



Teachers' Content Knowledge as a Predictor of Students' Performance in Basic Science amidst Incessant Industrial Strikes in the Zaria Education Zone: Implications for Science, Technology, and Mathematics Education Development

Zainab Sulaiman
Department of Integrated Science,
Federal College of Education Zaria.

ABSTRACT

This study examines the impact of teachers' content knowledge on students' performance in Basic Science within the Zaria Education Zone, Kaduna State, Nigeria. The research focuses on the relationship between students' frequent industrial strikes affecting Science, Technology, and Mathematics Education (STME) and the skills of Basic Science teachers as predictors of students' performance. The study utilized a correlational ex-post facto design, with a sample of 373 students and 50 teachers from 14 randomly selected coeducational schools. Key instruments used for data collection included the Content Knowledge (CK) test and the Basic Science Performance Test (BSPT), which were validated with reliability coefficients of 0.81, 0.85, and 0.79, respectively. Two research objectives, questions, and hypotheses guided the study. The main hypothesis tested whether there is a significant relationship between students' industrial strikes and teachers' skills as predictors of student performance in Basic Science. The findings revealed a significant relationship, indicating that students' industrial strikes and teachers' skills significantly predict student performance. The study recommends regular assessments of this relationship to improve Basic Science education outcomes.

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INTRODUCTION

Basic Science in Junior Secondary Schools is a course of study which is devised and presented in such a way that students gain the concept of the fundamental unity of science, the commonality of approach to problem of scientific nature and helps students to gain an understanding of the roles and functions of science in everyday life and the world in which they live. According to Baiki (2000), and Agbo, (2008), Basic science is the bedrock to advance studies in science, technology and engineering. The implementation of the basic science program started in July, 2006 with the appropriation of the UBE fund to the Universal Basic Education Commission (UBEC) and subsequent disbursement to States. The education program is

regarded as a reinforcement of the 9-3-4 policy on education 2007 rather than a new policy in itself. The New Basic Science curriculum was approved by the National Council of Education (NCE) in December 2005. There is no doubt that curriculum is the bedrock of any educational reform of which the Basic Science is not an exception.

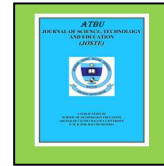
Basic science is one of the core subjects listed in the National Policy on Education (FRN, 2013) for Junior Secondary Schools in Nigeria. It is a basic subject that lays the foundation for the takeoff of the sciences (Biology, Chemistry and Physics) in the Senior Secondary school classes. Basic Science is defined by UNESCO in Igwe (2003) as "an approach to science in which concepts and principles are presented so as to express the fundamental unity of scientific thought

Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

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and avoid premature or undue stress the distinction between the various scientific fields. Basic science is one of the subjects taught in Nigeria Junior Secondary Schools.

Subject content knowledge (SCK) refers to the subject matter a teacher should possess, it is a specific content knowledge that teachers teach students. Grossman (1994) and Isah (2011) defined subject content knowledge as the stuff of a discipline, functional information, organizing principle and central concepts of the subject. The content knowledge of a prospective science teacher is developed primarily in science courses taught by science Department

These policies have provided guidelines on science and technology education in Nigeria. In this respect several science curricula were developed and introduced into the school system. One of such is Integrated Science curricular development now Basic Science. The core Nigeria Integrated Science project (NISP) was the series of researches that indicated that subject content knowledge influences instructional practices across subject area (as cited in Isah 2011).

Gender difference is another issue, research in science education indicates influence of gender on academic attainment. Researchers on gender issue point to masculine image of science, the lack participation of women in science subject and how teachers influence gender, difference in science were investigated. Odetoyinbo (2004) and Usman (2010) noted that boys perform better than girls at activities that required manipulations. Another major factor

which contributes to this higher achievement among male is the greater amount of teacher and resources interaction which male appear to receive in classroom (James 2000: Isah 2011).

STATEMENT OF THE PROBLEM

The importance of Basic science as a subject that lays foundations of sciences into senior secondary schools and serve as a bedrock for other science subjects which lead to scientific and technological development cannot be over emphasized, it is unfortunate however, that student's performance in the subject use to be very poor based on examination results from JSCE Examination in upper Basic Science (Igwebuke, 2013). Usman in Mutum (2016) asserted that failure rate in the sciences is high. Academic performance in Basic Science has generally been on the decline (Adamu, 2014). Transition from Junior Secondary School to Senior Secondary School is challenging because they face a lot of stress associated with science learning (Usman, 2017). Researchers such as Mkpanang (2005) and Obiaha (2006) reported that there were inadequate resources for the teaching of science subjects in Secondary School. It was also reported by the Junior Secondary School Examination (JSSCE), Zonal Coordinator that 57% of students that sat for JSSCE especially in Basic Science failed. Therefore, the statistics of Basic Science Performance in Zaria Educational Zone indicates rates of over 70% failure as shown in Table 1.1

Table 1: Students performance Trends in (JSCE) results of Basic Science, in Kaduna State from 2012 to 2023.

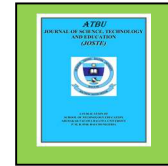
Year	No of students that sat for JSCE exam	No. of Students that pass with (A1-C6)	% of Students that Pass (A1-C6)	No. of Students that Failed (D7-F9)	% of Students that Failed (D7-F9)
2012	367562	120560	33%	247002	67%
2013	659132	204330	31%	454802	69%
2014	791227	245280	31%	545947	69%
2015	866616	251319	29%	615297	71%
2016	289520	84520	29%	205000	71%
2017	182759	39225	21%	143534	79%

Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

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2018	182759	80233	19%	347801	81%
2019	791311	23511	30%	535941	69%
2020	289531	83522	28%	214552	70%

Sources: Kaduna State Ministry of Education, Nigeria (2023)

In the same vein, Pedagogical Skills and Content Knowledge and skills includes those special attributes a teacher possessed that helped him/her guide a student to understand content in a manner that was personally meaningful. It include among others the understanding of how particular topics, problems or issues are organized presented and adapted to the diverse interests and abilities of the learners and presented for instruction using appropriate pedagogical skills and knowledge of the skill. To this effect, the present study seeks to investigate the Teachers' Pedagogical Skills and Content Knowledge as Predictor of Students Attitude and Performance in Basic Science, Zaria Education-Zone, Kaduna State, Nigeria.

Objectives of the Study

The study has the following objectives to:

1. find out the relationship between Pedagogical Skills and Content Knowledge of Basic Science Teachers as Predictors to Students' Performance in Basic Science;
2. determine the relationship between Pedagogical Skills and Content Knowledge of male Basic Science Teachers as Predictors to Students' Performance in Basic Science.

Research Questions

The following questions were formulated to guide the study:

1. what is the relationship between Pedagogical Skills and Content

Population of the Study

The population of the study comprised all the Public Junior Secondary School (J.S.S.2) students and teachers in Zaria Education Zone. There are 38 junior secondary schools comprising days, boarding, single and co-educational schools

- Knowledge of Basic Science Teachers as Predictors to students' Performance in Basic Science?
2. what is the relationship between the male Basic science Teachers' Pedagogical Skills and Content Knowledge as Predictors to students' performance in Basic science?

Null Hypotheses

The following null hypotheses are set to be tested at $P \leq 0.05$ level of significance:

HO₁: There is no significant relationship between Basic Science Teachers' Pedagogical Skills and Content Knowledge as predictors to students' Performance in Basic Science.

HO₂: There is no significant relationship between Pedagogical Skills and Content Knowledge of male Basic Science Teachers as predictors to students' Performance in Basic Science.

METHODOLOGY

Research Design

The research design is a correlational study involving one-shot case study. The study involves the collection of Teachers' Pedagogical Content Knowledge (TPCK), Teachers' Pedagogical Skills Observation Schedule (TPSOS), Basic Science Performance (BSP) and Basic Science Students Attitude Questionnaire (BSSA). Therefore, this study intends to determine the relationship between Teachers' pedagogical skills and content knowledge as predictor to students' attitude and performance in Basic Science in Zaria Education Zone, Kaduna state

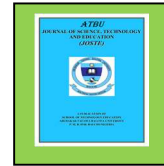
with the total number of 9601 male students and 8907 female students, totaling 18,508 students. In the same vein, there is a total of 107 basic science teachers with 53 male and 54 female Basic Science Teachers which constitutes the

Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

Department of Integrated Science, Federal College of Education Zaria.

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population of the study. Table 3.1 and 3.2 represents the population of the study:

Sample and Sampling Techniques

Purposive and simple random sampling techniques were used in selecting the sample schools. Coeducational schools were purposively selected in order to accommodate gender variables from the school in Zaria education zone. Zaria education zone has thirty seven junior secondary schools (37) offering Basic Science and a total number of one hundred and seven Basic Science teachers respectively. Twenty eight schools were randomly selected in the zone for participation.

A general Basic Science Performance Test (BSPT) was administered to JSS II Basic Science Students in each of the 28 schools selected to determine their equivalence in terms of Academic Performance. This was achieved by subjecting the students' scores to Analysis of Variance (ANOVA) and Scheffe's post hoc test at $P \leq 0.05$ level of significance. ANOVA was used to determine the existence of any significant difference in the students of selected schools while the Scheffe's Post Hoc test was used to separate the schools and determine which schools were not significantly different. As a result of this exercise 14 schools were found to be significantly not different. The total number of Female students from the (14) selected schools was (184) and the total number of Male students from the 14 selected schools was (191) respectively.

The total number of both Male and Female students in the study was (375) and this is in consensus with Krejcie and Morgan (1970) and Usman (2010) who recommended that the sample of (375) is appropriate for 18,508 population in a study. In the same vein, the selected schools has fifty (50) Basic Science Teachers, twenty five (25) male and twenty five (25) female which is also in line with Krejcie and Morgan (1970) that for a population of 110, the minimum sample should be 50. The schools were also labelled "School A, B, C, D, E, F, G, H, I, J, K, L, M, and N, respectively. Because of the large number of the sample schools, one Arm was randomly selected using

lottery from each of the selected schools respectively. Table 3.2 represent the sample for the study.

Instrumentations

Four instruments were used for the purpose of data collection. These are Teachers' Pedagogical Content Knowledge Test (TPCKT), Teachers' Pedagogical Skills Observation Schedule (TPSOS), Basic Science Performance Test (BSPT) and Basic Science Students Attitude Questionnaire (BSSAQ).

Basic Science Performance Test (BSPT)

BSPT Consist of 50 multiple choice items with four options (A-D). Three among them are distracters while the other one is the correct option, it was developed by the researcher to determine the Academic Performance of Students in Basic Science. The instrument was developed from two topics of Basic Science.

Validity of the Instruments

Basic Science Performance Test (BSPT) was developed by the researcher. The Instruments were validated by the panel of Science Educators and Psychologists. experts comprising Professors, Doctors in the Department of Science Education, Ahmadu Bello University, Zaria; two Basic Science Teachers with minimum of B.Sc. (Ed) Integrated Science with not less than 10 years teaching experiences each and one Professor in the Department of Educational psychology, guidance and counselling, Ahmadu Bello University, Zaria. They checked:

1. Check the clarity of the statement
2. Check whether the time allocated to the instrument was sufficient.
3. Check the Content of the test item if it's appropriate to the objectives of the study
4. Verify if the language used is at the same level with the ability level of the participants in the study.

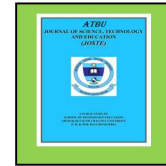
There comments, correction, suggestion and recommendation regarding the face and content validity of the test item were

Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

Department of Integrated Science, Federal College of Education Zaria.

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noted and helped in producing the final version of the Instruments. The instruments were pilot tested to determine the reliability of the instruments. Two government secondary schools were used for pilot testing with a total of number of 12 Basic Science Teachers and 50 Basic Science students respectively. The schools are part of the population but not among the sample schools. The reliability coefficient of a test is the consistency with which the test repeatedly measures what it is supposed to measure. Indices of reliability give an indication of the extent to which a particular measurement is consistent and reproducible (Lakpini, 2006).

The reliability of BSPT was determined by using test-retest method. Pearson Product Moment Correlation coefficient statistics was used for the analysis and the reliability coefficient was found to be “r = 0.81”. To this effect, the obtained reliability coefficient of both BSPT (0.81), TPCKT (0.80) and TPKST (0.85) and BSSAQ (0.79) were found to be fit for the study based on the recommendations of Spiegel (1992), Stevens (1986), and Olayiwola, (2010), that stated that an instrument is considered reliable if it lies between 0 and 1, and that the closer to the calculated reliability coefficients to 1, the more reliable is the instruments.

Data Collection Procedure

An introductory letter was collected from the Department of Science Education and Zaria Education Zonal Office which introduces the researcher to the authorities of the sampled schools and pilot testing schools.

Data Analysis Procedure

Statistical Package for Social Sciences (SPSS) IBM version 2.0 was used to analyses the data collected. Mean and Standard Deviation statistics were used to answer the research questions. The null hypotheses were tested at $P \leq 0.05$ level of significance.

RESULTS

Research Question One: What is the relationship between Pedagogical Skills and Content Knowledge of Basic Science Teachers as Predictors to students’ Performance in Basic Science?

To answer research question one, the data generated from BSPT, TPCK, and TPSOS were subjected to descriptive statistics and the summary of the result is presented in Table 4.2.2.1

Table 1: Descriptive Statistics on the Relationship between TPCK, and TPSOS on Students’ Performance.

Variables	N	Mean	Std. D	R	Remark
Students’ Performance	423	36.3	14.8		
Teachers’ Pedagogical Content Knowledge	423	5.29	14.5	0.89	Positive relation exist
Teachers’ Pedagogical Skills	423	2.55	7.08		

Result in Table 1 shows the R value of 0.89, which indicates the existence of high relationship between Teachers’ Pedagogical Knowledge, Teachers’ Pedagogical Skills, and Basic Science Students’ Performance. This shows that there is relationship between Teachers’ Pedagogical Content Knowledge (TPCK), Teachers’ Pedagogical Skills (TPSOS) and Basic Science Students’ Performance (BSPT) respectively.

Null Hypothesis One: There is no significant relationship between Basic Science Teachers’ Pedagogical Skills and Content Knowledge as predictors to students’ Performance in Basic Science.

To test the null hypothesis one, the data generated via Teachers’ Pedagogical Content Knowledge, Teachers’ Pedagogical Skills, and Basic Science Students’ Performance Test were subjected to Multiple Regression Analysis statistics. And the results obtained were computed and used to draw Table 4.2.2.

Corresponding author: Zainab Sulaiman
 ✉ Zsulaiman2015@gmail.com
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Table 2: Summary of Multiple Regression Analysis on the Relationship between Teachers' Pedagogical Content Knowledge and Skills on Students' Performance.

Variables	N	Mean	Std. D	Level of Effects	R	R ²	Adjusted R ²	F	P	Remark
Students' Performance	423	36.3	14.8							
Teachers' Pedagogical Content Knowledge	423	5.29	14.5	0.952						
Teachers' Pedagogical Skills	423	2.55	7.08	0.981	0.89	0.80	0.80	874	0.01	Sig.

- a. Dependent Variable: Performance
- b. Predictors: (Constant), TPSOS, TPCK

Results of the Multiple Regression Analysis in Table 2 shows that significant relationship exist between teachers' pedagogical content knowledge and skills, and students' academic performance. Reason been that the p value of 0.01 is lower than the adopted 0.05 alpha level of significance and the computed F value of 874.6 is greater than the 3.000 F critical. In the same vein, strength of the relationship between Teachers' Pedagogical Knowledge and Teachers Pedagogical Skills on Students' Academic Performance is strong, this is because the calculated R, R² and Adjusted R² values of 0.898, 0.806 and 0.801 are each greater than the standard Regression level of 0.440 respectively. Their level of effect on academic performance are 0.952 for Teachers Pedagogical Knowledge and 0.981 for Teachers Pedagogical Skills, this shows that even though both have significant

relationship, Teachers Pedagogical Skills predicts students' performance higher than Teachers Pedagogical Knowledge. Therefore the null hypothesis which state that there is no significant relationship between Basic Science Teachers' Pedagogical Content Knowledge and Skills as predictors to students' Performance in Basic Science is hereby rejected

Research Question Two: What is the relationship between Teachers' Pedagogical Knowledge and skills as Predictors to male students' performance in Basic science?

To answer research question two, the data generated from BSPT, TPCK, and TPSOS were subjected to descriptive statistics and the summary of the result is presented in Table 4.2.3

Table.3: Descriptive Statistics on the Relationship between TPCK, and TPSOS on Male Students' Performance.

Gender	Variables	N	Mean	Std. D	R	Remark
	Students' Performance	221	36.2	14.9		
Male	Teachers' Pedagogical Content Knowledge	221	5.29	14.5	0.89	positive relation
	Teachers' Pedagogical Skills	221	2.49	6.84		

Result in Table 3 shows the R value of 0.891, which indicated the existence of positive relationship between Teachers' Pedagogical Content Knowledge, Teachers' Pedagogical Skills, and male Basic Science Students'

Performance. This shows that there is relationship between Teachers' Pedagogical Content Knowledge (TPCK), Teachers' Pedagogical Skills (TPSOS) and male Students' Performance respectively.

Corresponding author: Zainab Sulaiman
 ✉ Zsulaiman2015@gmail.com
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Null Hypothesis Two: There is no significant relationship between Pedagogical Content Knowledge and Skills of male Basic Science Teachers as predictors to students' Performance in Basic Science.

To test the null hypothesis two, the data generated via Teachers' Pedagogical Content Knowledge, Teachers' Pedagogical Skills, and Basic Science Students' Performance Test were subjected to Multiple Regression Analysis statistics. And the results obtained were computed and used to draw Table 4.2.4.

Table 4: Summary of Multiple Regression Analysis on the Relationship between Teachers' Pedagogical Content Knowledge and Skills on Male Students' Performance.

Gender	Variables	N	X	Std. D	Level of Effects	R	R ²	Adjusted R ²	F	P	Remark
Male	Students' Performance	212	36.2	14.9							
	Teachers' Pedagogical Content Knowledge	212	5.29	14.5	0.982						
	Teachers' Pedagogical Skills	212	2.49	6.84	0.995	0.89	0.79	0.79	401	0.01	Sig.

P value < 0.05, R, R² and Adjusted R² > 0.440, F computed > 3.000 F critical

Results of the Multiple Regression Analysis in Table 4.2.4 shows that significant

relationship exist between teachers' pedagogical knowledge and skills, on male students' academic performance. Reason been that the p value of 0.01 is lower than the adopted 0.05 alpha level of significance and the computed F value of 401 is greater than the 3.000 F critical. In the same dimension, There is strong relationship between Teachers' Pedagogical Knowledge and Teachers Pedagogical Skills on male Students' Academic Performance, this is because the calculated R, R² and Adjusted R² values of 0.89 0.79 and 0.79 are each greater than the standard Regression level of 0.440 respectively. Their level of effect on academic performance are 0.982 for Teachers Pedagogical Knowledge and 0.995 for Teachers Pedagogical Skills, this shows that even though both have significant relationship, Teachers Pedagogical Skills predicts male students' performance higher than Teachers Pedagogical Knowledge. Therefore the null hypothesis which state that there is no significant relationship between Teachers' Pedagogical Knowledge and Skills as predictors to male students' Performance in Basic Science is hereby rejected

DISCUSSION OF FINDINGS

This study was to analyze Teachers' Pedagogical Content Knowledge and Skills on Upper Basic Science Students' Performance and Attitude in Zaria Education-Zone, Kaduna State, Nigeria. For this purpose, Basic Science Performance Test (BSPT), Basic Science Students' Attitude Questionnaire (BSSAQ) Teachers' Pedagogical Knowledge (TPKC), and Teachers Pedagogical Skills (TPSOS) were used to collect data on students' performance and Attitude. The data collected were analyzed at P ≤ 0.05 level of significance. The discussion of the results from research questions and null hypotheses are presented as follows:

The results in Table 4.2.2 showed that statistically significant relationship exist between Teachers Pedagogical Content Knowledge and Skills on Basic Science students' Academic Performance. Hence, the null hypothesis was rejected. The rejection of the null hypothesis indicate that significant relationship exist between the dependent and independent variables respectively. This is due to the fact that Teachers' Pedagogical Knowledge and Skills are the key elements for every academic success in science. This finding is in support of the findings of Isah

Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

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(2011), and Ibeneme (2018), who concluded from their findings that Pedagogical Knowledge and Skills predicts students' performance significantly. The finding is in disagreement with the finding of Fakeye (2012) who concluded that there is no significant relationship between Teachers' Knowledge and Skills and students' academic performance.

The results in Table 4.2.4 showed that statistically significant relationship exist between Teachers Pedagogical Content Knowledge and Skills on Male Basic Science students' Academic Performance. Thus, the null hypothesis was rejected. The rejection of the null hypothesis indicate that significant relationship exist between the dependent and independent variables respectively. This is due to the fact that Teachers' Pedagogical Content Knowledge and Skills are the key elements for every academic success in science. This finding is in support of the findings of Thomas and Olugbenga (2012), and Ibeneme (2018), who concluded from their findings that Pedagogical Knowledge and Skills predicts male students' performance significantly. The finding is in disagreement with the finding of Isah (2011) who concluded that there is no significant relationship between Teachers' Knowledge and Skills and male students' academic performance.

SUMMARY and CONCLUSION

This study investigates Teachers Pedagogical Content Knowledge and Skills as predictors to Upper Basic Science students' Performance and Attitude in Zaria Education Zone, Kaduna State, Nigeria. Six Objectives, Research questions as well as six null hypotheses were formulated and tested using descriptive and inferential statistics at $P \leq 0.05$ level of significant. The study also reviewed related literature under the followings subheadings: The Concept of Basic Science., Teaching of Basic Science at Junior Secondary Schools, Philosophy and Objectives of Basic Science, Concept of Pedagogy, Teachers' Pedagogical Knowledge, Teacher's Pedagogical Skills, Relationship between Pedagogical Knowledge and Pedagogical Skills, Gender and Academic Performance in Science, Overview of

Similar Studies, and Implications of the Literatures Reviewed for the Present Study.

The study Adopted correlational design. The instrument used for the study was Basic Science Performance Test (BSPT), A sample of 373 students; and 50 Basic Science Teachers' randomly selected from Zaria education zone was used in the study. The major findings of the study include: There is significant relationship between Teachers Pedagogical Content Knowledge and Skills on students' performance. The findings further revealed that there is significant relationship between Teachers Pedagogical Knowledge and Skills on students' Attitude. The finding also revealed that significant relationship exist between the teachers pedagogical knowledge and skills on performance and Attitude of male and female basic science students' respectively.

RECOMMENDATIONS

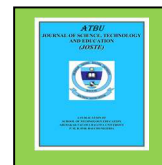
Based on the findings of this study, the followings recommendations were made;

- i. Assessing the relationship between Teacher's pedagogical content knowledge and skills on basic science students' performance and attitude should be encouraged. Thus, it is obvious from the findings of this study that Teacher's pedagogical knowledge and skills has a strong relationship with Basic science students' attitude and performance
- ii. Professional bodies such as Federal and State Ministries of Education should organize seminars and workshops about the relationship between basic science teachers' knowledge, pedagogical skills, skills in relation to students' performance and attitude

LIMITATIONS OF THE STUDY

The following are the limitations of this study:

- i. Due to the Corona Virus pandemic, the study took time before its conclusion.



- ii. The sample schools were located in different axes which also contributes to the delay in completing the study

SUGGESTIONS FOR FURTHER STUDIES.

The following suggestions are put forward for further studies:

1. The study on assessing the relationship between Teacher's pedagogical content knowledge and skills on basic science students' performance and attitude could be extended to other basic science concepts.
2. Studies on the assessment of the relationship between Teacher's pedagogical content knowledge and skills on basic science students' performance and attitude could be extended to other subjects in both junior and senior secondary schools, Colleges of Education, Polytechnics, and Universities as the result obtained here is limited to junior secondary schools.

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Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

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Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

Department of Integrated Science, Federal College of Education Zaria.

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Corresponding author: Zainab Sulaiman

✉ Zsulaiman2015@gmail.com

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