COMPARATIVE EFFECTIVENESS OF TWO INSTRUCTIONAL STRATEGIES ON PHYSICS STUDENTS' ACADEMIC PERFORMANCE IN OSUN STATE, NIGERIA

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Abstract

The study determined the effectiveness of collaborative and flexible grouping learning strategies in enhancing immediate academic performance of Physics students in Senior Secondary Schools in Osun State. Pre-test, post-test, control quasi-experimental design was adopted for the study. The target study population comprised Senior Secondary School Two (SSS II) Physics students in Osun State, while the study sample comprised three intact classes of 129 Senior Secondary School Two (SSS II) Physics students in Ife East Local Government Area, Osun State. Multistage Sampling Procedure was used to select the sample. Physics Academic Performance Test (PAT) was used to collect data for the study. Data collected were analysed using inferential statistics of ANOVA and Analysis of Covariance (ANCOVA) at 0.05 level of significance. Result from research hypothesis one showed that there was a significant difference in the effectiveness of the strategies in enhancing academic performance in Physics among the students ($F = 9.545$, $p < 0.05$). Result of research hypothesis two showed that there was a significant difference in the effectiveness of the learning strategies in the delayed academic performance of the respondents ($F=13.35$, $p<0.05$). The result however showed that collaborative learning strategy was more effective in enhancing academic performance and delayed academic performances of Physics students than the flexible grouping learning and conventional strategy. It is therefore recommended that policy makers especially the Ministry of Education should try to put forward policies that would encourage adherence to innovative teaching strategies such as collaborative learning strategy in Physics classrooms.

Keywords: Science education, physics, students' academic performance

Introduction

Physics is a branch of science that is centred on matter and its interaction with energy, it is taught at the senior secondary level with the objective of providing basic literacy for functional living in the society; as well as stimulating and enhancing creativity NERDC (2009). With respect to its numerous advantages, Physics is introduced in Nigerian secondary school curriculum so as to provide a solid foundation for everyday living. This will be achieved through adequate teaching and learning with the application of appropriate strategies. The teaching of Physics is also important to develop computational skills and ability to be accurate to a degree relevant to the problem in hand. Physics was also essential to the stimulating and promoting

the creativity of students. (FGN, 2004). To achieve these stated objectives, the onus rest on the teachers to possess adequate pedagogical skills. These pedagogical skills can only be established during teaching/learning process by the teacher. It is then demanded of Physics teachers to begin to;

(i) select the appropriate content based on the use of learners
(ii) select the appropriate instructional materials to make learning meaningful;
(iii) select the appropriate methodology
(iv) select the mode of evaluation so as to test whether the objectives have been accomplished or not.

Despite the effort and ability aimed at enhancing Science and Technology Education in Nigeria, the goals have not been the same with respect to gender. Girls are underachieving and inadequately-represented in Physics as a subject (Ogunleye & Babajide, 2011). This may imply that there exists a gap in the enrolment and performance of male/female students in Physics. Nkwo, Akinbobola and Edinyang (2008) found out that male students achieved higher than girls. Ukwungu (2006) after performing a meta-analysis of gender differences in students' performance in Physics discovered higher success rate in boys than girls. Okwo and Otubah (2007) also reported that boys do better than girls in Physics essay test. On the other hand, Adeoye (2010) reported that females achieved better than males when Physics test items are based on concepts that require learners of low numerical ability while the reverse is the case when the test is based on Physics concepts that require learners of higher numerical ability.

Adequate teaching strategies would be important for the possession, acquisition and application of knowledge learnt in Physics and would enhance full participation of male and female students in Physics. Teachers need to begin to use appropriate strategies needed for the development of a scientifically literate individual. This will first be evident in their learning outcomes in school. When students are taught using adequate skills and strategies, learning outcomes such as students' academic performance, behaviour and delayed academic performances (retention) will be improved. When students' learning outcomes are improved, it then becomes easier to impact on the society as what is learnt is what will be applied. Singh and Mahajan (2017) corroborated this by explaining that Learning outcomes are influencing devices that direct students to the outcomes of the expected course, then they really demonstrate and help teachers understand the path to be followed and make students aware of what they are supposed to learn at the end of the course. This is believed to help map the students' contribution path to society. Unfortunately, this has not been the case in Nigeria.

Students' performance in Physics over the past decade has not been encouraging. Omoifo (2012) explained that there has been a downward trend in students' performance in Physics over the years and

this has however not changed in recent years. The West African Senior School Certificate Examination (WASSCE) Chief Examiners' Reports (WAEC, 2012) showed that candidates' weaknesses in Physics were due to lack of knowledge of the basic concepts, principles, laws and their appropriate applications to solving, analyzing and explaining physical problems. This was also the same problem reported in WAEC Chief Examiners' Report (2018) as students were believed to generally lack understanding of concepts in Physics.

Various findings has revealed fluctuating performances of students in secondary school Physics and the strategies used for teaching might be one of the factors responsible for this, in addition to low level of science process skills exhibited by the candidates. It is expected that teachers select and determine the best strategy that will assist to make teaching and learning effective. This may likely make it possible for the students to effectively learn the way and process of science hence ultimately assist in achieving scientific goals. There are different strategies in science education but one of the key responsibilities of the teachers is to select which is the most effective to achieve learning objectives.

Selecting appropriate teaching strategy for the teaching of Physics is important to prepare students for future endeavours (Zakaria & Iksan, 2007). Teachers' knowledge of appropriate strategy will also depend on the knowledge of the students individual differences. Abubakar and Isyaku (2012) emphasized that teachers and the adoption of teaching strategy are part of the major challenges of Physics education in Nigeria. He stated that lack of competence of teachers in selecting appropriate strategies, unavailability of the right environmental conditions and materials that will help achieve teaching and learning poses great challenge to the actualization and realization of scientific goals especially in Physics. When some of these challenges are alleviated, teachers will be able to employ the use of the right methods and strategies to achieve the goals of learning. Ojediran (2016) emphasized the importance of training of teachers using and selecting appropriate methodology as it was believed that this training will facilitate knowledge and understanding of these teachers in the use of teaching strategies which can help facilitate the needed changes in the society as stipulated by the NUC (National Universities Commission). Furthermore, he added that this training will assist teachers in selecting modern strategies such as cooperative and collaborative strategies that will encourage students to work together in groups, This will ultimately have effects on students learning outcomes since they will have the opportunity to express themselves and share their feelings to one another, thereby making learning meaningful to each member of their respective groups.

One of the modern strategies that might help to improve teaching and learning is the use of Collaborative Learning Strategy

(CLS). This strategy involves the use of small groups to allow students work together and gain from each other (Iji, Ochu, Adikwu & Atamonokhai, 2017). In addition, they observed that the use of collaborative instructional strategies assists students in gaining understanding of concepts in a more meaningful way. It was also seen that collaborative strategy engages the students positively by improving their motivation and team spirit with one another as this will help them retain information for long and also recall and apply this information accurately when the need arises. This depicts that the use of CLS will encourage learners to work together and help each other so as to bring about a holistic and complete academic performance of educational objectives.

Flexible grouping learning strategy is another component of cooperative learning strategy that allows students to work jointly in groups. This strategy is believed to help students improve their learning outcomes. Flexible grouping relates to collaborative learning strategy but at the same time differs in some ways. In flexible grouping, learners are grouped by specific goals of learning, and also, membership changes when the need arises.

In his own findings, Reisner (2008) observed that flexible grouping strategy is mostly applicable to teacher to students' ratio. It permits a class that is lesson specific to individual need and levels of skill of the students. Instructions are also carried out at students' pace, it gives students more opportunity to practice the skills learnt. Several researchers (Ford, 2013; Gary & Chapman, 2002) believe that flexible grouping strategy is better at improving students' performance and meeting students' individual, manipulative, observational and other scientific needs. It brings purposeful opportunities for students to express themselves within their own comfort limit.

Flexible grouping also allows students to work in groups that are mixed differently depending on the goal of the learning task at hand. In this strategy, students break apart once the task is completed (Opitz, 1999). Factors that determine the grouping of students include interests, knowledge or a combination of factors. The group is ever evolving as students are not expected to stuck in a single group from the beginning of the class till the end. Castle, Dentz, and Tortora (2005) sees flexible group as an organizational strategy for the classroom so as to meet a broad range of student needs within a single classroom. The teacher assesses the class before the start of the lesson to define what skills students may need in order to focus on and creates groups to meet the students' individual needs. This makes teaching and learning more effective and enhances academic performance of learning outcomes.

Statement of the Problem

The inclusion of physics education in the curriculum is an essential element in fostering scientific literacy and cultivating critical thinking abilities in students. In the specific context of Osun State, Nigeria, it is imperative to conduct an investigation and

comparative analysis of various instructional strategies to ascertain their efficacy in improving the academic performance of physics students, especially group learning strategies as many studies have confirmed it effective, but the most effective of these strategies is yet to be ascertained.

Given the importance of practical classes in knowledge acquisition, strategies need be explored to improve students learning outcomes particularly in subjects like physics where application of knowledge acquired through classroom interaction is very paramount to immediate and transferred learning. Many strategies have been explored with limited success. This study explores the comparative effectiveness of two strategies in improving Physics Students' Learning Outcomes in Osun State Senior Secondary Schools: hence this study.

This study seeks to assess and compare the results of collaborative and flexible grouping learning strategies in order to ascertain the instructional approach that is more efficacious in promoting meaningful learning experiences and enhancing academic achievements among physics students in Osun State. The outcomes of this research undertaking will make a valuable contribution to the current corpus of knowledge by offering evidence-based suggestions for instructional strategies that can improve the quality of physics education in Osun State. The anticipated outcomes of this study are expected to provide valuable insights for decision-making procedures, offer guidance for educational policies, and ultimately contribute to the facilitation of physics education of exceptional quality that effectively caters to the requirements of students in Osun State.

Purpose of the Study

The specific objectives of the study are to:

i. compare the effectiveness of collaborative and flexible grouping learning strategies in enhancing academic performance of Physics students in Senior Secondary Schools in Osun State; and
ii. compare the effectiveness of collaborative and flexible grouping learning strategies in enhancing academic performances of male and female Physics students in Senior Secondary Schools in Osun State

Research Hypotheses

Based on the objectives of the study, two research hypotheses were formulated at 0.05 level of significance:

Ho_1. There is no significant difference in the post-test scores of students exposed to collaborative and flexible grouping learning strategies in enhancing academic performance of Physics students in Senior Secondary Schools in Osun State.

Ho_2. There is no significant difference in the effectiveness of collaborative and flexible grouping learning strategies

in enhancing academic performance of male and female Physics students in Senior Secondary Schools in Osun State

Methodology

The study adopted a pre-test, post-test, control quasi-experimental design. Three groups were created for the study. The first group (Experimental Group I) was treated with Collaborative strategy while the second group (Experimental Group II) was treated with Flexible Grouping learning strategy, and the third group was taught with the conventional method. The three groups responded to the pre-test which was administered before treatment and also to the post-test and the delayed academic performance test after exposure to the two different treatment conditions. The design for the study is as presented schematically below:

Group I O_1 X_1 O_2 O_3
Collaborative Strategy

Group II O_4 X_2 O_5 O_6
Flexible Grouping Strategy

Group III O_7 X_3 O_8 O_9
Conventional Method

Where:

O_1, O_4, O_7 = Pre-test Observations for Groups I, II and control group (TEM).

O_2, O_5, O_8 = Post-test Observations for Groups I, II and control group (TEM).

O_3, O_6, O_9 = Delayed Academic performance test Observation for Groups I, II and control group (TEM).

X_1 = Treatment using Collaborative Learning Strategy

X_2 = Treatment using Flexible Grouping Learning Strategy

X_3 = Teacher Expository Method.

Targetted study population comprised Senior Secondary School Two (SSS II) Physics students in Osun State. The study sample comprised three intact classes of 129 Senior Secondary School Two (SSS II) Physics students in Ife East Local Government Area Office, Osun State.

Multistage Sampling Procedure was used to select the sample. Out of the three senatorial districts in Osun State, one senatorial district was selected using simple random sampling technique. One Local Government Area was then selected from the selected senatorial district using simple random sampling technique. Senior secondary schools were selected from the selected Local Government Area. Two of the selected schools were randomly assigned to the collaborative and flexible Instructional grouping strategies. Experimental Group I was exposed to the Instructional contents using Collaborative Learning Strategy (CLS) and group II was taught same contents using Flexible instructional Grouping Learning Strategy (FGLS). While the third school students were taught using Teacher Expository Method (TEM).

Physics Academic Achievement Test (PAAT) was used to collect data for the study. PAAT consisted of 25 multiple choice questions. The research instrument

was presented for face and content validation by two experts in Department of Science and Technology Education (STE), Obafemi Awolowo University, Ile-Ife and two experienced Physics teachers in the secondary schools who are seasoned examiners of WAEC and NECO for vetting and corrections. Based on their comments, some of the items in the research instrument were modified in line with their suggestions and remarks.

The instructional package consisted of topics on Equilibrium of Forces, and Simple Harmonic Motion. The central theme of the instructional package was to make the learners actively involved in the lesson delivery process, the pedagogical framework on which the instructional package relied is collaborative and flexible grouping learning, which allows students to work in small groups to complete a given set of tasks, in accordance to the stated objectives of the lessons.

The research procedure consisted of four stages: the pre-treatment, treatment, post-treatment and retention ages respectively. The PAAT was administered to selected students in the three selected schools to ascertain their academic performance in Physics, before the treatments was administered. The treatment stage started two weeks after the pre-test had been administered which lasted for two weeks based on the schools' time table. Experiments were conducted during regular class hours, which consisted of three periods per week (40 minutes each) making a total of 120 minutes weekly for two weeks. The post-treatment stage commenced after the treatment stage was over. The post-test (PAAT) was administered to the three schools, and the scripts were collected for marking, and analysis were then carried out on them. The delayed academic achievement test was later administered two weeks after the post-test was taken to determine their retention ability with the treatments.

The data collected were analysed using inferential statistics of ANOVA and ANCOVA, and tested at 0.05 level of significance.

Results:

Research Hypothesis 1: There is no significant difference in the post test scores of students exposed to collaborative and flexible grouping learning strategies in enhancing immediate academic performance of Physics students in Osun State Senior Secondary Schools

To test the hypothesis, the scores of the respondents to the Physics Academic performance Test (PAT) were collected for the pre-test and post-test and then subjected to Analysis of Covariance (ANCOVA). The pre-test scores acted as covariate to provide a background knowledge on the difference in performance of the students before the treatment was administered and it was shown that no difference exist in the pre-test performance of the respondents ($F= 0.928$, $P > 0.05$). The post-test was then administered after the treatment has been administered to the students. The result of the analysis using the Statistical Package

for Social Sciences (SPSS) is presented in Table 2.

Table 3: ANCOVA Table of the Post test score of the Academic Performance of students exposed to CLS and FGLS and TEM in Osun state secondary schools

Dependent Variable: Academic Performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	410.850[a]	3	136.950	7.459	0.000	0.151
Intercept	1191.699	1	1191.699	64.910	0.000	0.340
Pre Test	17.034	1	17.034	0.928	0.337	0.007
Group	350.495	2	175.247	9.545	0.000	0.132
Error	2313.273	126	18.359			
Total	12686.000	130				
Corrected Total	2724.123	129				

a. R Squared = .151 (Adjusted R Squared = .131)

Table 3 showed that $F = 9.545$, $p < 0.05$ for the post-test scores. This implies that a significant difference existed in the effectiveness of Collaborative Learning Strategy, Flexible Grouping Learning Strategy and Teacher Expository Method in enhancing the academic performance of secondary school students in Physics in Osun state. Hence, the null hypothesis that states that there is no significant difference in the effectiveness of collaborative, flexible grouping and teacher expository learning strategies on immediate academic performance of Physics students in Osun State Senior Secondary Schools was rejected. A Partial Eta Squared value of 0.132 showed that the strategies used accounted for 13.2% variation in the performance of the students exposed to the three strategies. Hence, the null hypothesis was rejected. A pairwise comparison in Post- Hoc analysis was then carried out on the three groups to determine the direction of difference in the performance of students in the three groups.

Table 4: Scheffe Post Hoc Comparison on effectiveness of collaborative, flexible grouping and teacher expository learning strategies in immediate academic performance

Dependent Variable: Academic Performance

Scheffe

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
CLS	FGLS	3.73*	0.880	0.000	1.55	5.91
	TEM	0.37	0.965	0.928	-2.02	2.77
FGLS	CLS	-3.73*	0.880	0.000	-5.91	-1.55
	TEM	-3.35*	0.944	0.002	-5.69	-1.02

TEM	CLS	-0.37	0.965	0.928	-2.77	2.02
	FGLS	3.35*	0.944	0.002	1.02	5.69

Based on observed means.
The error term is Mean Square(Error) = 18.349
*. The mean difference is significant at the .05 level.

CLS- Collaborative Learning Strategy
FGLS- Flexible Grouping Learning Strategy
TEM- Teacher Expository Method (Control)

The pairwise comparison in Table 3 showed that there is a significant difference in the performance of students exposed to Collaborative Learning Strategy and Flexible Grouping Learning Strategy ($p < 0.05$) with those exposed to Collaborative Learning Strategy performing better than those exposed to Flexible Grouping Learning Strategy with a difference in mean score of 3.73. There was also a significant difference in the performance of those exposed to Flexible Grouping Learning Strategy and Teacher Expository Method ($p<0.05$) as those exposed to Teacher Expository Method also performed better with a mean difference score of 3.35. Those exposed to CLS performed slightly better than those in TEM with a difference in mean score of 0.37.

Research Hypothesis 2: There is no significant difference in the effectiveness of collaborative and flexible grouping learning strategies in enhancing delayed academic performances of male and female Physics students in Osun State Senior Secondary Schools

To test the hypothesis, the scores of the respondents to the delayed academic performance Test were collated and then were subjected to Two-Way ANOVA. The result of the analysis is presented in Table 5

Table 5: TWO-WAY ANOVA Table of the Delayed Academic performance of Male and Female Students Exposed to CLS, FGLS and TEM

Dependent Variable: DA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	591.999[a]	5	118.400	6.290	0.000	0.202
Intercept	11845.840	1	11845.840	629.282	0.000	0.835
Group	502.532	2	251.266	13.348	0.000	0.177
Sex	11.011	1	11.011	0.585	0.446	0.005
Group * Sex	122.845	2	61.422	3.623	0.042	0.050
Error	2334.224	124	18.824			
Total	14545.000	130				
Corrected Total	2926.223	129				

a. R Squared = .202 (Adjusted R Squared = .170)

Table 5 showed that there was a significant difference in the effectiveness of the learning strategies in enhancing delayed academic performance of the respondents in the study area (F=13.35, p<0.05). It also showed that a significant difference exist in the effectiveness of the strategies on delayed academic performances of male and female Physics students in Osun State Senior Secondary Schools (F=3.623, p<0.05). Hence, the null hypothesis that state that no significant difference exist in the effectiveness of the strategies on delayed academic performances of male and female Physics students in Osun State Senior Secondary Schools was hereby rejected. A partial eta squared value of 0.05 shows that the strategies and sex account for 5 % variation in the scores of the respondents in the study area.

Table 6: Scheffe PostHoc Comparison effectiveness of collaborative, flexible grouping and teacher expository learning strategies on delayed academic performance of male and female students

Dependent Variable: Delayed Academic performance

Scheffe

		Mean			95% Confidence Interval	
(I) Group	(J) Group	Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
CLS	FGLS	3.98*	0.892	0.000	1.78	6.19
	TEM	0.22	0.978	0.976	-2.21	2.64
FGLS	CLS	-3.98*	0.892	0.000	-6.19	-1.78
	TEM	-3.77*	0.956	0.001	-6.14	-1.40
TEM	CLS	-0.22	0.978	0.976	-2.64	2.21
	FGLS	3.77*	0.956	0.001	1.40	6.14

Based on observed means.

The error term is Mean Square (Error) = 18.824.

*. The mean difference is significant at the .05 level.

There is a significant difference in the delayed academic performance of students exposed to Collaborative Learning Strategy and Flexible Grouping Learning Strategy (p<0.05) with those exposed to Collaborative Learning Strategy having a better delayed academic performance than those exposed to FGLS with a mean score of 3.98. There was also a significant difference in the delayed academic performance of students exposed to Flexible Grouping Learning Strategy and Teacher Expository Method (p<0.05) as those exposed to Teacher Expository Method also have a better delayed academic performance with a mean difference score of 3.77.

Discussion

The study sought to investigate the effectiveness of collaborative, flexible grouping and teacher expository strategies in enhancing Physics students learning outcomes. In order to achieve this study, two objectives were raised, from which three research hypotheses were generated and tested.

Result from research hypothesis one showed that there is a significant difference in the effectiveness of Collaborative Learning Strategy, Flexible Grouping Learning Strategy and Teacher Expository Method in enhancing academic performance in Physics among the students. The result revealed that those exposed to Collaborative Learning Strategy had better performance than those exposed to Flexible Grouping Learning Strategy, while those exposed to Teacher Expository Method also performed better than those exposed to Flexible Grouping Learning Strategy. This result is consistent with that of Backer, Miller and Timmer (2018) who found that the use of collaborative learning strategy improves students' academic performance in science subjects in the United State.

Whereas, McKeen (2019) found that flexible grouping strategy has no direct influence on the academic performance of students in science related subjects in Georgia. Estébanez (2016) explained that students exposed to collaborative learning strategy performed better than those exposed to teachers' method because collaborative learning strategies help students acquire deeper understanding of the subject matter. Also, Kalhotra (2015) found that the use of teacher expository method could improve students' performance compared to flexible grouping. Flexible grouping learning strategy takes time for successful implementation, this may have affected the academic performance of students and also collaboration in groups may be uneven, that is one may have been grouped with with a person who may have contributed little effort (Kalhotra (2015).

Result to research hypothesis two showed that there was a significant difference in the effectiveness of the learning strategies in the delayed academic achievement of the respondents. A significant difference exist in the effectiveness of the strategies on delayed academic achievement of male and female Physics students. Also, the result showed that those exposed to Collaborative Learning Strategy had better performance than those exposed to Flexible Grouping Learning Strategy, while those exposed to Teacher Expository Method also performed better than those exposed to Flexible Grouping Learning Strategy. The result found no significant difference in the effectiveness of those exposed to Collaborative Learning Strategy and Teacher Expository Method. This finding is consistent with that of Tran (2014), who in their research among students in Vietnam found that collaborative learning strategy was effective in the academic achievement as well as delayed academic performance of students, compared to other strategies.

Moore (2008) and Sahin (2010) studies on this same subject matter also supported this findings. In addition, Auwal (2013) in his study in Nigeria found that students exposed to teacher expository method had better performance as well as in delayed academic performance. On the sex difference, Gbenga and Effiong (2015) in their research among Nigerian students found that there is no significant difference in students' academic performance in

science on the basis of sex. However, when these strategies were used, those exposed to collaborative learning performed better than those exposed to other methods of teaching (McKeen, 2019).

Conclusion

The study concluded that collaborative learning strategy was more effective in enhancing academic performance and delayed academic achievement of Physics students than the flexible grouping learning. It was also shown that the strategies used in the study have significant effectiveness in enhancing delayed academic achievement of male and female Physics students as students are exposed to collaborative learning strategy had a better delayed academic achievement than those exposed to flexible grouping learning strategy.

Recommendations

Based on the findings of the study, it was recommended that students:

should be encouraged in the use of collaborative learning strategy in improving their academic achievement.

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