

EFFECTIVENESS OF DALTON INSTRUCTIONAL-MODEL AND RECIPROCAL PEER-TUTORING STRATEGIES ON ACADEMIC PERFORMANCE OF BASIC SCIENCE STUDENTS IN KANO METROPOLIS

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Abstract

The study investigated the Effectiveness of Dalton Instructional-Model and Reciprocal Peer-Tutoring on Academic Performance of Students in Basic Science in Kano Metropolis. One objective with corresponding null hypothesis guided the study. Quasi-experimental design was adopted for the study, specifically, non-equivalent pretest and posttest control group design. A sample of 113 was drawn from the population of 7850 students of Upper Basic II from three mixed intact classes in Kano metropolis, using simple random sampling techniques. The experimental groups were taught using Dalton Instructional Model (DIM) and Reciprocal Peer-Tutoring (RPT), while control group was taught using Conventional Lecture strategy (CLS). The instrument used for data collection was Basic Science Academic Performance Test (BSAPT) with a reliability coefficient of 0.714. Data collected were analyzed using mean, standard deviation and Analysis of Covariance. The results revealed that students taught Basic Science concept using DIM had higher Academic Performance to the RPT than the Conventional Lecture strategy in influencing students' Academic Performance in basic science. The study concludes that DIM and RPT are better option in delivery Basic Science concepts. It was recommended that basic science teachers should adopt DIM and RPT when teaching to enhance students' Academic Performance in basic science.

Keywords: Academic Performance, Basic Science, Dalton Instructional Model, Reciprocal Peer-Tutoring

Introduction

Teaching is the assistance, guidance, direction rendered to learners to discover self, not a mere lip service but most respected profession. The teachings that go on in most of our schools are dominated orally, the teachers are to ensure that teaching strategy employed is to create fresh environment and interest to the Basic Science students (Okereke, 2024). Basic Science is a necessity for Science and Technology development in Nigeria. Basic science formally known as Integrated Science is a subject taught in public and private schools at the upper basic level (junior secondary school) in Nigeria.

The reason for teaching Basic Science according to Federal Republic of Nigeria (FRN, 2014), is that, it widens the knowledge of the learners which enables them to appreciate the unity among science subjects such as, Agricultural Science, Biology, Chemistry and Physics. National Education Research and Development Council (NERDC, 2013), stipulated that the objectives of the Basic Science curriculum are to enable learners: develop interest in science; acquire basic knowledge and skills in science; apply scientific knowledge and skills to meet societal needs; take advantage of the numerous career opportunities offered by science; become prepared for further studies.

Therefore, Gambo (2019) opined that, the requirements on learners are increasing and one of the necessary abilities is to work well independently as well as in a team. To achieve this target, teachers

should use diverse teaching methods, such as, conventional lecture strategy, cooperative learning, collaboration, discussion, Dalton instructional-model, inquiry, reciprocal peer-tutoring, and demonstration method. Udo (2016) is of the opinion that poor academic performances in Basic Science were partly due to insufficient instructional materials, poor learners' subject academic performance, unqualified/ not subject teachers and ineffective strategies of teaching employed by teachers.

However, the chief examiner report on Basic Science Student Academic Performance Results from Kano Education Resource Department (KERD) for 2016 – 2022 in Basic Education Certificate Examinations (BECE) in Kano State, observed that in the years under consideration, there was no time the percentage credit pass in Basic Science was up to 50% except 2019 which is a minimum credit pass for a candidate to go into Science class in the senior secondary section at any secondary school. Statement from the reports indicated that usage of conventional lecture strategy which is teacher-centred contributed to the failure rate of students' academic performance in basic science. The examiners therefore called for introduction of innovative method of teaching such as Dalton Instructional Model (DIM) and Reciprocal Peer-Tutoring (RPT) which are students-centred. It is in the light of the above that, the present study aims at comparing the effects of Dalton Instructional-Model, Reciprocal Peer-Tutoring and Conventional Lecture strategies on academic performance of Upper Basic Students in Basic Science in Kano Metropolis.

Dalton Instructional Model is an organized learning packaged environment which encourages easy access to material representation of a phenomenon, an idea for learners to work with each other at their pace. However, study by Parkhurst (2010), describes, Dalton plan as where students are allowed to work at their pace and only receive individual help from the teacher (facilitator) when necessary. In Dalton Instructional Model there is no formal class instruction, learners draw up their time-tables which they use to explore academic syllabuses through entirely personal efforts. Learners are also encouraged to work together and thereby help one another in the course of their work.

Therefore, Hanior (2017) opined that, Dalton Instructional Model is also known as Dalton laboratory strategy, because laboratories replace classrooms. The classroom is seen as an educational workshop equipped with books, maps, drawings, photographs, and other materials that will enable each student with little assistance as possible, to complete the work which student should do and predict solutions throughout the work so as to improve student academic performance. In order to improve academic performance among Upper Basic Students in Basic Science, this research will compare the effects of Dalton Instructional Model, Reciprocal Peer-Tutoring and Conventional Lecture strategy.

Reciprocal Peer-tutoring is an approach whereby two or more learners alternate and share their thoughts with mates as the tutor and tutee during each class. Peer tutoring is the process in which skilled and trained students help and support other students who are less skilled or have low level of knowledge in an interactive, meaningful and organized way. Also, Ullah, Tabassum and Kaleem (2018) explained that Peer tutoring among student is useful in learning new skills, knowledge and solutions to each other's problems by playing, talking, quarreling and sharing ideas as students will perform better in their examination. Therefore, the effect of Dalton Instructional-Model and Reciprocal Peer-tutoring that is student centered strategies of teaching may increase learners' positive academic performance toward Basic Science subject. Also, may establish the potentials inherent in that subject, that such learner will definitely relate better to the subject learning academic performance in the Basic Science.

Conventional lecture strategy has been acknowledged of facilitating covering of large content area at a time and very suitable for large class but the strategy was criticized for being teacher-centred, failure to recognize the uniqueness of the learner and does not facilitate the development of reasoning skills

and academic performance in the students. Adamu, Haruna and Bashir (2015) and Sultana and Zaki (2015) reported that lecture strategy used in school have failed to ensure the quality instructions learners desire. The need to improve the academic performance of students in Basic Science prompted scholars to investigate the strategies that would be more appropriate. Wealth of literature shows the effectiveness of dalton instructional-model and reciprocal peer-tutoring on academic performance of students in basic science. Advocates of interactive instructional strategies such as Hanior (2017), Godpower and Ihenko, (2017), Ullah, Tabassum and Kaleem (2018), Moosavi (2019), Shehu (2021), Egbujoo(2020), and Onah (2022) considers dalton instructional-model and reciprocal peer-tutoring of students in basic science to be effective on academic performance.

Academic performance is the extent to which a learner, teacher or institution has attained their short and long-term educational goals. Academic performance is commonly measured through examinations or continuous assessments but there is no general agreement on how it is best evaluated or which aspects are most important procedural knowledge. However to Godpower and Ihenko, (2017) the poor academic performance, non-application of science to production activities and insufficient teaching resources and poor teaching methodology employed by teachers among others are problems associated to low academic performance in basic science.

Statement of the Problem

Basic Science is a core subject that all upper basic students in Basic Science in Kano Metropolis offer before graduation to senior science class. The problem of students’ poor academic performance in upper basic levels in Nigeria has been an educational issue. In solving any problem however, it is proper to understand the causes of such problems. These causes are looked into from several perspectives including the role of the students, teachers, school environment, society, government and so on. Evidence from the examination office from KERD in the study area revealed that the results in Table 1: Basic Science Students Performance Results of KERD from 2016 – 2022 in Basic Education Certificate Examinations (BECE), Kano State.

Year	Total of no students	Pass population	%Pass	Fail population	%Fail
2016	82715	20133	24.34	62582	75.66
2017	87112	19232	22.08	67880	77.92
2018	80182	32704	40.79	47478	59.21
2019	84392	42795	50.71	41597	49.29
2020	83647	30989	37.05	52658	62.95
2021	89109	32777	36.78	56332	63.22
2022	82300	38300	46.54	44000	53.46

Source: Kano Education Resource Department (KERD), 2023.

This situation remains almost the same yearly and the circumstance is more worrisome and as it affects students’ academic performance in basic science in Kano Metropolis. Therefore, considering the role of Dalton instructional-Model and Reciprocal Peer- tutoring strategy on improving the academic performance of students prompted the researcher to carry out this study.

Objective of the Study

The aim of this study is to determine the effectiveness of Dalton instructional-Model, Reciprocal Peer-tutoring and conventional lecture strategy on Academic Performance of Students in Basic Science in Kano Metropolis. Specifically, the study intends to investigate the:

- i. Comparative effectiveness of the three strategies on academic performance of students in Basic Science in Kano Metropolis.

Research Question

The following research question guided the study:

What is the mean academic performance score of students taught Basic Science using Dalton instructional-Model, Reciprocal Peer-tutoring and conventional lecture strategy?

Null Hypothesis

Based on the research question, the following null hypothesis were formulated and tested at $P \leq 0.05$ level of significance in the study.

H0₁: There is no significant difference on the mean academic performance score of students taught Basic Science using Dalton instructional-Model, Reciprocal Peer-tutoring and conventional lecture strategy.

Methods

The study employed quasi experimental design using pretest, posttest non-randomized control group. The population comprised 7850 from 21 public upper basic schools in Kano Metropolis. The sample of the study was 113 Upper Basic Science 2 students (38 students in DIM (treatment group I), 40 students in RPT (treatment group II) and 35 students in CLS (control group) of three intact classes selected from the 7 coeducational schools in Kano Metropolis. The selection of the school and intact class was done using simple random sampling technique by balloting. The instrument for the study was Basic Science Academic Performance Test (BSAPT) made up of 25 items multiple choices, adapted from past questions of Basic Education Certificate Examination (BECE) in Kano State.

The instrument “Basic Science Academic Performance Test (BSAPT)” was designed by the researchers, validated by experts in science education, test and measurement and basic science teacher. The concept taught was Environmental pollution. The instrument was pilot tested using students who were not part of the study area but shared similar characteristic with the main study. The reliability of the administered instrument was obtained using split-half method and spear-brown formula to determine the reliability co-efficient of 0.714. The experimental groups were taught using Dalton Instructional-Model and Reciprocal Peer-tutoring while the control group was exposed to Conventional Method for four weeks. The data collected were analyzed using mean and standard deviation for research question and research hypothesis was tested using one-way Analysis of Covariance (ANCOVA) at 0.05 level of significant.

Data Presentation and Analysis

The data collected from the sample of the study were presented in subsequent tables.

Research Questions 1: What is the mean academic performance score of students taught Basic Science using Dalton instructional-Model, Reciprocal Peer-tutoring and conventional lecture strategy?

Table 2 presents pre-test and post-test mean difference among students taught in basic science concepts using Dalton Instructional Model, Reciprocal Peer-Tutoring and the Conventional Lecture Method. The Dalton Instructional Model group, consisting of 38 students, exhibited a mean pretest post-test score of 60.11 (SD = 21.23) and 86.53 (SD = 10.90) with a mean difference of 26.42. In comparison, the Reciprocal Peer Tutoring group, comprising 40 students, demonstrated a pretest post-test mean of 48.30 (SD = 14.04) and 68.70 (SD = 11.59) and a mean difference of 20.40 compared to the Conventional Lecture Method group. The CLM group, consisting of 35 students, presented a pretest post-test mean score of 46.63 (SD = 12.07) and 61.14 (SD = 10.38) with mean difference of 14.51. The post-test mean gains indicate that students taught using Dalton Instructional Model (M = 86.53) exhibited the highest mean gain (17.83), followed by the Reciprocal Peer-Tutoring group (M = 68.70,

Mean= 7.56), and the CLM group (M = 61.14). This depicts those students taught using Dalton Instructional Model exhibited the highest mean gain difference, followed by the Reciprocal Peer-Tutoring group, and the least was the Conventional Lecture Method group. The findings imply that students taught with Dalton Instructional-Model have more substantial in understanding basic science concepts compared to those taught using Reciprocal Peer-Tutoring and Conventional Lecture Method as evidenced by the highest mean academic performance gain score among the groups examined.

Table 2: Pre-test and Post-test Mean academic performance Gain Scores between Students taught Basic Science Concepts using Dalton Instructional-Model, Reciprocal Peer-Tutoring and those taught using Conventional Lecture strategy

Methods	N	Pretest		Posttest		Mean Gain
		\bar{x}	SD	\bar{x}	SD	
DIM	38	60.11	21.23	86.53	10.90	26.42
RPT	40	48.30	14.04	68.70	11.59	20.40
CLS	35	46.63	12.07	61.14	10.38	14.51

Source: *Fieldwork, 2024*

H0₁: There is no significant difference on the mean academic performance score of students taught Basic Science using Dalton instructional Model, Reciprocal Peer-tutoring and Conventional Lecture strategy.

Table 3 presents the results of a One-way Analysis of Covariance (ANCOVA) examining the between-subject effects of the different teaching methods: Dalton Instructional-Model, Reciprocal Peer-Tutoring, and the Conventional Lecture Method, on students' academic performance in basic science concepts. The dependent variable considered is students' academic performance. The corrected model, accounting for covariates, demonstrated a significant effect on academic performance ($F(3, 109) = 51.931, p < .000, \eta^2 = .486$). The intercept revealed a substantial contribution to the model ($F(1, 109) = 4843.822, p < .000, \eta^2 = .476$), indicating an overall effect on academic performance.

Table 3: One way Analysis of Covariance for between subject Effects of students taught basic science concept using Dalton Instructional-model, Reciprocal peer-tutoring and Conventional Lecture Method

Tests of Between-Subjects Effects						
Source	Type III Sum of	df	Mean Square	F	Sig.	Partial Eta

	Squares					Squared
Corrected Model	12565.681 ^a	2	6282.841	51.931	.000	.565
Intercept	586021.395	1	586021.39	4843.82	.000	.765
			5	2		
MT	12565.681	2	6282.841	51.931	.000	.155
Error	13308.159	110	120.983			.526
Total	617440.000	13				
Corrected Total	25873.841	112				

a. R Squared = .486 (Adjusted R Squared = .476)

Dependent Variable: Academic Performance

Table 4 further presents the post-hoc comparisons using the Sheffe test analysis of the academic performance of students taught basic science concepts using three different teaching methods: Dalton Model, Reciprocal Peer-Tutoring, and Conventional Lecture Method. Multiple comparisons were conducted, and the results are reported in terms of mean differences, standard errors, significance levels, and 95% confidence intervals. DIM demonstrated a significantly higher mean difference in academic performance compared to Reciprocal Peer-Tutoring (Mean Difference = 17.83, SE = 2.492, $p < .000$, 95% CI [11.64, 24.01]) and Conventional Lecture Method (Mean Difference = 25.36, SE = 2.577, $p < .000$, 95% CI [18.99, 31.78]).

Reciprocal Peer-Tutoring, in turn, exhibited a significant mean difference when compared to Dalton Instructional Model (Mean Difference = 17.83, SE = 2.492, $p < .000$, 95% CI [-24.01, -11.64]) and a positive mean difference when compared to Conventional Lecture Method (Mean Difference = 7.56, SE = 2.546, $p = .000$, 95% CI [1.24, 13.87]). The Conventional Lecture Method revealed a significantly lower mean difference in academic performance compared to Dalton Instructional Model (Mean Difference = -25.38, SE = 577, $p < .000$, 95% CI [-31.78, -18.99]) and Reciprocal Peer Tutoring (Mean Difference = -7.56, SE = 2.546, $p = .000$, 95% CI [-13.87, -1.24]). The observed significance at the .05 level indicates that these differences are statistically significant. sheffe adjustments were applied to control for multiple comparisons. This implies that Dalton Model and Reciprocal Peer-Tutoring Methods are associated with higher academic performance compared to the Conventional Lecture Method and Dalton Model yields a superior academic performance compared to Reciprocal Peer Tutoring Method. See post hoc test.

Table 4: Post-hoc Analysis of Students’ Interest taught Basic Science Concepts Using the Dalton model, Reciprocal peer-tutoring and Conventional Lecture strategy

(I)	(J)	Mean	Std.	Sig.	95% Confidence Interval	
MT	MT	Difference (I- J)	Error		Lower Bound	Upper Bound
DIM	RPT	17.83*	2.492	.000	11.64	24.01
	CM	25.38*	2.577	.000	18.99	31.78
RPT	DIM	-17.83*	2.492	.000	-24.01	-11.64
	CM	7.56*	2.546	.014	1.24	13.87
CM	DIM	-25.38*	2.577	.000	-31.78	-18.99
	RPT	-7.56*	2.546	.014	-13.87	-1.24

The error term is Mean Square (Error) = 120.983.

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

Discussion of Finding

Based on the outcome of the study, the summary of the finding;

The result from research question which was affirmed by test of corresponding null hypothesis shows

that there was significant difference among the mean academic performance score of students taught environmental pollution using DIM, RPT and those taught using CLS in the study. The finding was in line with the studies of Hanior (2017) on effect of heuristic and Dalton laboratory plan on students' academic achievement in social studies who reported that there is significant difference between the mean scores of experimental and control groups of students prior to receiving treatment. Similarly, the study of Egbujuo (2020) indicates that Reciprocal Peer Tutoring has significant effect on students' achievement in chemical equilibrium concepts. For instance, there was a significant gain in achievement by the experimental group compared to the control group. This significant gain in achievement by the experimental group was a result of the treatment given.

Conclusion

Based on the finding of the study, it was concluded that Dalton Instructional Model and Reciprocal peer-tutoring had positive impact on academic performance when taught basic science among upper basic students. This implies that the use of Dalton Instructional-Model and Reciprocal peer-tutoring in Basic Science would help to improve academic performance of students in basic science and could go a long way to reduce the poor academic performance of students especially at the Basic Education Certificate Examination.

Recommendation

Based on the finding of the study, this recommendation was drawn:

School principals through the heads of departments should encourage Basic science teachers to adopt Dalton Instructional-Model and Reciprocal peer-tutoring in the classroom as teaching strategies since it improved students' academic performance and understanding of the Basic Science subject in Kano Metropolis.

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