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Effects of Kolawole's Problem-Solving Teaching Strategy and Teachers' Characteristics on the Academic Performance of Secondary School Students in Mathematics in Nigeria

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Abstract

The study investigated the effects of Kolawole's Problem Solving (KPS) teaching strategy and teachers' characteristics on the academic performance of secondary school students in Mathematics in Nigeria. Specifically, the study examined the difference in the pre-test and post-test mean score of students exposed to KPS and conventional strategies. The study investigated the influence of teachers' qualification, experience and gender on the performance of students exposed to KPS strategy. The study adopted quasi – experimental pre-test and post-test two group design and descriptive research design of the survey type. The sample consisted of 562 S.S.S. 2 students (class intact size) and eighteen Mathematics teachers drawn from eighteen public secondary schools in three geo-political zones of Nigeria namely South-East, North Central and South-West. The sample was selected using multistage sampling procedure. Two research instruments namely Achievement Test in Mathematics (ATM) and Inventory on Teachers' Characteristics (ITC) were used to collect relevant data for this study. The four hypotheses were analyzed by Analysis of Covariance (ANCOVA), Two-way Analysis of Variance (ANOVA) and Multiple Classification Analysis at $\alpha = 0.05$ level of significance. The findings of the study showed that the use of KPS enhanced better performance of students in Mathematics than the conventional strategy. Teachers' characteristics

such as their qualification, teaching experience and gender did not influenced students' performance in Mathematics when exposed to KPS strategy. Based on the findings of the study, it was recommended among others that teachers irrespective of their characteristics can make use of KPS strategy in teaching Mathematics.

Keywords: *Kolawole's Problem-Solving, Teachers' Characteristics, Academic Performance, Students, Mathematics*

Introduction

The importance of Mathematics in most fields of human endeavour cannot be underestimated. Its usefulness in science, technological activities as well as commerce, economics, education and even humanities is almost at par with the importance of education as a whole (Joseph, 2012). Mathematics is one of the key subjects in both the primary and secondary education system in Nigeria. Mathematics liberates the mind and also gives individuals an assessment of the intellectual abilities by pointing towards direction of improvement (Zhu, 2007).

There are hues and cries among stakeholders in education over the growing rate of failure and lack of interest in Mathematics and subsequent dropout in the Nigeria secondary schools in recent times. The problem appears to be responsible for the tremendous wastage of human potential and facilities for education apart from the financial wastage, which a developing country like ours can ill afford. The mass failure has been attributed to teachers' methodology, lack of qualified teachers, and lack of experienced teachers among others. All of these appeared to have been investigated yet the problems seem to have remained persistent going by the recurring mass failure in Mathematics external examinations in the country.

There are many innovative strategies such as peer modelling, goal setting strategy, cooperative method, project method among others, that could be used in other to improve students' academic performance in Mathematics but this study is interested in Kolawole's Problem-Solving (KPS) and three teachers' characteristics namely qualification, teacher's experience and gender.

The researcher is interested in Kolawole's Problem-Solving (KPS)

strategy because it seems from literature available that no researcher has investigated the influence of teachers' characteristics and KPS on students' academic performance in Mathematics. Researchers like Kolawole, Oladosu and Ajetunmobi (2013), Kolawole and Ojo (2016), Kolawole and Olofin (2017a), Kolawole and Olofin (2017b), to mention but a few have investigated the effect of KPS on students' academic performance in Mathematics but none of these researchers investigated if teachers' characteristics will have any effect on students' academic performance in Mathematics when exposed to KPS.

In view of the above, the researcher is of the opinion that Kolawole's Problem-Solving (KPS) teaching strategy could positively affect the performance of teachers. Kolawole's Problem-Solving (KPS) method which by design deliberately takes care of: (i) **Teaching** (i.e. Content versus Behavioural Objective for the teacher) (ii) **Learning** (i.e. Content versus Behavioural Objectives for students) and (iii) **Evaluation Process** or blueprint (i.e. Taxonomy of Educational Objectives, which incorporates content versus illustrative verbs).

The teachers are the users of this strategy and hence occupy a pride of place in the teaching and learning process (Kolawole, 2013). The teachers are the heart and soul of any strategy and live wire of the school system. The teachers' knowledge of the subject matter and the method of teaching the subject matter are known to be highly important in bringing about good performance among the students (Kolawole, 2013).

Kolawole's problem-solving teaching strategy is an innovative method of teaching Mathematics. Kolawole (2013) postulated a comprehensive easy-to-use problem-solving method called *Kolawole's Problem-Solving (KPS) teaching strategy* which by design deliberately takes care of: (i) Teaching (i.e. Content versus Behavioural Objective for the teacher) (ii) Learning (i.e. Content versus Behavioural Objectives for students) and (iii) Evaluation Process or blueprint (i.e. Taxonomy of Educational Objectives, which incorporates content versus illustrative verbs). According to Kolawole and Olofin (2017a), the unique feature of Kolawole's Problem-Solving (KPS) teaching strategy is that the teacher can use it for teaching and evaluating the students. In this regard, the KPS method involves a combination of content, teacher's activities, student's activities and evaluation that could be operated concurrently (or simultaneously).

The term teacher characteristics can be referred to as qualities that can be measured with tests or derived from their academic or professional records. Teachers' characteristics could go a long way to have impact on the performance of students. It is unfortunate, however, that many teachers do not realize that their character coupled with their relationship or interactions with the students have a far reaching implication on the performance of their students (Igwebuike, 2012). Teacher characteristics in this study are those attributes exhibited by teachers in the classroom and during teaching and learning process. Teachers' characteristics examined in this study are teacher's qualification, gender, and teaching experience.

Furthermore, since the teacher is the main implementer of the curriculum and controls what goes on in the classroom, poor students' achievement in Mathematics cannot be improved without investigation into teacher characteristics (qualification, experience and gender) with a view to proffering solutions. The qualification of teachers seem to be an important indicator for their knowledge and competence in teaching, Likewise, teachers' experience seems to play a role in using any teaching strategies. Experienced teachers appear to have a richer background of experience to draw from and can contribute insight and ideas to the course of teaching and learning, are open to correction and are less dictatorial in classroom.

The problem of the study is therefore to investigate the effects of teachers' characteristics such as qualification, experience and gender, and teaching strategies such as Kolawole's problem-solving (KPS) and Conventional strategies on the academic performance of secondary school students in Mathematics.

Purpose of the Study

The purpose of the study was to examine the effects of KPS teaching strategy and teachers' characteristics on the academic performance of secondary school students in Mathematics in Nigeria. Specifically, the study examined:

i. the difference in the pre-test and post-test mean score of students exposed to KPS and conventional strategies;
ii. the influence of teachers' qualification on the academic performance of students exposed to KPS;

iii. the influence of teachers' gender on the academic performance of students exposed to KPS;
iv. the influence of teachers' teaching experience on the academic performance of students exposed to KPS

Research Hypotheses

Based on the aforementioned questions the following hypotheses were generated

1) There is no significant difference in the pre-test and post-test mean score of students exposed to KPS and conventional strategies.
2) Teachers' qualification has no significant influence on the academic performance of students exposed to KPS strategy.
3) Teachers' gender has no significant influence on the academic performance of students exposed to KPS strategy.
4) Teachers' teaching experience has no significant influence on the academic performance of students exposed to KPS strategy.

Literature Review

Concept of Kolawole's Problem-Solving (KPS) Strategy

Kolawole's Problem-Solving (KPS) Strategy is a 5 step mechanism that maps the domains with the behavioural objectives or passwords which is expressed in term of terms and terminologies which are used to teach, learn, solve, test and evaluate a given problem. The evaluative verbs for each of the steps are coded into the following passwords i.e. IKTT, D,I^2,R^3,E,C^2,T^2, D,E,V,E,C^3,Q^2,U,I,T^2, $S^3\mathbf{C^3}RIPT^3$, and $A,P,P,R,A,I,S.E^2$. Kolawole (2013) postulated a comprehensive easy-to-use problem-solving method called; *Kolawole's Problem-Solving (KPS) method* which by design deliberately takes care of: (i) Teaching (i.e. Content versus Behavioural Objective for the teacher) (ii) Learning (i.e. Content versus Behavioural Objectives for students) and (iii) Evaluation Process or blueprint (i.e. Taxonomy of Educational Objectives, which incorporates content versus illustrative verbs). The unique feature of KPS method is that it can be applied in virtually all areas of life. It can be used by teachers for teaching and evaluating the students. In this regard, the KPS method involves a combination of content, teacher's activities, student's

activities and evaluation that could be operated simultaneously. It can also be used by students and researchers to write theses and articles.

Kolawole classified KPS into five – step problem solving method as follows:

a. Identifies the Problem/Topic: Identify all relevant Keywords, Terms, Terminologies (KTT) of the problem/Topic. In the first step of KPS, breaking of the subjects matter into relevant Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or appropriate action/passwords are identified (Kolawole, 2013).

b. DIRECT the Problem/Topic: At this stage, the teacher DIRECT the problem/topic via D,I^2,R^3,E,C^2,T^2 i.e. **D**efine, **I**dentify, **I**ndicate **R**ecognise, **R**elate **R**egulate, **E**numerate, **C**ategorize, **C**lassify, **T**each and **T**est. The teacher teach the students how to Define, Identify, Indicate Recognise, Relate Regulate, Enumerate, Categorize, Classify and Treat all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic

   The student at this level should be able to define, identify, indicate recognise, relate, regulate, enumerate, categorize, classify and treat all relevant terms, terminologies, sign, symbol, concepts, and others. In evaluating the students, Teacher ask questions on how to **D**efine, **I**dentify, **I**ndicate **R**ecognise, **R**elate **R**egulate, **E**numerate, **C**ategorize, **C**lassify and **T**reat all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic (Kolawole, 2013).

c. DEVECQUIT the Problem/Topic: This third step of KPS is the level at which the teacher $\mathbf{D,E,V,E,C^3,Q^2,U,I,T^2}$ the problem/topic i.e. **D**iscuss, **E**xplain, **V**erify, **E**xpatiate, **C**riticize, **C**ompose, **C**ompare **Q**uery, **U**nderstand, **I**nquire, **T**ransform, **T**est. The teacher teach the students how to Discuss, Explain, Verify, Expatiate, Criticize, Compose, Compare Query, Understand, Inquire, Transform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic. In evaluating the students, the teacher ask questions on how to Discuss, Explain, Verify, Expatiate, Criticize, Compose, Compare Query, Understand, Inquire, Transform all Identified Keywords (K), Terms (T),

Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic (Kolawole, 2013).

d. SCRIPT out the Problem/Topic: This fourth step in KPS is the level at which the teacher **S^3,C^3,R,I,P,T^3** the topic i.e. **S**olve, **S**implify, **S**ketch, **C**alculate, **C**ompute, **C**onstruct, **R**ead, **I**nterprete, **P**lot, **T**abulate, **T**ransform **T**est. The teacher teach the students how to Solve, Simplify, Sketch, Calculate, Compute, Construct, Read, Interprete, Plot, Tabulate and Transform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic.

   In evaluating the students, Teacher ask questions on how to Solve, Simplify, Sketch, Calculate, Compute, Construct, Read, Interprete, Plot, Tabulate and Transform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic (Kolawole, 2013).

e. APPRAISE the Problem/Topic: The last step of KPS is the level at which the teacher **'APRAISE^2'** the topic i.e. **A**pply, **P**review, **P**redict, **R**eview, **A**ssess, **I**nduce, **S**ummarize, **E**stimate and **E**xamine (Kolawole, 2013).

   Kolawole's Problem-Solving (KPS) method by its peculiar design takes care of the possible teaching and learning problem. The most unique feature of KPS method is that while the teacher can use it for teaching and evaluating the students (Kolawole, Oladosu & Ajetunmobi, 2013), the learner can also simultaneously use if for learning and evaluating himself (or herself) (Kolawole & Olofin, 2017b) as shown in the table and figure below.

Table 1: KPS TEACHING LEARNING ⟶ SOLVING ⟶ EVALUATION ⟶ MODEL

S/N	*DOMAIN*	*Teacher's Teaching and Evaluation Activities*	*Student's Learning and Evaluation Activities*
1.	***Domain 1*** Identifies the Topic via {**I,K,T,T**}	Teachers, Identify all relevant Keywords (K), Terms (T), Terminologies (T)	Students, Learn how to Identify all Keywords (K), Terms (T), Terminologies (T)

		[IKTT] of the problem/topic or equivalent verbs. In evaluating the students, Teacher, Ask questions on Identify, Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic	[IKTT] of the problem/topic Students, Answer questions on how to Identify, Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic
2.	***Domain 2*** DIRECT the Problem/Topic via {**D,I^2,R^3,E,C^2,T^2**}	Teacher, Teach the students how to **D**efine, **I**dentify, **I**ndicate **R**ecognise, **R**elate **R**egulate, **E**numerate, **C**ategorize, **C**lassify and **S**olve all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic. In evaluating the students, Teacher ask questions on how to **D**efine, **I**dentify, **I**ndicate **R**ecognise, **R**elate **R**egulate, **E**numerate, **C**ategorize, **C**lassify and **S**olve all Identified Keywords	Students, learn how to **D**efine, **I**dentify, **I**ndicate **R**ecognise, **R**elate **R**egulate, **E**numerate, **C**ategorize, **C**lassify and **S**olve all Identify Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic. Students, Answer questions on how to **D**efine, **I**dentify, **I**ndicate **R**ecognise, **R**elate **R**egulate, **E**numerate, **C**ategorize, **C**lassify and **S**olve all Identify Keywords (K), Terms (T), Terminologies (T)

		(K), Terms (T), Terminologies (T) [IKTT] of the problem/topic.	[IKTT] of the problem/topic.
3.	***Domain 3*** DEVECQUIT the Problem/Topic via {**D,E,V,E,C^3,Q^2,U,I,T^2}**	Teacher, Teach the students how to **D**iscuss, **E**xplain, **V**erify, **E**xpatiate, **C**riticize, **C**ompose, **C**ompare **Q**uery, **U**nderstand, **I**nquire, **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic. In evaluating the students, Teacher ask questions on how to **D**iscuss, **E**xplain, **V**erify, **E**xpatiate, **C**riticize, **C**ompose, **C**ompare **Q**uery, **U**nderstand, **I**nquire, **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic.	Students, learn how to **D**iscuss, **E**xplain, **V**erify, **E**xpatiate, **C**riticize, **C**ompose, **C**ompare **Q**uery, **U**nderstand, **I**nquire, **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic. Students, Answer questions on how to **D**iscuss, **E**xplain, **V**erify, **E**xpatiate, **C**riticize, **C**ompose, **C**ompare **Q**uery, **U**nderstand, **I**nquire, **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic.
4.	***Domain 4***	Teacher, Teach the students how to	Students, learn how to **S**olve, **S**implify,

	SCRIPT out the Problem/Topic via {**S^3,C^3,R,I,P, T^{3}}**		**S**olve, **S**implify, **S**ketch, **C**alculate, **C**ompute, **C**onstruct, **R**ead, **I**nterprete, **P**lot, **T**abulate and **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic. In evaluating the students, Teacher ask questions on how to **S**olve, **S**implify, **S**ketch, **C**alculate, **C**ompute, **C**onstruct, **R**ead, **I**nterprete, **P**lot, **T**abulate and **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic.	**S**ketch, **C**alculate, **C**ompute, **C**onstruct, **R**ead, **I**nterprete, **P**lot, **T**abulate and **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic. Students, Answer questions on how to **S**olve, **S**implify, **S**ketch, **C**alculate, **C**ompute, **C**onstruct, **R**ead, **I**nterprete, **P**lot, **T**abulate and **T**ransform all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic.
5.	***Domain 5*** APPRAISE the Problem/Topic via {**A,P,P,R,A,I,S,E^2}**		Teacher, Teach the students how to **A**pply, **P**review, **P**redict, **R**eview, **A**ssess, **I**nduce, **S**ummarize, **E**stimate and **E**xamine all	Students, learn how to **A**pply, **P**review, **P**redict, **R**eview, **A**ssess, **I**nduce, **S**ummarize, **E**stimate and **E**xamine all Identified Keywords

	Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic.	(K), Terms (T), Terminologies (T) [IKTT] of the problem/topic or equivalent verbs or synonyms of the problem/topic.
	In evaluating the students, Teacher ask questions on how to **A**pply, **P**review, **P**redict, **R**eview, **A**ssess, **I**nduce, **S**ummarize, **E**stimate and **E**xamine all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic.	Students, Answer questions on how to **A**pply, **P**review, **P**redict, **R**eview, **A**ssess, **I**nduce, **S**ummarize, **E**stimate and **E**xamine all Identified Keywords (K), Terms (T), Terminologies (T) [IKTT] of the problem/topic.

©Kolawole and Olofin (2017a)

Empirical Studies

Ojo (2018) conducted a study entitled "Effects of Two Problem Solving Methods on Senior Secondary School Students Learning Outcomes in Simultaneous Equations in Ekiti State, Nigeria" with a sample of 302 students. The result of study showed that KPS is most effective for enhancing better students' performance in simultaneous equations, followed by Polya method and lastly conventional method. As effective as Kolawole's Problem-Solving (KPS) strategy was, the strategy was not gender and location biased.

The possible reason advocated for this high effectiveness of Kolawole's Problem-Solving (KPS) strategy is simply its inherent ability to always appropriately connect (or link) teaching, learning and evaluation in one integral whole. As such the probability of excellent performance by most learners is greatly enhanced (Kolawole & Olofin, 2017b).

Anita (2013) carried out a study on Teacher characteristics and students' academic achievement in Biology in schools in Nandi south district, Kenya. A sample of 20 schools and 20 Biology teachers were purposively selected. Data collected were analysed using descriptive and inferential statistics (SPSS Version 17). Findings revealed that teachers' qualification does not influence students' academic achievement. However, Maundu (2006) concluded that there was significant correlation between teacher qualification and pupil performance.

Murnane (2006) found that teacher effectiveness improves rapidly over the first three years of teaching and reaches its highest point between the third and fifth year but found no substantial improvement after year five. In contrast, Murnane & Phillips (2001) state that experience had a significant positive effect on elementary student achievement among teachers during their first seven years of teaching. On gender issue, Akiri and Ugborugbo (2008) found that there was a significant relationship between teachers' gender and students' academic achievement. Thomas (2006) concluded that teacher's gender does have large effects on student test performance.

Methodology

This study adopted quasi – experimental pre-test and post-test two group design (one experimental group and one control group) and descriptive research of the survey type. The survey research provided conceptual and methodological design for investigating the influence of teachers' characteristics. The base line of the knowledge of students that were used for the study and homogeneity were established by pre-test while post-test was used after the treatment to measure students' performance. The pattern of the experimental design is as shown below.

E_1: O_1 X_1 O_2: Experimental group

C: O_3 X_c O_4: Control group

Where

O_1, O_3– Observations before treatment

O_2, O_4 – Observations after treatment

X_1 – Treatment via KPS strategy

X_c – Treatment via Conventional Strategy

The targeted population for the study consisted of all the Senior Secondary School (S.S.S.) two students and Mathematics teachers in public secondary schools in three geo-political zones of Nigeria namely South-East, North Central and South-West. The sample consisted of 562 S.S.S. 2 students (class intact size) and eighteen Mathematics teachers drawn from eighteen public secondary schools in three geo-political zones of Nigeria namely South-East, North-Central and South-West. The sample was selected using multistage sampling procedure.

In stage one; a state was selected from each of the three geo-political zones of Nigeria namely South-East, North-Central and South-West using simple random sampling technique. The next stage involved the selection of two Local Government areas from each of the three states through simple random sampling technique. In stage three, three public secondary schools were selected from each of the Local Government area through stratified random sampling technique. In stage four, the S.S.S. 2 class intact size of each of the eighteen schools were used for the study. The last stage involved the selection of a Mathematics teacher from each of the 18 schools using purposive sampling technique.

Two research instruments namely Achievement Test in Mathematics (ATM) and Inventory on Teachers' Characteristics (ITC) were used to collect relevant data for this study. ATM was self-designed by the researcher and measured students' academic performance in Mathematics. It consisted of section A and B, section A sought for the bio-data of the respondents which include the name of the school, identification number, school location, sex and geo-political zones. Section B of ATM consisted of 50 objectives items with five options made of thirteen questions on Knowledge, thirteen questions on Comprehension, seven questions on Application, seven questions on Analysis, five questions on Synthesis and five questions on Evaluation. The items covered all the topics to be taught for the 10 weeks. The ATM was used for both pre-test and post-test for data collection. Inventory on Teachers' Characteristics (ITC) only sought for information on teachers' qualification, gender and Mathematics teacher's teaching experience.

The instrument was validated by face, content and criterion relative (concurrent) validity methods. It was given to three mathematics teachers teaching Senior Secondary Schools who were also team leaders in West Africa Examination

Council (WAEC) marking exercise. The unified examination conducted by some states Ministry of Education was used as a criterion test to validate ATM. The validity coefficient obtained was 0.87. Fulon formula was used to establish the reliability coefficient of 0.85 for ATM.

The study was carried out in three phases namely pre-treatment stage, treatment stage and post-treatment stage. At the pre-treatment stage, the researcher obtained permission from the authorities of the eighteen schools. Two (2) days workshop was organized for each of the research assistants who handled the KPS strategy. The research assistants were evaluated after the workshop to ensure that they perfected the use of the KPS strategy. Pre-test was administered to the experimental group and the control group before the commencement of the treatment in order to ascertain the homogeneity of the two groups.

At the treatment stage, the training package consisted of a lesson plan on KPS strategy for teachers. Students were exposed to eighty minutes of teaching learning and evaluation twice per week for ten consecutive weeks. The control group has no special treatment. They were taught using conventional method (normal classroom interaction) for ten weeks

At the end of the treatment stage, ATM was re-administered on the students to determine the effects of the treatment on them. The objective options of the same Achievement Test in Mathematics (ATM) used during the pre-test were re-arranged to avoid test-wiseness and administered to the experimental and control groups

The four hypotheses were analyzed by Analysis of Covariance (ANCOVA), Two-way Analysis of Variance (ANOVA) and Multiple Classification Analysis at $\alpha = 0.05$ level of significance.

RESULTS

Hypothesis 1: There is no significant difference in the pre-test and post-test mean score of students exposed to KPS and conventional strategies.

Table 2: Analysis of Covariance (ANCOVA) for Pre – test and Post – test Mean Scores of Students under the Groups

Source	***Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
Corrected Model	23329.318[a]	2	11664.659	693.127*	.000
Intercept	1926.052	1	1926.052	114.448*	.000

Pre-test	54.360	1	54.360	3.230	.073
Groups	23324.639	1	23324.639	1385.975 *	.000
Error	9407.437	559	16.829		
Total	**499366.000**	**562**			
Corrected Total	**32736.754**	**561**			

a. R Squared = .713 (Adjusted R Squared = .712) * P < 0.05

The result presented in table 2 shows that there is a significant difference in the pre – test and post – test mean scores of students in the groups (KPS and Conventional Strategies) as P= 0.000<0.05. There is a strong evidence to reject the null hypothesis which states that there is no significant difference in the pre-test and post-test mean score of students exposed to KPS and conventional strategies. This result led to the rejection of the null hypothesis. By implication, there is significant difference in the pre-test and post-test mean score of students exposed to KPS and conventional strategies. In order to find out the more probable effective strategy, Multiple Classification Analysis (MCA) was carried out. The result is shown in Table 3.

Table 3: Multiple Classification Analysis (MCA) of students' performance in Mathematics by treatment

Grand Mean = 29.07

Variable + Category	N	Unadjusted Dev'n	Eta^2	Adjusted for Independent + Covariate	Beta
Experimental (KPS)	270	6.44	.93	6.51	.09
Control	292	-6.44		-6.37	
Multiple R					.844
Multiple R^2					.713

The result in Table 3 shows the Multiple Classification Analysis (MCA) of students' performance in Mathematics by treatment. It reveals that, with a grand mean of 29.07, students exposed to KPS strategy had higher adjusted mean score of 35.51(29.07+6.44) than their counterparts in the control group with

control group 22.63(29.07+(-6.44)). This means that KPS strategy was the more effective strategy of teaching Mathematics in Nigeria. There was a very high multiple relationship (R= 0.844) between the two groups and academic performance of students in Mathematics. The two treatment strategies can also account for 71.3% variability in academic performance of the students in Mathematics. It means that other 28.7% are variables outside the treatment that could not account for the variability in the academic performance of students in Mathematics.

Hypothesis 2: Teachers' qualification has no significant influence on the academic performance of students exposed to KPS strategy.

Table 4: Two-way Analysis of Variance (ANOVA) for influence of teachers' qualification on academic performance of students exposed to KPS strategy

Source	***Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
Corrected Model	3066.515[a]	5	613.303	130.683*	.000
Intercept	263420.430	1	263420.430	56129.660*	.000
Teachers' Qualification	17.874	2	8.937	1.904	.151
Performance	2294.083	1	2294.083	488.824*	.000
*Teachers' Qualification *Performance*	8.118	2	4.059	.865	.422
Error	1238.971	264	4.693		
Total	**344715.000**	**270**			
Corrected Total	**4305.485**	**269**			

a. R Squared = .712 (Adjusted R Squared = .707) * P < 0.05

From Table 4, the p-value (0.422) is greater than 0.05 level of significant i.e. P (0.422) >0.05. This led to the non – rejection of the hypothesis. This means that teachers' qualification has no significant influence on the academic performance of students exposed to KPS strategy. The KPS teaching strategy is not biased based on teachers' qualification.

Hypothesis 3: Teachers' gender has no significant influence on the academic performance of students exposed to KPS strategy.

Table 5: Two-way Analysis of Variance (ANOVA) for influence of teachers' gender on academic performance of students exposed to KPS strategy

Source	***Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
Corrected Model	3041.009[a]	3	1013.670	213.239*	.000
Intercept	297400.003	1	297400.003	62562.203*	.000
Teachers' Gender	6.544	1	6.544	1.377	.242
Performance	2832.072	1	2832.072	595.765*	.000
*Teachers' Gender * Performance*	10.968	1	10.968	2.307	.130
Error	1264.476	266	4.754		
Total	**344715.000**	**270**			
Corrected Total	**4305.485**	**269**			

a. R Squared = .706 (Adjusted R Squared = .703) * P < 0.05

Table 5 shows that the F-cal value of 2.307 is not significant because the P value (0.130) > 0.05. This implies that the null hypothesis is not rejected. Hence, teachers' gender has no significant influence on the academic performance of students exposed to KPS strategy. The KPS teaching strategy is not teachers' gender biased.

Hypothesis 4: Teachers' teaching experience has no significant influence on the academic performance of students exposed to KPS strategy.

Table 6: Two-way Analysis of Variance (ANOVA) for influence of teachers' teaching experience on academic performance of students exposed to KPS strategy

Source	***Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
Corrected Model	3029.496[a]	5	605.899	125.360*	.000
Intercept	254931.616	1	254931.616	52744.929*	.000
Teachers' Experience	8.551	2	4.275	.885	.414
Performance	2257.454	1	2257.454	467.064*	.000
*Teachers' Experience * Performance*	.592	2	.296	.061	.941

Error	1275.989	264	4.833
Total	**344715.000**	**270**	
Corrected Total	**4305.485**	**269**	

a. R Squared = .704 (Adjusted R Squared = .698) * P < 0.05

Table 6 shows that the F-cal value of 0.061 is not significant because the P value (0.941) > 0.05. This implies that the null hypothesis is not rejected. Hence, teachers' teaching experience has no significant influence on the academic performance of students exposed to KPS strategy. The KPS teaching strategy is not biased based on teachers' teaching experience.

Discussion

The findings of this study revealed that there was significant difference in the pre-test and post-test mean score of students exposed to KPS and conventional strategies. There was a better improvement in the performance of students resulting from their exposure to KPS. This implies that the introduction of KPS to the experimental group made them to perform better than the control group that was not exposed to treatment. The findings of Kolawole, Oladosu and Ajetunmobi (2013) show that KPS strategy application in some schools yielded better results than the conventional method. Also, the study is in line with the assertion of Kolawole and Ojo (2016), and Kolawole and Olofin (2018b) who were of the opinion that the use of conventional method to teach students in school diminishes their interest and performance in Mathematics.

The finding of the study also showed that teachers' qualification had no significant influence on the academic performance of students exposed to KPS strategy. By implication, qualification of the teachers has no influence on the academic performance of the students who were exposed to Mathematics through KPS strategy. This conforms with the finding of Anita (2013) who concluded that teachers' qualification does not influence students' academic performance. The finding negates that of Rowan (2007) and Thomas (2014) who submitted that teachers' qualification influences students' academic performance.

It is to be noted that teachers' gender had no significant influence on the academic performance of students exposed to KPS strategy. This is in line with the submission of Akiri and Ugborugbo (2008) and Luschei (2011) who found out that teachers' qualification has no impact on students' academic

performance. However, the finding contradicted the findings of Saha (2003), Thomas (2006), and Sparks (2013) who submitted that teachers' qualification had impact on students' academic performance.

Another major finding of this study is that, teachers' teaching experience has no significant influence on the academic performance of students exposed to KPS strategy. The KPS teaching strategy is not biased based on teachers' teaching experience. This result supports the finding of Zuelke (2008) who concluded that teachers' experience has no influence on students' academic performance while it contradicted the findings of Rice (2003) and Olaleye (2011) as they concluded that teachers' experience has significant influence on students' academic performance.

Conclusion

It could be concluded that the use of KPS enhanced better performance of students in Mathematics than the conventional strategy. Teachers' characteristics such as their qualification, teaching experience and gender did not influenced students' performance in Mathematics when exposed to KPS strategy.

Recommendations

Based on the findings of this study, the following recommendations were made.

1) Teachers, irrespective of their characteristics should make use of Kolawole's Problem-Solving (KPS) strategy in teaching Mathematics.
2) Mathematics teachers should be given adequate orientation through workshops and seminars to update their knowledge in the use of Kolawole's Problem-Solving (KPS) strategy in teaching.
3) Due to the stages involved in Kolawole's Problem-Solving (KPS) strategy, teachers should manage the time allocated well in order to accommodate the use of KPS strategy in teaching Mathematics.

REFERENCES

Akiri, A. A. & Ugborugbo, N. M. (2008). An examination of genders influence on teachers productivity in secondary schools. *Journal of Social Science*, 17(3), 185-191.

Anita, J. K. (2013). A study of teacher characteristics and students' academic achievement: Case of Biology subject in selected secondary schools in Nandi South District, Kenya. *Indian Journal of Research*, 2(3), 66-69.

Igwebuike, T. S. (2012). Evaluating Teacher Education Programme in Nigeria. *Journal of Research in Curriculum*, 31(1), 104 - 111.

Joseph, E. U. (2012). Psycho-Academic variables and mathematics achievement of 9th grade students. *Nigeria British Journal of Education, Society & Behavioural Science*, 2(2), 174-83.

Kolawole, E. B. & Ojo, O. (2016). Statistical Analysis of the Effects of Kolawole's Problem Solving (KPS) and Conventional Teaching Methods on the Academic Performance and Retention of Secondary School Students in Mathematics in Ekiti State, Nigeria. *Research Journal of Education*, 2(6), 100-109.

Kolawole, E. B. & Olofin, S. O. (2017a). Content Analysis of Kolawole's Problem Solving (KPS) Method: Key to Sustainable Change in Mathematics Teaching and Research Development. *ABACUS, Journal of Mathematical Association of Nigeria*, 42(1), 360 - 376.

Kolawole, E. B. & Olofin, S. O. (2017b). Content Analysis of Kolawole's Problem Solving (KPS) Method. Book of Reading of Prof. M.F. Alonge, *Journal of Tests and Measurement*, 47 – 84

Kolawole, E. B. & Olofin, S. O. (2018b). Effects of Goal Setting Skill and Peer Modelling Strategies on Academic Performance of Ekiti State Students in Mathematics. In Book of Reading of Prof. Onwuamanam, Ado – Ekiti: University Press, 293 – 303

Kolawole, E. B. (2013). Kolawole's Problem Solving Method (KPS): A Panacea to Mathematical and Life's Problems. *Standard Journal of Education and Essay*, 1(8), 131 – 141. http://www.standresjournal.org/journals

Kolawole, E. B. and Olofin, S. O. (2018a). Appropriate Statistical Tests for Data Analysis. In Salman M.F. *Enhancing Mathematics Education in Nigeria*, Ilorin: Unilorin Mathematics Education Group, 209 – 219

Kolawole, E. B., Oladosu, C. T. & Ajetunmobi, O. (2013). Comparability of Effectiveness of Problem Solving Methods on Learners Performance in Mathematics. *Unique Journal of Educational Research*, 1(2), 012 – 019.

Luschei, T. F. (2011) The effectiveness and distribution of male primary teachers: Evidence from two Mexican states. *International Journal of Educational Development*, 5(3), 12-19

Maundu, J. N. (2006). Student Achievement in Science and Mathematics: A Case of Extra Provincial, Provincial, and Harambee Secondary Schools in Kenya. PhD Thesis. McGill University, Montrea

Murnane, R. J. (2006). Staffing the nation's schools with skilled teachers in improving America's schools. In E. Hanushek & D. Jorgenson (Eds.), *The role of incentives.* Washington, DC: National Research Council, National Academy.

Murnane, R. J., & Phillips, B. (2001). Learning by doing. Vintage and selection: Three pieces of the puzzle relation teaching experience and teaching performance. *Economics of Education Review,* 8(1), 214 – 219

Ojo, O. F. (2018). Effects of Two Problem Solving Methods on Senior Secondary School Students Learning Outcomes in Simultaneous Equations in Ekiti State, Nigeria, Unpublished Ph.D Thesis, Department of Science Education, Ekiti State University

Olaleye, F. O. (2011) Teachers Characteristics As Predictor Of Academic Performance of Students In Secondary Schools In Osun State –Nigeria *European Journal of Educational Studies* 3(3),505-511

Rice, J. K. (2003). Teacher Quality: Understanding the Effectiveness of Teacher Attributes. *Economic Policy Institute*. Retrieved on 13 Aug. 2019 from http://www.epinet.org/content.cfm?id=1500

Rowan, B. (2007). Using research on employees' performance to study the effects of teachers on students' achievement. *Sociology of Education,* 70(1), 256-285.

Saha, L. J. (2003). Social structure and teacher effectiveness on academic achievement: A comparative analysis, *Comparative Education* Review, 27 (l), 45 - 52

Sparks, S. (2013). Girls, teachers' gender Matters. Retrieved from www.npr.org./newsus/ education on 30th June 2019

Thomas, K. J. (2014). Estimating Teacher Impacts on Student Achievement: An Experimental Evaluation. http://ies.ed.gov/ncee/edlabs/regions/midwest/pdf/REL_2007030.Pdf. Retrieved on 18/11/2019

Thomas, S. D. (2006). The Effect of a teacher's Gender Using the National Education Longitudinal Survey. http://educationnext.org/the-whychromosome. Retrieved on 18/11/2019

Zhu, Z. (2007). Gender differences in mathematical problem solving patterns: A review of Literature. *International Education Journal*, 8(2), 187-200.

Zuelke, W. (2008). The case study approach on teachers' characteristics and science achievement, *Educational Research*, 9(4), 604 – 611.