Effects of Lesson Study and Team Teaching on Students' Achievement in Physics in Selected Secondary Schools in Niger State

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ABSTRACT

The study was carried out to examine the effects of Lesson study and Team teaching on students' achievement in Physics in selected secondary schools in Niger State. The study employed a quasi-experimental (pre-test post-test non-equivalent group design) and was guided by two research questions and two corresponding hypotheses. The population of the study comprised of 34,694 Senior Secondary School II Physics students (20,320 Male, 16,374 Female). 380 students (213 male, 167 Female) in the six purposively sampled science and technical colleges were used for the study. Data was collected from the sampled students using Physics Achievement Test for Students (PATS). The reliability coefficient for PATS was calculated using Pearson Product Moment Correlation (PPMC) and its value given as 0.77. To answer the research questions, mean and standard deviation were used. The corresponding hypotheses were tested using ANOVA at 0.05 decision level. The Tukey procedure was used to make pairwise comparisons of means where necessary. The results revealed that there was a statistically significant difference among the groups taught Physics using Lesson Study model, Team Teaching and Lecture method ($F_{(2,377)} = 8.708$, p (0.000) < 0.05). A further analysis shows that significant difference exists between the group of students taught using Lesson Study model and those taught using Lecture method (p = 0.000). Another significant difference was also found between the group of students taught using Team Teaching and those taught using Lecture method. However, there was no statistically significant difference between the students taught using Lesson Study and those taught using Team Teaching The male and female in the experimental groups performed better than male and female in the control group $F_{(5,374)}=4.517$, p (0.001) < 0.05. From the study, it was recommended that Physics teachers should implement Lesson Study for active participation of students towards enhancing students' achievement in Physics.

Keywords: Lesson study, Team teaching, Collaboration, Professional Development, Content Knowledge, Academic achievement, Gender

INTRODUCTION

Physics is a branch of science that deals with the structure of matter and how the fundamental constituents of the universe relate. When compared to other science subjects, a large number of students perceived Physics as a tough subject probably because of its relationship with mathematics. Also, physics has been perceived as a difficult subject across all levels of learning (Chala et al., 2020).

There are several factors which affect the quality of Physics education. According to Suma et al. (2019), one of such factors is teachers' knowledge base for teaching. Teachers' knowledge base has significant impact on the quality of instruction and student achievement. Shulma (1987) documented various forms of knowledge which are pertinent to teaching. These include; (1) content knowledge, (2) general pedagogical

knowledge (3) curriculum knowledge (4) pedagogical content knowledge (5) knowledge of learners and their characteristics (6) knowledge of educational end, purposes and values (7) knowledge of educational contexts.

Shulma emphasized the importance of pedagogical content knowledge of teacher above others in improving the quality of instruction. When a blend of pedagogical knowledge and content knowledge is developed, teachers will be able to put students' academic achievement into account when defining and planning the curriculum and teaching strategy to be implored so as to meet the diverse needs of learners.

A correlational study by Jolif (2018) affirmed the relationship between teachers' content knowledge and students' academic achievement. He opined that teachers' poor content knowledge is one of the causes of poor students' achievement in science. Corroborating this is the opinion of Poopola and Falebita (2016), that the impact of teachers on students' achievement in any subject depends on teachers' content knowledge of the subject matter. This impact can be enhanced through a continuous enrichment of experience and systematic examination of own teaching styles by other teachers through collaboration teaching. Hence, the need for sustainable teacher professional development programmes which can develop teachers' content knowledge (Suma et al., 2019).

The use of all-inclusive collaborative teaching strategies to facilitate sustainable teacher professional development for the implementation of the curriculum content by Physics teachers will allow the integration of the students into active participation during the teaching and learning processes. Examples of such all-inclusive collaborative teaching strategy include Lesson Study and Team Teaching. Kafula (2019), found a link between students' achievements and teacher' collaboration. It was noted that as teachers improve skills and knowledge, classroom instruction also receives a boost. Moreso, improving students learning outcomes such as achievement and attitude were identified to constitute a serious challenge for science education (Vilia et al., 2017).

Richit (2023), described Lesson Study as that which involves a conglomeration of teachers developing lesson plans that are observed, analyzed and revised together with the aim of achieving a common goal. Lesson study was defined as an approach that is systematic, and cyclical to the planning, teaching, observing, revising, and re-teaching of lessons. It is a model that permits group of teachers with a minimum of three teachers, to synergistically set goals and design instruction in line with the goals for students and the context of improvement of instruction is placed within the classroom Lesson. Once this is done, one lesson study member teaches while other members observe and collect data regarding how well goals are achieved via how he delivers and how well students assimilate instruction. Lesson study has the potential to enhance instruction and enrich classroom activities among others (Suma et al, 2019).

According to Goldshaft (2016), the fundamental philosophy of Lesson Study is that; it is only in the classroom that the evidence of effective classroom practice is proved. With the teacher as a researcher, professionalism of teaching practice is enhanced, learning is strengthened, teaching activities enriched, and the learning environment is changed. Also, Lesson Study does not only improve learning and teaching, it is also improving schools and raising standards (Goldshaft, 2016). Several literatures abound on the Japanese Lesson Study model which have been used in order countries to enhance students' achievement (Shuaibu, 2019; Poopola & Falebita, 2016; Nofrion et al., 2018; Kafula, 2019).

Similarly, Team Teaching also performs dual functions, that is, enhancement of quality of teaching and Professional learning through the collaborative efforts of teachers. It fosters the awareness of teachers to expand their scope of expertise through teamwork and interaction with other colleagues (Jui-min, 2007). Basically, the two broad categories of Team Teaching include:

1. Group of teachers collaborating to teach the same set of students, at the same time, in the same classroom;

2. Teachers working together but not necessarily teaching the same set of students nor necessarily teaching at the same time (Rottier, 2001).

The form of Team Teaching employed in the present study is the monitoring teacher. Two teachers collaborate and jointly plan a lesson then one teaches while the other teacher moves round to monitor students' understanding and behaviour (Rottier, 2001).

Several testimonials of teachers and researchers who have been involved in team teaching affirmed it to be an effective strategy to enhance students learning outcomes (Besharati & Mazdayasna, 2017; Nandwa, 2017; Ike, 2016; Hooda & Sharma, 2016). Some of the benefits of team teaching as outlined by (Ferradans, 2016; Dalal, 2014; Nor *et al.,* 2012; Plank, n.d) include the following;

1. Emergence of a greater curricular coherence for students.
2. Deepening of Students' analytical skills.
3. The collaborative process of planning and designing the Lesson contents together also improves the quality of instruction. This leads to improved students learning outcomes and retention rates.
4. The diversification of teaching methods and teachers' expertise exposes the students to different teaching styles and delivery.
5. Teachers' contributive ideas during co-planning leads to the emergence of high-quality lessons.
6. It provides opportunity for students to develop cooperation among themselves and good human relation with teachers and the society at large.
7. tudents are accorded the opportunity to freely express themselves as they view the subject content from different perspectives making the classes more interesting.
8. The students can give feedback and suggestions for improvement having evaluated different teachers' styles of teaching.

Also, of utmost importance, is the influence of gender difference on students' achievement. Vokic and Aleksic (2020) highlighted factors such as learning experience and gender as part of the factors that affect how students learn during teaching and learning process. Other factors include culture, cognitive abilities, creativity and learning style. Dawal (2021), found out that there was significant difference between the mean achievement of male and female students in physics. The finding contradicts the findings of Areo (2022) and that of Poopola and Falebita (2016) who in their different studies found no significant difference in the achievement scores of male and female students in Physics and Mathematics respectively.

Furthermore, the West Africa Examination Council Physics Chief examiners' report documented that students' achievements have not been encouraging in topics such as projectile, linear momentum, measurement of heat energy II and sound waves. Nge'the (2016) noted that the conventional lecture method has not been carrying students along for active participation and has also failed to deliver the desirable outcomes when dealing with students' misconceptions. Therefore, the present study sought to examine the effect of lesson study and team teaching on students' achievement in selected topics in Physics, where students have recorded low achievement as documented in West Africa Examination Council Chief Examiners report.

Aim and Objectives of the Study

The aim of this study was to determine the effect of Lesson study and Team teaching on students' achievement in physics. Specifically, the study sought to determine the;

1. effect of lesson study and team teaching on physics achievement of the participating students.
2. gender difference in the achievement scores of physics students who participated in lesson study and team teaching.

Research Questions

The following research questions were answered in the study;

1. What is the mean difference in the physics achievement of students who participated in lesson study and those who participated in team teaching?
2. What difference exists in the mean achievement scores by gender of physics students who participated in lesson study and team teaching?

Research Hypotheses

Based on the above questions, the following null hypotheses were raised to guide the study: –

HO$_1$: There is no significant difference in the mean scores of students who learnt physics using lesson study and team teaching.

HO$_2$: The mean achievement score of male and female physics students who participated in lesson study is not significantly different from those who participated in team teaching.

METHODOLOGY

The study employed a quasi-experimental (pre-test post-test non-equivalent group design). It involves the use of multiple-choice questions to elicit responses from the participating physics students. The population of the study consists of all the thirty-four thousand six hundred and ninety four students (20,320 Male; 16,374 Female) in all the four hundred and six (406) Senior Secondary Schools in Niger State in the 2020/2021 academic session.

There are three Senatorial zones in Niger State, namely; Zone "A" Zone "B" and Zone "C". Multi-stage sampling technique was employed to obtain the sample for the study. Firstly, by simple random sampling technique, two out of the three Senatorial zones were selected for this study. Afterwards, by purposive sampling technique, three schools were selected from each of the two selected senatorial zones, making a total of six schools. However, the emerged schools were randomly assigned to control and experimental groups in their respective intact classes.

A fifty-item standardized multiple choice Physics Achievement Test for Students (PATS) was the only instrument used for data collection. The researcher used test-retest method to obtain two sets to determine the reliability coefficient to be 0.77 using Pearson Product Moment Correlation (PPMC). The chosen topics were taught using Lesson Study, Team Teaching for the experimental groups while Lecture Method was used for the control group.

The three groups were subjected to a Pre-test and Post-test. The researcher trained the participating teachers in the experimental groups and prepared all teaching instruments. The scores obtained from the pre-test and post-tests were analyzed using mean and standard deviation to answer the

research questions. The corresponding hypotheses were tested with ANOVA at 0.05 decision level. The Tukey procedure was used to make pairwise comparisons of means where necessary.

Results

The results were analyzed and presented based on the raised research questions.

Research Question One

What is the mean difference in the physics achievement of students who participated in lesson study and those who participated in team teaching? To answer this research question, mean and standard deviation were used and the results of the analysis are presented in Table 1

Table 1: Comparison of Mean and Standard Deviation in Pre-test and Post-Test Achievement Result for Students Taught Lesson study Model, Team Teaching and Lecture Method

Group	N	Post-test		Pre-test		Mean Diff.
		Mean	SD	Mean	SD	
Lesson Study	129	63.35	9.4	30.93	7.3	32.42
Team teaching	125	61.46	7.2	31.52	6.4	29.94
Lecture method	126	58.93	8.6	30.06	5.3	28.87

The results in table 1 shows the mean and standard deviation of the pre-test and post-test result of students taught physics using lesson study, team teaching and lecture method. The findings show a pre-test mean score of 30.93 with a standard deviation of 7.34 and post-test mean score of 63.35 with a standard deviation of 9.41 for Lesson study group. A pre-test mean score of 31.52 with a standard deviation of 6.35 and post-test mean score of 61.46 with a standard deviation of 7.23 for team teaching group. A pre-test mean score of 30.06 with a standard deviation of 5.31 and post-test mean score of 58.93 with a standard deviation of 8.63 for lecture method group. However, the students taught using lesson study had the highest mean gain of 32.42, followed by the group taught using team teaching of 29.94 and the group exposed to lecture method had 28.87. Thus, from the mean gain comparison, students in the lesson study group recorded the highest improvement in the knowledge of the concepts taught.

Research Question two

What difference exists in the mean achievement scores by gender of Physics students who participated in lesson study and team teaching? To answer this research question, mean and standard deviation was used and the results of the analysis are presented in Table 2.

Table 2: Comparison of Mean and Standard Deviation of Pre-test and Post-Test Achievement Result for students by gender taught Lesson study Model, Team Teaching and Lecture Methods

Gender	N	Post-test		Pre-test		Mean Diff.
		Mean	SD	Mean	SD	
LS male	82	64.49	9.283	29.90	6.892	34.59
LS female	47	61.36	9.391	32.72	7.829	28.64
TT male	82	62.00	7.310	30.51	6.141	31.49
TT female	43	60.42	7.045	33.44	6.374	26.98

Lec Male	49	58.98	8.623	32.45	4.869	26.53
Lec Female	77	58.90	8.684	28.55	5.033	30.35

The results in table 2 shows the mean and standard deviation of the pre-test and post-test achievement result for students by gender taught with Lesson study model, Team teaching and lecture method. The findings show a pre-test mean score of 29.90 with a standard deviation of 6.89 and post-test mean score of 64.49 with a standard deviation of 9.28 for Lesson study male group. A pre-test mean score of 32.72 with standard deviation of 7.83 and post-test mean score of 61.36 with standard deviation of 9.39 for Lesson study female group. Pre-test mean score of 30.51 with standard deviation of 6.14 and post-test mean score of 62.00 with standard deviation of 7.31 for team teaching male group. Pre-test mean score of 33.44 with standard deviation of 6.37 and post-test mean score of 60.42 with standard deviation of 7.05 for team teaching female group. Pre-test mean score of 32.45 with standard deviation of 4.87 and posttest mean score of 58.98 with standard deviation of 8.62 for lecture method male group. Pre-test mean score of 28.55 with standard deviation of 5.03 and post-test mean score of 58.90 with standard deviation of 8.68 for lecture method female group. However, the mean difference comparison shows that the lesson study male group had the highest improvement in the knowledge of the concepts taught.

RESEARCH HYPOTHESES

Pre-test Physics Achievement Score

The pre-test data were analyzed using analysis of variance (ANOVA) to determine whether the Lesson study model, Team teaching and Lecture method groups were equivalent in the overall score in Physics achievement before the intervention. The result is as displayed inTable 3.

Table 3: Shows the Analysis of Variance (ANOVA) Comparison of Experimental and Control Groups on Pre-test

Source	Sum of Squares	Df	Mean Square	F-value	P-value	Remark
Between Groups	134.820	2	67.410	1.647	0.194	**NS**
Within Groups	15427.064	377	40.921			
Total	15561.884	379				

Table 3 displays ANOVA results. The finding shows that there is no statistically significant difference between the pretest scores of the experimental groups (Lesson study and Team-teaching groups) and the control group, F (3,379) = 1.647, p (0.19) > 0.05. This implies that the students in the three groups were equivalent with respect to their prior knowledge on the topics covered in the administered pretest. Therefore, Analysis of Variance (ANOVA) was used to analyze the post-test data to determine the effect of treatment.

HO$_1$: There is no significant difference in the mean scores of students who learn physics using lesson study and team teaching. To test this hypothesis, ANOVA was used, the result of the analysis is presented in table 4a.

Table 4a: Summary of ANOVA Results of Students' Achievements Taught Physics using Lesson Study Model, Team Teaching and Lecture Method

Source	Sum of Squares	Df	Mean Square	F-value	P-value	Remark
Between Groups	1252.540	2	626.270	8.708	0.000	**Sig**

Within Groups	27112.667	377	71.917				
Total	28365.208	379					

Table 4a show ANOVA results. The finding shows that there was a statistically significant difference among the groups taught Physics using Lesson study model, Team teaching and Lecture method, F (2,377) = 8.708, p (0.000) < 0.05. Hence, HO_6 was rejected.

In view of the significant difference, a follow up analysis of Tests Between- Subjects Effects was conducted for each of the independent variable with the significant level of 0.05. The result is as shown in table 4b.

Table 4b: Pairwise Comparisons of Students' Achievements Taught Physics using Lesson Study Model, Team Teaching and Lecture Method

Dependent Variable: PAPost-test

(I) Method	(J) Method	M. D (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
LS	TT	1.89284	1.06435	.178	-.6116	4.3972
	LECT	4.42027*	1.06220	.000	1.9209	6.9196
TT	LS	-1.89284	1.06435	.178	-4.3972	.6116
	LECT	2.52743*	1.07056	.049	.0084	5.0465
LECT	LS	-4.42027*	1.06220	.000	-6.9196	-1.9209
	TT	-2.52743*	1.07056	.049	-5.0465	-.0084

Table 4b shows test of between subjects of the achievement of students taught Physics using Lesson study model, Team teaching and Lecture method. It shows that significant difference exists between the group of students taught using Lesson study model and those taught using Lecture method (p = 0.000). Another significant difference also exists between the group of students taught using Team teaching and those taught using Lecture method. However, there was no statistically significant difference between the students taught using Lesson study and those taught using Team teaching (p = 0.178).

HO$_2$: The mean achievement score of male and female physics students who participated in lesson study is not significantly different from those who participated in team teaching. To test this hypothesis, ANOVA was used, the result of the analysis is presented in table 5a.

Table 5a: Summary of ANOVA Results on Achievement Between Male and Female Students Taught Physics using Lesson Study Model, Team Teaching and Lecture Method

Source	Sum of Squares	Df	Mean Square	F-value	P-value	Remark
Between Groups	1615.255	5	323.051	4.517	.001	**Sig**
Within Groups	26749.952	374	71.524			
Total	28365.208	379				

Table 5a shows ANOVA results on Achievement between Male and Female Students taught Physics using Lesson study model, Team teaching and Lecture method. The finding shows that there was a statistically significant difference between Male and Female taught using Lesson study model, Team Teaching and Lecture method, F (5, 374) = 4.517, p (0.001) < 0.05. Hence, HO_7 was rejected.

In view of the significant difference, a follow up analysis of Tests Between- Subjects Effects was conducted

for each of the gender variable with the significant level of 0.05. The result is as shown in table 5b.

Table 5b: Pairwise Comparisons of Male and Female Students Achievements Taught Physics using Lesson Study (LS) Model, Team Teaching (TT) and Lecture Method

Dependent Variable: PAPost-test

(I) Gender	(J) Gender	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
LS male	LS female	3.12610	1.54727	.333	-1.3061	7.5583
	TT male	2.48780	1.32079	.414	-1.2957	6.2713
	TT female	4.06920	1.59235	.111	-.4922	8.6306
	Lec Male	5.50821*	1.52706	.005	1.1339	9.8826
	Lec Female	5.59170*	1.34206	.001	1.7473	9.4361
LS female	LS male	-3.12610	1.54727	.333	-7.5583	1.3061
	TT male	-.63830	1.54727	.998	-5.0705	3.7939
	TT female	.94310	1.78469	.995	-4.1693	6.0555
	Lec Male	2.38211	1.72669	.739	-2.5641	7.3283
	Lec Female	2.46560	1.56546	.616	-2.0188	6.9500

*. The mean difference is significant at the 0.05 level.

Table 5b shows test of between subjects of the achievement of male and female taught Physics using Lesson study, team teaching and Lecture method. The result indicates that there was no significant difference between the achievement of LS male and LS female taught Physics. Estimated mean is 3.12610, $p = (.333) > 0.05$.

The result shows that there was no significant difference between the achievement of LS male and TT male taught Physics. Estimated mean is 2.2 4780, $p = (.414) > 0.05$.

The result shows that there was no significant difference between the achievement of LS male and TT female taught Physics. Estimated mean is 4.06920, $p = (.111) > 0.05$.

The result shows that there was significant difference between the achievement of LS male and Lec Male taught Physics. Estimated mean is 5.50821, $p = (.005) < 0.05$. Therefore, the significant difference was in favour of Lesson study male group.

The result shows that there was significant difference between the achievement of LS male and Lec Female taught Physics. Estimated mean is 5.59170, $p = (.001) < 0.05$. Therefore, the significant difference was in favour of Lesson study male group.

DISCUSSION OF RESULTS

The mean gain comparison revealed that the students in the lesson study group recorded the highest improvement in the knowledge of the concepts taught. Aligning with this, is the findings of Poopola and Falebita (2016) in Mathematics which revealed that students in the lesson study had higher achievement mean scores than those in the control group (lecture method). Also, the study further showed that there was a statistically significant difference in the achievement of students taught physics using lesson study model and those taught using lecture method in favour of lesson study. This could be as a result of the effective

implementation of lesson study. This corroborates the findings of Shuaibu (2019) in Basic Science and Technology which found out that learners taught using lesson study improve significantly than their counterpart in control group.

Also, the mean gain comparison revealed that the students in the team teaching group recorded a higher improvement in the knowledge of the concepts taught than those in the control group (lecture method). This finding corroborates the findings of Besharati and Mazdayasna (2017), Hooda and Sharma (2016) who in their separate studies found out that the students in the experimental group (team teaching) recorded higher academic achievement in the post-test than the students assigned to control group (traditional method). Furthermore, there was a statistically significant difference in the achievement of students taught physics using Team teaching and those taught using Lecture method. This agrees with the finding of Nandwa (2017) in Mathematics which revealed that there was significant difference in the mean achievement of students taught using team teaching and those taught with conventional method in favour of the team teaching group. Similarly, aligning was the findings of Ike (2016) having done a comparative study on the effects of team-teaching strategies and conventional teaching approach in secondary schools found out that students taught with team teaching performed better than students taught with conventional strategies. However, there was no statistically significant difference between the students taught using Lesson study and those taught using Team teaching.

Furthermore, when the effects of lesson study model, team teaching and lecture method on male and female Students taught Physics were analysed using ANOVA, there was a statistically significant difference between both genders. A further analysis using a test of between subjects of the achievement of male and female indicates that there was no significant difference between the achievement of male and female groups taught Physics using lesson study. Also, there was no significant difference between the achievement of students taught Physics based on gender using

lesson study and team teaching. This could be as a result of gender differences being considered during the implementation of both lesson study and team teaching. This aligns with the finding of Areo (2022) whose study revealed that there was no significant influence of gender on students' achievement in Physics. Also, the finding of Poopola and Falebita (2016) revealed that there was no significant difference in the achievement scores of male and female students in Mathematics. However, the finding contradicts the result of Dawal (2021), whose study revealed a significant difference between the mean achievement of male and female students in physics. We could therefore infer that both lesson study and team teaching enhanced the achievements of both gender in Physics equally.

However, there is a significant difference between the achievement of lesson study male group and lecture method male group taught Physics. This is in agreement with the finding of Dawal (2021), who found out that there was significant difference between the mean achievement of male and female students in physics. The finding contradicts the findings of Areo (2022) and that of Poopola and Falebita (2016) who in their different studies found no significant difference in the achievement scores of male and female students in Physics and Mathematics respectively.

CONCLUSION

It was concluded that among the three strategies considered in the study, the students taught using lesson study achieved better than students taught using team teaching and lecture method strategies. Hence, lesson study is the best strategy for improving on the academic achievement of students in Physics. Also, it was further found out that gender do not have significant effect on the achievement of male and female students taught Physics using lesson study, and also on the achievement of male (lesson study) and female (team teaching) groups taught Physics. However, there was significant difference between the achievement of male (lesson study) and male (lecture method) groups taught Physics in favour of lesson study.

RECOMMENDATIONS

1. Physics teachers should implement lesson study for active participation of students towards enhancing students' achievement in Physics.
2. Nigerian Curriculum planners should take a cue from Japanese curriculum planners who used lesson study to teach difficult topics.
3. School administrators should create an enabling environment where teachers can collaborate and synergize resources in order to enhance teaching and learning processes, thereby building a learning community of teachers.
4. When implementing lesson study, individual and gender differences should be catered for.

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