024	.044
Error	1635.094	209	7.823			
Total	37518.000	214				
Corrected Total	1766.804	213				

Tests of Between-Subject Effect

Dependent Variable: POST-TEST SCORES

R Squared = .075 (Adjusted R Squared = .057)

Results from Table 1 indicated that after adjusting for pretest scores, there was a significant effect of the between-subjects factor group (interaction patterns), $F(3,209)=3.217$, $p=0.024$, partial $\eta^2 = 0.044$.

Table 2: Adjusted Mean Performance Scores of Students taught using the Cooperative, Competitive and Individualistic Interaction Patterns and Conventional Teaching Method

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Cooperative	13.527[a]	.367	12.802	14.251
Competitive	12.895[a]	.417	12.073	13.718
Individualistic	12.061[a]	.355	11.361	12.761
Conventional	13.334[a]	.400	12.546	14.122

Covariates appearing in the model are evaluated at the following values: PRE-TEST SCORES = 4.79

Adjusted mean performance scores as shown in Table 2 suggest that students in the individualistic interaction pattern group have lower performance scores when compared to the cooperative, competitive interaction patterns and the conventional teaching method.

Table 3: Pairwise Comparisons of Mean Difference in Performance of Students taught using the Cooperative, Competitive and Individualistic Interaction Patterns and Conventional Teaching Method

Dependent Variable: POST-TEST SCORES						
(I) GROUP	**(J) GROUP**	**Mean Difference (I-J)**	**Std. Error**	**Sig.[a]**	**95% Confidence Interval for Difference[a]**	
					Lower Bound	**Upper Bound**
Cooperative	Competitive	.631	.556	.257	-.464	1.727
	Individualistic	1.466*	.511	.005	.458	2.473
	Conventional	.193	.543	.723	-.878	1.263
Competitive	Cooperative	-.631	.556	.257	-1.727	.464
	Individualistic	.835	.548	.129	-.246	1.915
	Conventional	-.439	.578	.449	-1.578	.700
Individualistic	Cooperative	-1.466*	.511	.005	-2.473	-.458
	Competitive	-.835	.548	.129	-1.915	.246
	Conventional	-1.273*	.535	.018	-2.327	-.219
Conventional	Cooperative	-.193	.543	.723	-1.263	.878
	Competitive	.439	.578	.449	-.700	1.578
	Individualistic	1.273*	.535	.018	.219	2.327
Based on estimated marginal means						
a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).						
*. The mean difference is significant at the .05 level.						

Additional statistics provided by the pairwise comparisons of mean difference in the performance of students taught using the interaction patterns (Table 3) revealed that there is a significant mean difference between the performance of students in the cooperative and individualistic interaction pattern. Also, there exist a significant mean difference between the performance of students in the conventional teaching method group and the individualistic interaction pattern group.

5.2 Hypothesis Two

Hypothesis two states that there is no significant difference in the performance of male and female students taught Physics using cooperative, competitive, individualistic interaction patterns and conventional teaching method. Inferences were drawn for responding to this hypothesis by comparing the posttest scores of male and female students in each of the interaction pattern group using t-test statistics. The results obtained are as presented in Table 4.

Table 4: Table showing Differences in the Performance of Male and Female students in the Cooperative, Competitive, Individualistic Interaction Patterns and Conventional Teaching Method

Group	Gender	N	$\bar{X}$	s.d	Df	t	*p*
Cooperative	Male	30	13.37	2.98	56	0.531	0.597
	Female	28	13.75	2.47			
Competitive	Male	22	12.77	3.22	43	0.278	0.782
	Female	23	13.04	3.31			
Individualistic	Male	32	12.25	3.20	60	0.523	0.603
	Female	30	11.83	3.06			
Conventional	Male	20	12.76	2.98	47	0.429	0.687
	Female	29	11.34	3.02			

From table 4, the t-value are 0.531, 0.278, 0.523, 0.429 respectively for cooperative, competitive, individualistic interaction patterns and conventional teaching method groups which indicated that there is no significant difference between male and female performance in the groups at $p<0.05$

5.3 Research Hypothesis Three

Hypothesis three stated that there is no significant difference in the retention ability of students taught physics using cooperative, competitive, individualistic interaction patterns and conventional method of teaching. Prior to the determination of whether significant differences exist in the retention ability of students taught Physics with the

different interaction patterns, the effect of the each of the interaction patterns on students' retention ability was first determined. This was done by comparing the retention test scores with the post-test scores using the paired sample t-test. The results obtained were later represented using ANOVA presented in Tables 5.

Table 5: Analysis of Variance of differences in the Retention Ability of Students taught using the Cooperative, Competitive, Individualistic and Conventional Interaction Patterns

ANOVA					
Source of Variation	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	98.141	3	32.714	4.231	.006
Within Groups	1623.840	210	7.733		
Total	1721.981	213			

Results obtained from Table 5 shows that $F(3,210)=4.231$, $p<0.05$. From the table above, there is a significant difference in the retention ability of the students in the interaction patterns and conventional teaching method groups. The Scheffe Post hoc multiple comparisons analysis as shown in Table 6 reveals that there is a significant difference between the retention ability of students in the cooperative and individualistic interaction pattern groups and between the retention ability of students in the competitive and individualistic interaction pattern groups both in favour of the cooperative interaction pattern group.

Table 6: Multiple Classification Analysis of Differences in the Retention Ability of Students taught using the Cooperative, Competitive, Individualistic and Conventional Interaction Patterns

(I) GROUP	**(J) GROUP**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Cooperative	Competitive	1.030	.552	.327	-.53	2.59
	Individualistic	1.487*	.508	.038	.06	2.92
	Conventional	1.725*	.540	.019	.20	3.25
Competitive	Cooperative	-1.030	.552	.327	-2.59	.53
	Individualistic	.458	.545	.872	-1.08	1.99
	Conventional	.696	.574	.690	-.92	2.31
Individualistic	Cooperative	-1.487*	.508	.038	-2.92	-.06
	Competitive	-.458	.545	.872	-1.99	1.08
	Conventional	.238	.532	.977	-1.26	1.74

Conventional	Cooperative	-1.725*	.540	.019	-3.25	-.20
	Competitive	-.696	.574	.690	-2.31	.92
	Individualistic	-.238	.532	.977	-1.74	1.26
*. The mean difference is significant at the 0.05 level.						

6. Discussions

Findings indicated that significant differences exist between the performance of students in cooperative and individualistic interaction patterns in favour of the cooperative group. The findings of agreed with that of previous studies such as those of Johnson, Maruyama, Johnson, Nelson and Skon (1998), Slavin (1990), Alebiosu (1998), Esan (1999), Olorukooba (2007), Kolawole (2008), Effandi (2010) and Ojo (2011). The findings of this study thus supports major findings that have supported the notion that collaborative skills are highly essential in helping students learn scientific concepts. Findings of the study also showed that students in the conventional teaching method group perform better than students in the individualistic interaction pattern group. This finding is not surprising when viewed from the perspective that the conventional teaching method utilizes a combination of various teaching strategies, techniques and methods in the accomplishment of learning outcomes.

The result showed that there was no significant difference in the performance of male and female students taught Physics under cooperative, competitive, individualistic interaction patterns and conventional teaching method. This implies that male and female students exposed to the same interaction pattern do not differ significantly in their performance scores in Physics. The implication of this is that gender is not a barrier to performance when cooperative, competitive, individualistic interaction patterns and conventional teaching method are in use. The findings of this study is supported by the previous research efforts of Okebukola and Ogunniyi (1984) and Ojo (2011) who observed non-significant gender differences in achievements in cooperative small group in biology and mathematics respectively.

Findings revealed that there is significant difference in the retention ability of students in the groups. More specifically, there is difference between the retention ability of students in the cooperative and competitive interaction pattern group and between the retention ability of students in the cooperative interaction pattern group and the conventional teaching method group. The findings of the present study has thus emphasized the need for physics concepts to be presented to the learners in a way or method that touches their sub-consciousness which can trigger quick recalling of other or related concepts being taught or learnt (Kundu & Tutoo, 2002). From the above

findings, it might be established that the use of teaching strategy such as cooperative learning enable students to collaborate in terms of understanding, explaining and retaining the concept they have learnt in a physics class.

7. Conclusion

From the study, it could be inferred that the cooperative interaction pattern is better than the other interaction patterns of competitive and individualistic interaction patterns and the conventional teaching method in improving students' learning outcomes in Physics. It should therefore be used in the teaching of Physics in secondary schools.

8. Recommendations

Based on the findings of the study, it is hereby recommended that Physics teachers should expose the students to cooperative learning method to encourage social interaction, active engagement and self-motivation among learners. Also, teachers should be encouraged to attend regular workshops and seminars to acquaint themselves with requisite skills to use cooperative teaching method. Textbook writers should shift emphasis from teachers' activities to students' activities that will promote the incorporation of cooperative learning method in Physics textbook. Curriculum planners should ensure that curriculum implementation put into practice the use of cooperative teaching method. The heads of educational institutions should supervise the implementation of the cooperative teaching method in their institutions.

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