ASSESSMENT OF CLASSROOM INTERACTIONS AND SENIOR SECONDARY SCHOOL STUDENTS' LEARNING OUTCOMES IN CHEMISTRY IN OYO STATE, NIGERIA

BY

Godwin Olusegun OGUNDARE
Matric No: 142482
B.Ed Chemistry (Ibadan), M.Ed Educational Evaluation (Ibadan)

A Thesis in the International Centre for Educational Evaluation (ICEE)
Submitted to the Institute of Education

In partial fulfillment of the requirements for Degree of

DOCTOR OF PHILOSOPHY

of the

UNIVERSITY OF IBADAN

AUGUST, 2019

ABSTRACT

Statistics show that Senior Secondary School (SSS) students' performance in chemistry in public examinations in Nigeria is slightly above average. Past studies on improving student performance have focused largely on teacher and student characteristics with little consideration for Pattern of Classroom Interactions (PCI) and the timing of interactions. Therefore, the study was designed to assess PCI (teacher-talk, student-talk, integrative and dominative teaching styles) and threshold time for a chemistry teacher to expose his or her typical interaction pattern to observers. The relative and joint contributions of PCI, Teacher Gender (TG) and Teacher Qualification (TQ) to SSS students' learning outcomes (achievement and attitude) in Chemistry in Oyo State, Nigeria were also examined.

The study was anchored on Skinner's Operant Conditioning and Kohn's Student Directed Learning theories. Survey design and classroom observational techniques were adopted. Random sampling was used to select two out of eight educational zones in Oyo State and three Local Governments Areas (LGAs) from each of the two. Subsequently, three public SSS were randomly selected from each Local Governments and intact SSS II chemistry classes yielded a total of 1004 students(449 male and 555 female) and 18 Chemistry teachers (eight male and ten female) were observed. Modified Flanders 16-Category Interaction Analysis System (Scott's pi = 0.96), Classroom Interaction Analysis Sheet (Scott's pi = 0.85), Chemistry Achievement Test (CAT) (r = 0.86) and Students' Attitude to Chemistry Questionnaire (SACQ) (r = 0.89) were used. Data were analysed using percentages, t-test, One-way ANOVA and Logistic regression at 0.05 level of significance.

In all four segments of 10 minutes threshold established during observation, teacher talk was predominant. Teacher-talk (73.8%) was far higher than student-talk (9.4%). Within the first 10 minutes, 70.0% of the teachers had shown the pattern of dominative teaching style. The differencebetween male and female teacher talk and student talk patterns was not significant. However, teacher qualification had a significant effect on pattern of teacher-talk ($F_{(2,\ 15)}$ = 4.96); B.Ed. teachers ($\bar{x}$= 32.17) were the least dominative, while B.Sc. teachers ($\bar{x}$=9.00) were the most dominative. Teachers of other qualifications had average mean of 26.00. Teacher qualification also had a significant effect on student-talk pattern ($F_{(2,\ 15)}$ = 4.96); B.Ed. teachers ($\bar{x}$= 34.83) were the least dominative, while the B.Sc. teachers ($\bar{x}$= 14.33) were the most dominative. Teachers with other qualifications performed variably with a mean score of 20.33. Although, PCI, TG and TQ jointly predicted achievement in chemistry (NagelkerkeR^2 =0.01), only PCI [Exp (B) = .67] showed a significant effect independently. Students whose teachers were integrative had a higher score in CAT than those whose teachers were dominative. The PCI, TQ and TG jointly predicted attitude to chemistry (Nagelkerke R^2 =0.02). However, PCI [Exp (B) = 1.48] and TG [Exp (B) = 1.31] were significant in predicting students' attitude to chemistry independently.

Unlike the dominative, the integrative teaching style improved secondary school students' achievement in and attitude to chemistry in Oyo State. Therefore, chemistry teachers should adopt the integrative teaching style.

Keywords: Teacher-student talk,Flanders' interaction category system, Dominative teaching style, Integrative teaching style

Word count: 493

CERTIFICATION

I certify that, this research work was carried out by **Ogundare, Godwin Olusegun** in the International Centre for Educational Evaluation, Institute of Education, University of Ibadan, Ibadan, Nigeria under my supervision

…… ……..

B.A.Adegoke **Date**
B.Ed., M.Ed., Ph.D. (Ibadan)
Institute of Education, University of Ibadan, Ibadan

DEDICATIONS

This thesis is dedicated to Almighty God who gave me life to start and complete this programme in good health of mind and body. May His name be praised both now and forever.

And

It is also dedicated to my loving and caring wife – Mrs. Grace Kikelomo Ogundare and Children – Goodness Jesuseun Ogundare and Gloria Opeyemi Ogundare who are more precious than Gold. I love them so much.

ACKNOWLEDGEMENTS

First, l acknowledge all-knowing God who made the work possible. All glory, honour and adoration to almighty God the maker of what is visible and invisible.The one who was, who is and who will forever be. He reigns from everlasting to everlasting. He never fails, he remains the same. May His name be praised both now and forever. I give honour to the Blessed Virgin Mary the mother of our lord Jesus Christ who is also the seat of wisdom for supporting me throughout this course.

To my loving and hardworking supervisor and father, Dr. B.A Adegoke, I say ordinary words are not enough to express my gratitude to him. He is more than a supervisor, he is my daddy. He stood by me strongly when the going got though. He provided the needed guidance at the appropriate time, moral, and financial support. I really appreciate him. May the lord continue to bless him, his family and all hisendeavour. Amen

To my good friend and brother in the lord, Dr. Simon O. Alieme. I really appreciate his contribution to this work. May the lord continue to uphold him both now and forever.I really appreciate the support given me by Prof. Adenike E. Emeke of the Institute of Education University of Ibadan. She is really a mother. I appreciate the Director of the Institute of Education, Prof. Folajogun V.Falaye and the head of International Centre for Educational Evaluation, Prof. Jeremiah Gbenga Adewale for their love and support shown to meduring this programme. May the lord continue to bless their family and work, Amen.

I appreciate all my lecturers in the Institute of Education: Emeritus Prof. PAI Obanya, Prof.P.N.Okpala, Prof. C.O.Onocha, Prof. J.A.Adegbile, Prof.A.O.U.Onuka, Prof. Eugenia A. Okwilagwe, Dr. Monica N. Odinko, Dr. Joshua O. Adeleke,Dr. Olanrewaju I. Junaid, Dr.Sherifat F.Akorede, Dr. J.A.Abijo, Dr. E.O.Babatunde, Dr. Olutayo Omole, Dr. M.A.Metibemu, Mr. Tunde Oladele, Mr. Destimenu.

I appreciate my parents – Mr and Mrs Marcus Ogundare who provided care and support both morally and financially toward this programme. I appreciate my other siblings: Mr. John Ayoola Ogundare, Engr (Dr.) Daniel Olasupo Ogundare, Mrs Rebecca Omobola Abioye, Mrs Mary Olusola Fajoloye, Dr. Oscar Olakunle Ogundare and

Rev.Fr. David Temitope Ogundare. They all contributed in one way or another to the overall success of this programme. May the lord continue to bless their families through Christ our lord.

In a special way I appreciate my adorable, loving, caring, understanding wife and mother of my children, Mrs Grace Kikelomo Ogundare. She provided encouragement for me in the course of the programme. She is my best friend. I appreciate my children in a special way – Goodness Jesuseun Ogundare and Gloria Opeyemi Ogundare. I love them so much.I really appreciate my colleagues in the Institute of Education for their support during this programme – Dr. Ayoola Atanda, Dr. Segun Ojetunde, Dr. Theodora Adefowora, Dr. Daberechukwu Daberenze, Dr. Angela Olaitan Adedokun-Raheem, Dr. Samuel Agboola, Dr. Nathaniel Olaniran, Mrs Nkembuchukwu Adewoyin, Pastor Adeyemi Suraju, Pastor Kehinde Ogunyomi, Mr. Afeez Jinadu, Mr.Mayowa Olaoye, Mrs Anuoluwapo Egunjobi, Mrs Ikeoluwa Olanrewaju and others too numerous to mention.

I wish to humbly thank the Executive Secretary of NERDC – Prof. Ismail Junaidu and the management of NERDC for giving me the opportunity to undergo this programme. I appreciate my colleagues and staff of Nigerian Educational Research and Development Council, Dr.Garba D.Gandu, Dr. O.S. Akinsola, Dr. Fredrick E.Mefun, Dr. M.O.Salau (Retired), Dr. Eric A. Apeji (Retired), Dr. A.M. Asebiomo, Mr. Opeyemi Aina, Mr. Joseph Agba Ugbe, Mr. Jonathan Alebiosu, Mrs E.M. Ogundele, Mr.Adeleye Amos Joshua, Mrs Sandra O. Ejeh, Mrs Grace Uya, Mr. O.S. Salami (Retired), Mr. E. Igwe, Mr. Sylvester Christopher, Mr. E.J. Akpan (Retired), Mr. Isiaka Onitada and others members of staff. I really appreciate my special friends, Mr. Ebenezer Oludayo Atanda, Mr and Mrs Olakunle Akintola, Mr. Uduh Collins.

In a special way, I appreciate all the teachers and students who participated in this study. I say a big thank you to them all.

Godwin Olusegun OGUNDARE

TABLE OF CONTENTS

PAGE

LIST OF TABLES

Description **Page**

LIST OF FIGURES

Description **Page**

LIST OF ACRONYMS AND ABBREVIATIONS

CIP- Classroom Interaction Pattern

MFICS- Modified Flanders Interaction 16-category System

CIS -Classroom Interaction Sheet

CAT - Chemistry Achievement Test

SALOCQ - Students' Attitude to the Learning of Chemistry Questionnaire

TSI - Teacher-student Interaction

TMI - Teacher-material Interaction

SSI - Student-student Interaction

SMI - Student-material Interaction

SSS - Senior Secondary School

NERDC - Nigerian Educational Research and Development Council

WASSCE -West African Senior Secondary Certificate Examination

TG - Teacher Gender

TQ - Teacher Qualification

BTES - Beginning Teacher Evaluation Study

NCATE- National Council for Accreditation of Teacher Education

NBPTS - National Board for Professional Teaching Standards

NBCT - National Board of Certified Teachers

PDST - Professional Development Service for Teachers

FLDOE - Florida Department of Education

CLASS - Classroom Assessment Scoring System

VICS - Verbal Interaction Category System

CHAPTER ONE
INTRODUCTION

1.1 Background to the Problem

Chemistry is one of the important science disciplines that is being offered in senior secondary schools in Nigeria. The inclusion of chemistry education in the secondary school curricular is to help secondary school students have a good grasp of fundamentals of chemistry for all round scientific and technological development. Knowledge of chemistry is needed in such professions as nursing, medicine and agriculture. Moreover, a minimum of credit pass at ordinary level of education is needed for candidates seeking admissions into courses such as medicine, chemical engineering, agriculture and nursing in the Universities and other tertiary levels of education.This underscores the importance of chemistry education.

Despite the importance of chemistry to the scientific and technological developments of developing nations such as Nigeria, statistics show that level of students' performance in chemistry in public examinations is slightly above average. That is the ultimate (distinction) has not been reached. For example, the average level of performance (2007-2018) in chemistry in public examinations being conducted by the West Africa Examination Council is 59.2 % as analysed in Table 1.1. This therefore underscores the need to conduct more studies on how the level of performance of students in chemistry can be improved.

Table 1.1: Statistics of Results of May/June WASSCE (2007–2018) in Chemistry

Year	Total Entry	Total Sat	Total Sat %	A1–C6	A1–C6%	D7 & E8	D7 & E8 %	Total Failed	Total Failed %
2007	432230	422681	97.79	194284	45.96	104680	24.76	111322	26.33
2008	428213	418423	97.64	185949	44.44	114697	27.41	110417	26.38
2009	478235	468546	97.97	204725	43.69	114020	24.33	119260	25.45
2010	477573	465643	97.50	236059	50.70	109944	23.61	98165	21.08
2011	575757	565692	98.25	280250	49.54	151627	26.80	129102	22.85
2012	641622	627302	97.77	270570	43.13	192773	30.73	148344	23.65
2013	649524	639131	98.40	460470	72.05	95030	14.87	61340	9.60
2014	652809	644913	98.79	399062	61.88	142927	22.16	85461	13.25
2015	665527	658052	98.87	457979	69.59	120900	18.37	60484	9.19
2016	645740	640771	99.23	531360	82.92	63637	9.93	27703	4.32
2017	710098	704494	99.21	95789	86.70	32971	8.36	31371	4.45
2018	733403	728998	99.40	171147	59.20	105977	10.61	93375	12.8

Source: The West African Examination Council (WAEC), Test Development Division, Lagos.

Chemistry education at secondary school level may have little or no effect on nation's quest for technological development and overall scientific knowledge base of students if chemistry curriculum is implemented poorly by the chemistry teachers. Generally, researches such as those of Duffy, Warren and Walsh (2001), Adegoke (2007) and Mefun (2018)on implementation of science curriculum makes it clear that fidelity and quality in lesson delivery impact students' acquisition of the lesson content and outcomes. Therefore in this study, efforts were made to assess how teaching and learning activities in chemistry lessons were being conducted by chemistry teachers.

Teachers are vital in the classroom interaction process in Chemistry class. Fajemidagba (1986) said the teacher, apart from being at the implementation level of the educational policy, is also depended upon in the realization of educational programmes with his/her dedication and commitment to work. This invariably means that irrespective of the quality and quantity of buildings and other infrastructural facilities, and books that are provided in any educational system, in the final analysis,

the success and effective performance of the education system to a great extent depend on the teacher. In particular, according to the National Policy on Education (FRN, 2004 and 2013) the knowledge of the curriculum by the teacher is very paramount; as no educational system can rise above the level of the teacher.

In most secondary schools in Nigeria, a typical chemistry lesson, as scheduled on the official teaching time table, is usually for 40 minutes. However, three or four of such lessons are usually scheduled per week. During the 40-minute lessons, teachers and their students are expected to interact with one another. That is, the teacher interacts with the students; the students interact with the teacher; and of course students interact among themselves. Moreover, it is also expected that teacher interacts among some instructional things and students also interact with learning materials. During these interactions, the teacher is expected to take the lead and be the classroom manager.

The questions that arise now are: How do chemistry teachers utilize the 40 minutes? Do they use the whole allocated time to facilitate or hinder students' learning of chemistry? What happens at the initial stage, the middle stage and the final stage of the lesson? To what extent do chemistry teachers dominate the lesson or encourage students' participation in the teaching and learning activities during chemistry lessons? What is the level of teachers' and students' interaction with teaching materials? What is the minimum time a chemistry teacher needs to expose his or her typical classroom interaction pattern in a 40 – minute lesson? Research such as those of Adegoke, 2003; Isiugho-Abanihe and LongJohn, 2005; Adegoke, 2007 has shown that teacher-student interactions have effect on students learning outcomes. Therefore it is logical to observe what transpires in the classroom in order to suggest the best way chemistry teachers can manage their classrooms to engender higher achievement and positive attitude among their students.

One of the ways by which activities students' performance in chemistry can be improved is by observing the patterns of teacher-students interactions in the class with a view to suggesting patterns of interactions that can ultimately lead to students' conceptual understanding and ultimately enhance their performance in chemistry. Researches such as the ones conducted by (Akinsola,2000;Adegoke,2003;; IsiugoAbanihe 2005) show that if the classroom climate is friendly that is, if the

teacher allows students' participation in teaching-learning activities and respects students' ideas, it is likely that students will develop positive attitude towards learning and ultimately improve achievement. An assessment of the details of the kind of interactions that occur between the teacher and students during chemistry lesson is therefore important. Assessment of or probing the form of interactions in the classroom during teaching-learning process will provide information on how a teacher interacts with the student, and vice versa as well as provide information on actual time the teacher devotes to teaching the students and on the amount of time the teacher devotes to non-facilitating learning behaviours. Thus, it becomes important to assess teacher-students classroom interaction.

Classroom interaction involves classroom relationship between students and teacher, teacher and students, student with other students, teacher with instructional materials as well as interaction between students and learning aids. Audu and Achor (2003) described classroom interaction as an active encounter between teacher and the students through verbal, gestural and resource instrumentality which result in effective communication in a teaching/learning process. Classroom interaction has been referred to as the activities that take place between the teacher and the students which has an anticipated result (Akinsola, 2000). Similarly, Okoye (2009), stated that classroom interaction is aggregate of classroom activities which occur between the teacher and students as well as interaction with and learning resources. Thus, classroom interaction can be defined as verbal and non-verbal interactions between teacher and students, or between the students, or between teacher and learning material or between the students and learning materials. Verbal interaction occurs when the teacher or students talks during chemistry class. Non-verbal interaction occurs when the teacher demonstrates or students carry out teacher's directive without necessarily talking.

Copper and Robinson (2000) pointed out that classroom interaction can be classified into four dimensions vis: teacher-student, student-student, teacher-material and student-material. Teacher-student interaction pattern consists of where the teacher initiates guides and directs classroom talk with students (Viiri and Saari, 2006). In this study, when teacher asks question from student and student responds, or welcomes ideas from student when teaching-learning is going on, it is categorized as teacher-

student interaction. Other level of classroom interaction is student-student interaction: That is when students discuss among themselves especially to search for solution to a problem.

Student-student interaction pattern enables students talk with their peers (Classmate) in a group to solve a common problem (Viiri and Saari, 2006).This discourse pattern involves the participation of every member of the group. The teacher, after teaching, divides the students into five or six students per group, each group with a peer leader, who is trained by the teacher to lead the group. The students discuss assignments given to them by their teacher in groups, while the teacher coordinates them. In this study, whenever a teacher arranges students into groups of four's during chemistry class to discuss a given task, it is categorized as student-student interaction. For instance, during chemistry class, when teacher gives out a difficult question which can make students think deep and allows the student to discuss among themselves in groups so that answer could be generated from the students, it is categorized as student-student interaction. Apart from situations where students need to work with their peers, sometimes students may need to make use of learning materials as the teacher directs in an attempt to enhance learning. This is when students interact with instructional materials.

Student-material interaction pattern enables an individual or a class to work with instructional materials. Other examples of student-material interaction pattern include: reviewing and expanding lecture notes, using some apparatus during practical class, reporting practical work, carrying out experiments, searching the internet and reading materials on a website (Smith, 2000). It involves students' active participation and acquisition of manipulative skills (Okoli, 2006). In this study, whenever students make use of calculator or other materials to carry out an instruction given by the teacher, or when student uses a separating funnel to separate the mixture of kerosene and water as directed by the teacher, it is categorized as student-material interaction. However, interaction in the chemistry classroom is not limited to teacher-student, student-student, and student-material only, teacher-material interaction is another dimension of classroom interaction that is also important because learning is likely to be made concrete and real when a teacher uses real life object to substantiate his explanations.

In the teacher-material interaction pattern, the teacher illustrates teaching with instructional materials in the classroom (Jaja, 2002). Obodo (2004) found out that instructional resources are potent tools, which can be used to effectively communicate, while enriching the learning experiences of the learners. The materials which are used in chemistry class to enhance learning include big chart containing the periodic table of elements, dilute solutions of chemicals in reagent bottles, substances such as alum, salt, separating funnel, beakers and other apparatus which are used to carry out practical. In this study whenever teacher uses any of these during learning process, it is categorized as teacher-material interaction.The interaction patterns which were assessed include: teacher – student interaction pattern, student – student interaction pattern and teacher – material interaction pattern.

Research has shown that there are differences in the pattern of how teachers start their lessons. Some teachers begins the class by storytelling, ask related questions, introduce the topic, write note, give assignment and finally do evaluation of the topic under discussion. The sequence of teacher behaviour varies from one teacher to another; and this may have serious educational implications on the achievement and attitude of student to learn chemistry. According to Okwilagwe (2011) teacher's style of communication in the classroom goes a long way to make learning meaningful and effective. Activities like instruction (explanation), questioning, responses, feedback including initiated student talk and class management are expected to go on systematically. Ideally a good teacher should promote a pattern of teacher-student interaction that encourages the students' good participation in personal and team work in the class.(Akinsola, 2000).

Flanders (1970) gave evidence to corroborate the idea that classroom climate can be honestly and correctly determined and that such climate is related to teacher-student interaction. Different observational instruments have been used by different researchers to find out the type of instructional behaviours going on in the classroom. One of the earliest systematic observation instruments was the widely used Flanders interaction Analysis category System (FIACS) for recording teacher as well as students' verbal behaviour. It was believed that a fairly large percentage of classroom instructional time (indeed almost 80%) is spent in talking either by the teacher or the student. Literature on classroom observation (Adegoke,2003;, Isiugo-Abanihe and

Longjohn, 2005; Adegoke, 2007) lend credence to this. For example in their study, Isiugo-Abanihe and Longjohn (2005) found that teacher-student talk constituted about 83.5% of the instructional time in a typical science lesson in junior secondary schools in Port Harcourt, Nigeria.

The Flanders interaction Analysis Category System (FIACS) in its real and edited versions have been used widely in classroom observational studies (Gwimbi and Monk, 2002; Adegoke, 2003; Isiugo-Abaniheand Longjohn 2005; Adegoke 2013). For example, Adegoke (2003) used it to determine the effect of teacher influence on students' learning outcomes in Geometry in Ibadan, Nigeria. Also, Gwimbi and Monk (2002) used both structured and unstructured classroom observation instruments and questionnaire to study the relationship between classroom practice and philosophy of science of thirty-three A-level Biology teachers in Harare, Zimbabwe. In these studies, the authors, as in most observational studies, adopted instruments that are directly related to FIACS.

The Flanders system can be used to classify the pedagogical approaches employed by the teacher into integrative versus dominative styles. It can also be used to calculate the Integrative–Dominative (ID) ratio. Teacher with integrative versus dominative (ID) ratio greater than 1 is classified as having adopted integrative approach in teaching Chemistry, while teacher whose integrative versus dominative (ID) ratio is less than 1 is classified as having adopted dominative approach. Under Flanders' Category system, the integrative approach is characterized by teacher accepting feelings expressed by students, encouraging students to talk during class, accepting ideas suggested by the students, and asking questions from the students while the dominative approach is characterized when teacher lectures, talks continuously, gives command to students,gives directions to studentsand saying abusive words at the expense of students.

Teacher(s) does not necessarily have to allow indiscipline in their classroom or give room for students to take complete charge of the class, rather teachers share control with students and still take charge, guide and encourage students' participation in the class. However, experience has shown that students' performance may improve when their teacher is strict and hardly allows student active participation during the lesson. Because of strict nature of the teacher, students tend to comport themselves during

class, more focused and ensure assignment is done. This may translate into better achievement. Pattern of teacher-student interaction may result to better student achievement and attitude or poor student performance. It is therefore important to know through observation the kind of teacher behaviour that really translates into improved achievement and positive attitude towards learning.

Although some research works have been carried on teacher-student interaction, some aspects are yet to be properly examined. For instance, in his study, Adegoke (2007) argues that pupils learning outcomes improved when teachers give maximum opportunities to students to be actively involved in classroom activities. Though he found out the patterns of teacher-pupil interaction in primary science which was classified as either dominative or integrative but did not provide explanation on why teachers were dominative or integrative with respect to their qualification and gender. Also, Adegoke (2007) did not explain the pattern of classroom interaction in terms of student-student, teacher-materials and student-materials interactions. This study filled the gaps.

Owodunni (2015) assessed the influence of classroom interaction patterns on student Achievement in Basic Electricity at Technical Colleges in Federal Capital Territory, Abuja. He found that pattern of classroom interaction significantly influenced students' achievement in Basic electricity. But his work was limited to influence of classroom interaction on achievement in Basic electricity. The available literature thus reveal that much is yet to be done, by way of research, to find the actual pattern of classroom interaction in terms of student-student, student-material and teacher-materials interactions. The present study filled these gaps.

Okoye and Onwuachu (2018) investigated the influence of classroom interaction patterns on achievement in biology among Senior Secondary School Students in Anambra State. Result showed among others that pattern of classroom interaction significantly influenced students' achievement in biology. Similarly, Okafor, 2000; and Kalu, 2015; found significant relationship between classroom interaction and students' achievement. None of these studies was carried out in the subject area of chemistry.

Several studies have been carried out in other countries. They reported positive relationship and important role of teacher-student interaction in the classroom (e.g Pianta, Mashburn, Downer, Hamre and Justice, 2008; Wei, Den Brok, and Zhou,2009; Wentzel, 1998,2012). All these studies did not look at the combined effect of pattern of teacher-student interaction and teacher demographics (teacher gender and teacher qualification) on student achievement and students' attitude to learning especially chemistry.

Another factor which may affect student achievement is teachers' threshold time. Akinsola and Okpala (2001) defined threshold time as the minimum time required by a teacher to expose his typical classroom interaction pattern to observer during teaching – learning process. It is the warm up time a teacher uses to prepare when he enters the class to put things in order before real teaching commences. The effort is to find a way to reduce the threshold time as much as possible so that the available time meant for teaching on school time table will be effectively and judiciously used for real teaching. It is therefore important that, there is need to produce teachers with minimal threshold time.

The real academic learning time is the difference between the allocated time and threshold time. While some teachers may use five minutes to acclimatize, familiarize with the students and environment before actual teaching commences, others may use up to ten minutes out of the allocated time to arrange the class before real teaching starts. These times used by the teacher to do other things may have significant effect on the time available for student to learn and subsequently affect student achievement and attitude to learning. Issue of time management during teaching-learning process seems to receive less attention by the researchers. It appears teachers don't take the aspect of time allocation and management serious while delivering instruction or during teacher-student classroom interaction. Effect of this may be significant on our education system as a whole.

A teacher may have adequate mastery of the content and deliver instructional content very well but less attention has been paid by past studies to assess how time is allocated to each component of teaching process. A very important quality to be assessed from a good teacher is how he or she manages time during teaching. The educational significance of this is that it could provide empirical information on the

aspect of instruction delivery which enjoys more time than necessary or suffers less time or which aspect is being totally neglected during teaching and learning. For instance, if evaluation aspect is often neglected by the teacher, it is likely that essence of teaching might not be realized because evaluation will justify if students have really understood what is taught or not. Therefore, teacher's ability to manage time properly is an important issue in classroom interaction. Not much has been done to survey threshold time in science related discipline especially chemistry.

Threshold time has been found to be significant during teacher-student classroom interaction. Akinsola and Okpala (2001) defined threshold time as the minimal time required by a teacher to expose his or her typical classroom interaction pattern to observer(s). The essence is to effectively manage time needed to observe a teacher while teaching in order to establish his or her typical classroom interaction pattern. In their study, Akinsola and Okpala discovered that the average threshold time value of 14 minutes was most frequently used by the mathematics teacher trainees in exposing their classroom interaction patterns. The researchers further assert that the first five frequently used threshold time value by the mathematics teacher trainees in displaying their classroom interaction patterns are 12 minutes, 7 minutes, 17 minutes, 9 minutes and 14 minutes as these values are associated with 29.9%, 18.5%, 11.4%, 10.9% and 10.3% of the trainees respectively.

Thus, it can be inferred from these findings that the threshold time for a teacher to have meaningful teacher-student interaction in a chemistry lesson is important. Though Akiinsola and Okpala (2001) study provided a profile of threshold time for classroom interaction patterns of mathematics teacher trainees but did not provide indepth explanations for the significant group differences observed. This present study intends to cover this gap. Going by the importance of classroom interaction in enhancing student achievement it is important to carry out an assessment of teacher-student interaction and other dimensions of interactions going on in the classroom.

Among other factors that can affect teachers' threshold time is teacher gender. For instance Akinsola and Okpala (2001) surveyed threshold time for classroom interaction patterns of Mathematics Teacher Trainees in Ogun and Oyo state, Nigeria. They found that Female teacher trainees tend to have more threshold time than their male counterpart. This study observed a teacher once and did not combine Flanders

category instrument and classroom interaction sheet to observe teacher-student interactions. Teacher year of teaching experience can affect teachers' threshold time. For instance, in their study, Akinsola and Okpala (2001), who investigated threshold time for classroom interaction patterns, found that the more the trainees' years of teaching experience, the less the threshold time. The work did not assess how teachers' threshold time is affected by their academic qualification and the study observed teaching practice students.

Furthermore, it is essential to study some aspects of instructional time. It could be likenened to homeostasis in biology, gravity in physics or reinforcement in psychology. It gives room for understanding, prediction, and control. It is a concept of a great deal which requires more attention than it is usually given. (Berliner, 1990). Aspects of instructional time include allocated time, engaged time and academic learning time. Allocated time is the time that the state, district, school, or teacher provides the students for instruction. It is the total time available for learning; e.g the length of the school day or a class period. "It is the opportunity to learn". Engaged time (time on task) is the time that students appear to be paying attention to materials or presentations that have instructional goals. The California Beginning Teacher Evaluation Study (BTES) findings on engaged time or time on task demonstrate that the more engaged time students have, the higher they achieve. Academic learning time (ALT) is defined by Berliner (1990) as that part of allocated time in a subject matter area in which a student is engaged successfully in the activities or with the materials to which he or she is exposed.

Perusal of literature reveals that few studies had focused on estimating the minimal time required by teacher (especially chemistry teacher) to show his typical classroom interaction patterns and few had provided in-depth explanations for the significant group differences observed in threshold time. More importantly, very few studies had reported on the order (sequence) in which teacher presents instruction to the students. To put this study into its proper setting, and explain if the teachers' interaction patterns could be attributed to their qualification and gender, it is important to examine the demographics of teacher and assess the mediating influence of such demographics on teacher's activities in the classroom.

Teacher qualification is a factor that perhaps may have effect on students' achievement especially in chemistry which is one of the variables in this study. Teacher qualificationsentails content knowledge, pedagogical skills, teaching qualifications and verbal abilities. Previous studies find conflicting results regarding teacher qualification and achievement. Brewer (2000) Stigler and Hiebert (2007) argue that the more the teacher qualification, the better his teaching effectiveness which subsequently translates to student achievement. Similarly, Adekola (2006) claims that graduate teachers are more efficient and productive than non-graduate teachers in Business studies. Darling-Hammond (2005) also reports that teachers' academic qualification is a strong determinant of student achievement in reading and Mathematics. Owoeye (2002) also supported this when he observed that teacher's educational level turned out to be the most powerful determinant of academic achievement of students among the facilities he identified. In contrast, Chidolue (2000) finds a significant but negative relationship between teacher qualification and student achievement and attitude. However, Adeola (2011) and Simbo (2003) find no significant difference between student achievement and teacher qualification. Most of these studies gave the direction of difference between teacher qualification and academic achievement but none focus specifically on the mediating effect of teacher qualification on teacher-student interaction pattern.

The quality of teachers especially chemistry teachers in most of our secondary schools nowadays is a major worry to students, teachers, parents and guardian, school administrators and government. Research works such as Ajibola (2008), Yara and Otieno (2010), Obioma (2013) and Ogunyinka, Okeke and Adedoyin (2015) described low level of qualified teachers as a fundamental problem confronting the proper implementation of the new senior secondary school curriculum. In some schools, teachers who studied Physics, Biology and Basic science and technology in the universities though not qualified but are made to teach chemistry in secondary schools because of the acute shortage of Chemistry teachers. Some of these unqualified teachers lack requisite skills, knowledge and competences needed for teaching Chemistry. Apart from qualification, another factor which influences teacher–student interaction is gender.

Teacher gender is another factor which seems to affect classroom interaction pattern. Experience has shown that female teachers tend to teach disciplines like arts, nursing, catering, languages and literature more effectively in terms of instructional delivery while male teachers are proficient in sciences, engineering, and mathematics. Kaplan (2010) and Mack (2010) asserts in their studies that teacher gender dictates style of interaction among teachers and their students. The implication is that, students become more active, act more maturely and have a better performance at a higher level when teacher of same gender teaches them. (Kaplan, 2010; Mack, 2010).Olatoye and Ogunkola (2008) find no significant difference between male and female students' academic achievement in science. However, the role of gender in teaching and learning cannot be ignored.

Osafehinti (1995) argues that the gender of teachers determines their pattern of classroom interaction. According to him, male teachers are known for tolerance and arefriendlier in the classroom than their female folks. This is supported by the findings of Ifamuyiwa and Lawani (2008), which reveal that male teachers are more effective in classroom interaction than the female teachers. In contrary, Ajayi (1987); Smith (1992) and Adetayo (2008) claim that female teachers tend to be more productive in teaching profession than their male counterparts. For instance, Adetayo (2008) reports that male teachers do not recognize teaching as a respected profession, and therefore give less commitment to it compared to their female counterparts. However, Joshua et al. (2005) finds no significant effects of teacher gender on effective classroom interaction. Similarly, Olatoye (2006),Adegbileand Adeola (2011) reveal that female and male teachers are not different in their teaching effectiveness.

1.2 Statement of the Problem

Classroom interaction, the communication between teacher and learners as well as among learners, has been identified as one of the fundamental issues in the planning and presentation of classroom lessons. The possible cognitive and social gains as well as the positive learning outcomes resulting in and from such interactions within the classroom environment have also been stressed by researchers. Past studies on assessment of classroom climate have documented some information about what transpired in the classroom and the relationships between patterns of teacher-students classroom interaction and learning outcomes (achievement and attitude). However,

detailed information on student-student, teacher-material and student-material interactions have yet to be well documented especially with respect to chemistry as a subject.Another major aspect that has yet to be properly looked into is how teacher demographics relate or mediate the pattern of behaviour that teachers exhibit in the classroom. Equally important and yet to be well documented in the literature is determination of threshold time , that is, the minimum time at which a teacher demonstrates whether he or she is adopting a dominative or integrative teaching style.

Specifically, this study investigated how chemistry teachers deliver the chemistry curriculum (teacher behaviors) and how learners react to it inthe classroom (student behaviors) in an attempt to identifying prevailing teacher-student interaction pattern and describe variation in classroom-based implementation of chemistry curricula. In this study the researcher assessed the pattern of teacher-student classroom interactions during senior secondary school Chemistry lessons and the threshold time that it takes the teacher to exhibit his/her teaching behavioural pattern (dominative or integrative). The mediating effect of teacher characteristics such as gender and qualification on pattern of interaction was also examined. The extent to which the pattern of classroom interaction, teacher gender and qualification influencedstudent achievement in and attitude to chemistry was also assessed.

1.3 Research Questions

The following research questions guided the study:

1. (a) Using Modified Flanders 16-Category Interaction System (MFCIS), what is the pattern of teacher-student verbal interactions in terms of:
    i. Teacher talk?
    ii. Student talk?
    iii. Silence?
    iv. Non-functionalbehaviour?

    (b) Using Modified Flanders 16-Category Interaction System(MFCIS), is there anysignificant difference in the pattern of teacher- student verbal interaction between male and female chemistry teachers, as well as in terms of teacher qualification?

(c) If the interaction patterns of the teacher-student interactions are dichotomized into dominative and integrative, is there any group differences along:

i. Teacher gender?

ii. Teacher qualification?

1 What is the pattern of verbal and non-verbal teacher-student interactions using classroom interaction sheet in terms of:

i. Teacher-centred activity?

ii. Individual student activity?

iii. Teacher-student activity?

iv. Teacher-material activity?

v. Student-material activity?

vi. Student-student activity?

vii. Non facilitating learning behaviour?

3a. What is the average threshold time required by a chemistry teacher to show his typical classroom interaction pattern using:

i. Modified Flanders interaction 16 Category system?

ii. Classroom interaction sheet (CIS)?

b. Is there any group difference in the threshold time along teacher gender and teacher qualification?

1.4 Hypotheses

The following hypotheses were tested in the study:

1. Students' high achievement in chemistry can be reliably predicted from measures of pattern of classroom interaction, teacher gender, and teacher qualification.
2. Students' positive attitude to chemistry can be reliably predicted from measures of pattern of classroom interaction, teacher gender, and teacher qualification.

1.5 Scope of the Study

The study focused on assessment of pattern of teacher-student classroom interactions among senior secondary school chemistry teachers and students in Oyo state, Nigeria. It looked at classroom interaction in terms of teacher-centered activity, individual

student activity, teacher-student activity, teacher-material activity, student-material activity, student-student activity, non–facilitating learning, confusion and others. The MFCIS looked at teacher–student interactions in terms of teacher talk (accept feelings, praising or encouraging, accepting ideas suggested by students,asking questions from students, lecturing, giving commands to students, criticizing justifying authority), student talk (responding to teacher and initiating talk), silence (directed activity, contemplation, demonstration, grading student work) and non-functional (irrelevant behaviour e.g. making noise, receiving calls). It covered four dimensional classroom interactions- teacher-student, student-student, teacher-materials and student-materials. The study assessed the threshold time of the chemistry teachers. The study focused on some selected secondary schools and selected topics inSS2 in Oyo state. Therefore the results and conclusion drawn from the study were limited to the defined target population that was studied.

1.6 Significance of the study

This study was highly beneficial to various stakeholders in Nigerian Educational sector especially school administrators, policy makers, government, students and teachers. The researcher considers the work as significant in the sense that the findings provided empirical information for a better understanding of the detailed and comprehensive teacher-student classroom interaction and students' achievement in chemistry as well as attitude of students towards chemistry.

The findings from this study showed the prevailing kind of behaviour a teacher exhibits during chemistry lessons in Oyo state, and the extent to which teacher encouraged student active participation in class. The information provided would help government to know what aspect of teacher training to improve upon, and for the curriculum planners, it would help them to know which aspect to adjust in teacher-training college. The study provided empirical information on the true picture of classroom climate of the chemistry class in schools in Ibadan in terms of teacher domination or otherwise during teaching-learning process. Itwould help government to know that there are deficiencies or anomaly in the way teachers deliver instruction especially teacher-student interaction so as to know which aspect of teaching to improve on for the ultimate goal of improving performance of students in chemistry and science in general.

The results would help the curriculum planners to know which aspect of curriculum to adjust especially in terms of increasing student participation and involvement during

teaching learning process. The study provided information for policy makers and school administrators on the level of availability of instructional materials for teaching of science in schools in Ibadan. The outcome of the study helps to know the percentage of other irrelevant activities being done in the class which do not facilitate learning so as to establish the actual time (duration) devoted to active teaching-learning. This information would help policy makers, ministry of Education and curriculum planners to know the aspect to include in curriculum of teacher training college especially if the teacher lacks the appropriate skills in making the class student- centred and participatory enough and promote an atmosphere that can enhance meaningful learning.

1.7 Definition of Terms

Achievement in Chemistry: This refers to the students' scores on the chemistry objective test

Attitude to Chemistry: This refers to the predisposition of students to learn or to not learn chemistry and their feelings about the subject. It is reflected by their scores on a scale constructed and validated by the researcher.

Teacher Qualification: This was measured as B.Sc. Ed Chemistry (1), B.Sc Chemistry (2), Others(3),

High achievement in Chemistry: Those whose scores in chemistry achievement test that were at or above the 50^{th} percentile.

Low achievement in Chemistry: Those whose scores in Chemistry achievement test that were below the 50^{th} percentile.

Positive attitude to Chemistry: Those whose scores in attitude scale are at or above the 50^{th} percentile.

Teacher Behaviour: This was measured as being integrative (allows or give opportunity to students to participate in the lesson) and dominative (do not give opportunity for students to participate in the lesson).

Threshold time: Minimum or maximum time value (established for an attribute, characteristics or parameter) which serves as a benchmark for comparison or guidance and any breach of which may call for a complete review of the situation or the redesign of a system. The level or point at which you start to experience something or at which something starts to happen or change. In this study, ten minutes was established to serve as a benchmark for assessing patterns of teacher-student interaction in chemistry lesson.

CHAPTER TWO
LITERATURE REVIEW

2.1 Theoretical Background

Three theories that relate to classroom management as propounded by B.F. Skinner (1960), William Glasser (1998) and Alfie Kohn(2006) guided this study.

2.1.1 Skinner's Operant Conditioning (1960)

B.F. Skinner' work stressed that learning has to do with change in overt behavior. Skinner said that stimuli that occur in our surrounding dictate the kind of behaviour an individual exhibits. When a stimulus-response (S-R) pattern is rewarded, the individual behave likewise next time. Anything that can aid desired reaction from the learners such as encouragement, clapping, and using enticing phrase (very good, yes… go on) are forms of positive reinforcement. On the other hand, bad words used on students during the lessons, this kind of stimuli will not yield a good outcome on the part of students.The fundamental principle underlying Skinner's theory is thatwhen a student is appreciated and encouraged when he or she makes effort to talk, such students will do well on the next occasion.

Skinner's theory in operant conditioning can be applied into classroom management. When skinner's principle is used for classroom practices, the following are the ideals expected from the teacher:

- Teachers should set their test items by difficulty level so that students will not be scared away or lose interest in the classroom discussion but bring about positive encouragement.
- Teachers are expected to adopt a step-by step approach of instruction delivery and allow response from the student gradually. The class should progress in that systematic order.
- Prizes, encouraging words should be attached to every correct answer provided by the students while the class is going on.
- The learner is expected to respond each time and receive immediate feedback.

There are several means by which Skinner's theory can be used in today's education and society. Though benefits were used for good performance long before Skinner, many behavior management systems used in today's classrooms are affected by skinner's theory. Teachers use praise, positive feedback or when trying to transform a student of questionable character, and others use small amount of money to reinforce students when need arises.

This study is anchored on this theory because it emphasizes that positively reinforced behaviour will reoccur. If students are given opportunity to express themselves and teacher respects their ideas with positive reinforcement, the student will perform better. The kind of stimuli the teacher gives to student will determine how the student will respond in terms of his behaviour.

2.1.2 Glasser's Choice Theory 1998

William Glasser coined the term"choice theory"in 1998. It emphasises that everything human being does is to behave. Glasser says that most of man's behavior is deliberate, and we are guided by heredity to respond to five needs which include power, fun, freedom, belonging and love. In this theory, the most essential need is love and belonging because interrelationship with others is needed for satisfying all other needs.

Glasser's work influence learning theory in several ways. It has been used in many schools and has influenced the ways that teachers teach in classroom. First; Glasser recognize teachers as mind builders who should work hardly if they want good results from their students. The function of instructors as mind builders need them to lead students in believing that the only way to success is through hard work and dedication to duty. This could be possible if teachers develop and maintain good interpersonal relationship with their students. There are three common features of classrooms that use choice theory:

- Coercion is reduced because it does not encourage quality. Students were not made to exhibit desired behaviour by positive reinforcement and punishment. Teachers are expected to build good relationships with their students.
- Teachers should concentrate on quality. Students should have mastery of concepts redo their work until they have attained mastery and shown enough competencies. The focus is to attain deep learning through application.
- Self-evaluation is common. Students should be given needed information and take responsibility of their learning by assessing their own performance. This enhances responsibility and helps students attain goals while becoming skilled independent persons who are actively partake in their own education.

This theory supports this study because it emphasizes that teacher should encourage their students to carry out learning task again and again until they have mastery. This means teacher has to engage in effective interactions with the students to ensure they understand the concept being taught before moving to another topic.

2.1.3 Kohn's Student Directed Learning Theory 2006

Alfie Kohn'sworkempahasises motivation in form of external factor. Kohn statedthat environment that depend on external factor can be unproductive as year passes by. He maintains that positive reinforcement only makes students look for greater reinforcement instead of striving hard to work. Kohn believes that the normal classroom entails curiosity to learn which is determined by the nature of topic taught. Therefore, Kohn advocated for a very minimal standards. Regarding management of classroom, it is believed that teachers count on what is given to students in form of gifts rather than concentrate on hidden potential in each students.

To implement Kohn's techniques, teachers should give room for each student to find out about topic they prefer to learn.According to Kohn's theory there is too much emphasis on magnitude of scores rather than the learning process. He maintains that standards do not recognize that students learn at different pace. Students related activities should be given priorities. Normally, Kohn's imagined classroom situation should:

- Have classroom design with many activities on student team work.
- Have exhibition of many student's hand work.
- Involve much of student-student interaction.
- Promote mutual interaction between teacher and student.

- Make Learners more active and interested in classroom activities.
- Several classroom procedures taking place simultaneously.

This theory supports the present study because it emphasizes that teaching-learning should be students centred and students should be involved in various activities to keep them active while the learning is going on. This will involve effective interactions between the teacher and student and between the teacher and instructional materials and between student and other students.

2.2.1 History of Classroom Observation

In the late 1930's, Anderson came up with the idea of building an effective approach for the calculation of dominative and integrative behavior. Although classroom observation has existed for a very long time, objective and less biased measurement of observation dates back to recent time. Old approach of observation was biased in its calculations and could not be measured quantitatively. As a result of this innovation and invention have come up to correct the anomaly observed in the early traditional approach. Common observation scales were constructed in past few years (Amidon and Hough, 1970). Two approaches were used by early researchers for the observation of classroom interaction patterns namely: the category system and the sign system. The observer using the category system is supposed to record every statement made by the teacher which falls into one of the categories listed, that is, there will be many statements that will not be recorded at all. Examples of the category system are those of Anderson and Brewer (1946); Withall (1949). Flanders (1966); and Watson (1986) who used interaction Analysis categories to record classroom events which contains two areas. That is teacher event and student event. For the sign system, we have authors like Jayne (1945) and Morsh et al (1956). Although process studies on effective teaching that employed observational methods date more than thirty years, especially in the United States of America and other parts of the western world, the use of observational instruments in educational research in Nigeria, particularly in observing science classroom teaching and learning processes has been limited. There is inadequate knowledge of appropriate systematic observational procedures, and many researchers in Nigeria are discouraged by the tedium involved in conducting observational studies, whereas others are wary of problems of subjectivity with observational studies.

Withall (1949), made use of trained observers to categorise the possible verbal aspects of interactions in the classroom. He came up with seven categories which include acceptance and clarifying statements, directive and authoritative statements, learner-supportive statements, problem-structuring statements, neutral statements, reproving or deprecating remarks and teacher self-supporting remarks. Wubbels, Creton, and Hooymayers (1987) carried out a research in the area of teacher-student research in the Netherlands which aimed at using its findings to experiences of early childhood teachers. This maiden research in The Netherlands gave background for the present study, which assessed the classroom interaction between teachers and students.

In the course of classroom observation, a teacher is being evaluated. Some major parts of lesson presentation are shown while teachers are delivering instructions in the classroom. Classroom observation instruments serve as major instruments used in America, Europe and other Asian countries. Such instrument provides empirical and reliable data of detailed classroom activities. (Isoré, 2009; UNESCO, 2007).
Classroom observations can be relied on to provide more information to assess teacher growth progression and periodic performance.

2.2.2 Importance of Classroom Interaction in Teaching and Learning.

Classroom interaction is important in classroom because it makes students active, participatory, alert and ready to suggest their brilliant ideas**.** It is very likely that a passive teaching session may find it difficult to achieve instructional objectives stated for teaching. The teacher prepares the lesson such that instructional objectives entail cognitive, affective and psychomotor domains. To attain these, teacher needs to involve students in many activities during learning process. Sometimes teacher needs to use (interact with) some instructional materials to ensure that students have adequate grasp of the concept being taught. This therefore means that the role of effective classroom interaction cannot be under estimated. It is the outcome of teacher-student interaction that provides needed information on the challenges the student is encountering in the subject so that he will be able to provide diagnostic measures to address the challenge. From the interaction between students and teacher, it allows the teacher understand individual differences among the students and he will be able to provide necessary help or invite the parents if need be. Classroom

interactions give room to know the hidden potentials and talents of the students so that the student could be guided appropriately on the future career that will be beneficial.

Teaching is a process of enabling pupilto acquire knowledge and skills in an interactive procedure that involves the teacher, student and the environment which helps in promoting learning through classroom activities, (Aggarwal, 2006). Some classroom teaching/learning activities include: demonstration, questioning, experiments, reinforcement and reactions to teacher's teaching (Sadler, 2006). Inamullah (2005) stated that classroom relationship between the teacher and student is an important aspect of teaching process. Classroom interaction is the aggregate of classroom activitiesbetween the teacher, the student and the instructional materials.(Okoye, 2011). An interaction between the teacher and student during teaching – learning process changes behaviour, assists students to relate well in society, get lovable attitude and interest,and build a setting where a problem – solving skills can be developed (Okoye, 2011).

Aggarwal (2006) stated that teacher-student Interactions help in increasingstudents' active participation during teaching and learning process. Classroom Interaction Pattern (CIP) is a process where the teacher and student have inverse effects uponeach other through what they say or do in the classroom to achieve instructional objectives (Matelo, 2005). It is seen as a successful transmission of a message between the teacher and the student. Onimisi (2006) stated that classroom interaction pattern consist of a classroom setting where teacher and learners have inverse influence on one another through verbal and non-verbalinteractions. The verbal actions include: the teacher initiation of a lesson, students listen passively and respond through questions or recitation. Then the teacher may react either verbally or non-verbally in an encouraging or disapproving manner (Onimisi, 2006). An interaction that occurs in a classroom forms a communication context for learning. Thus, in teaching-learning process, classroom interaction pattern is the way a teacher discusses, converses, talks and expresses verbally and non-verbally to students during learning activities. It is the verbal communication pattern or style exhibited by the teacher and the students in a classroom activity.

Classroom interaction is the aggregate of classroom activities among the teacher, the students and the teaching aids during the teaching process (Okoye, 2011). Aggarwal (2006) maintained that classroom Interactions helps in improving students' active participation and involvement during teaching learning process. Then the teacher may react either verbally or non-verbally in an encouraging or disapproving manner (Onimisi, 2006). An interaction that occurs in a classroom forms a communication context for learning. Thus, in teaching-learning process, classroom interaction style is the way a teacher discusses, converses, talks and expresses verbally and non-verbally to students during learning activities. It is the verbal communication pattern or style exhibited by the teacher and the students in a classroom activity.

Classroom observation studies, despite their limitations, are of great benefit. They provide first-hand information about the object under observation. They are indeed the best method of depicting the state of instructional practices of teachers as well as identifying any problems that may exist. Classroom interaction goes a long way in promoting development of language in the students which will bring about competency in communicative skills.Some important aspect of teacher-student interaction can boost language learning opportunities. Therefore, teacher-student interaction and development of language skill and teaching are practically related and interconnected. The word "interaction" has original meaning. According to Rivers (1987), it was derived from Latin background "agree" meaning "todo" and "inter" meaning "among". Therefore, teacher-student relationship has to do with teacher action and corresponding reaction from students in the classroom. It entails giving and receiving messages.

According to Brown(2001) views interaction in communication perspective. it is the whole essence of communication. Without effective interaction, there will not be proper communication. A lot of works have been conducted on the classroom interaction which revealed that interaction is fundamental for meaningful learning to take place.

Interaction involves mutual, collaborative exchange of ideas, thoughts and feelings which brings about reverse influence on teacher and students. From the foregoing, teacher-student interaction is a style of communication among teachers, students which is reciprocated. Interaction with sociocultural groups like friends, coaches,

parents, peers and teachers can bring about good interpersonal relationship and nourishment to life.

The process variables of school quality, which have to do with patterns of interaction among teachers, learners and classroom settings during instruction, have been the focus of educational researchers and psychologists in recent years. Teacher-student interaction in the class can be effective communication which a reciprocal influence on the two parties involved. This has been known as one of the important aspects in the conduct of classroom lessons. (Obanya,2004; Duffy,Warren and Walsh,2001). It could be teacher-or- learner- initiated. The possible gains as well as the positive learning outputs resulting in and from such interactions within the classroom community have also been highlighted (National Research Council,2001).

Teacher-student interaction is very essential in Education. A research on classroom interaction provided evidence that good teacher-student relationship could positively affect academicachievement of learners. (Roorda, Koomen, Spilt, andOort, 2011).

2.2.3 Chemistry and its Impact on Mankind

Chemistry is the science which deals with properties, composition and uses of matter by studying the properties and behaviour of atoms and molecules (Upahi, 2015). It provides a good understanding of how our world works. Its practical aspect largely impacts on human life. Chemistry is a core science subject upon which technological break-through is built and is the pillar on which the wheel of science rotates. Chemistry is very essential and useful in fields such as medicine, agriculture, transportation, housing, industries among others. In addition, many careers exist in chemistry in the industries among others (Gongden, Gongdenand Lohdip, 2011).

Chemistry is happening all around us in the sense that the sun gives us light as well as heat, crops produce food for animals and man to feed on so as to produce energy, metals rust, and dead matter (plants and animals) also decay. These are all chemical processes. In the human body, photosynthesis, osmosis, diffusion among others in plants is also chemical processes. These processes have been in existence for millions of years and they can be explained through the knowledge of science. Chemistry is the science which provides the understanding of all these processes and the like. A very significant aspect of Chemistry is its application by humans in many areas for the convenience of mankind. Such include metallurgy, pharmacology, soap and detergent

manufacture, paper production, manufacture of dyestuffs, perfumes, fertilizers, textiles, drugs and even in petroleum refining. The production of ammunitions like bullets, hand grenades, explosives including bombs and other forms of weapons of mass destruction are also inclusive of the list.

An important aspect of science that is germane is chemistry. Chemistry is an essential science subject. It brings about an association among all other science subjects. It is essential requirement in pursuing a career in Zoology, Physiotherapy, Nursing, Nutrition, Medicine and Agricultural based disciplines. It tends to facilitate an understanding in other core science domains. Johnstone (1991) posited that students' experience Chemistry at the macro level in the laboratory but later Johnstone(2000) stated that for the subject to be understood more easily, it must move to the sub-micro level to understudy the nature of atoms, ions, electrons and molecules (which cannot be seen with the naked eyes) and recorded in some sign language. The sub-micro and representation levels receive priority in Chemistry teaching in Nigeria due to a variety of reasons. This approach divorces the macro or real life aspect from the other levels thus creating a barrier to students' understanding, which have been reported to affect their attitude towards Chemistry (Treagust and Chnadrasegaran, 2009). It follows therefore that a more positive attitude will result if the macro level (laboratory work) is emphasized in the teaching of Chemistry. Improving the quality of science instruction at secondary school levels in Nigeria requires knowledge and use of observational techniques that are systematic and easily adaptable to the Nigerian context and to the science discipline.

Science and technology are central to development. In today's world of high technological advancement, they are viewed as instruments per excellence required for nation building (Opara, 2004). It could be rightly argued that America's technological achievements and status today as a world power were greatly enhanced by its policy on restructuring of schools, especially regarding its science programmes immediately after the launching of the sputnik by Russia in 1957 (Rutherford, 1998). With that, emphasis was placed more on the content of instruction and how the instruction was delivered. The curriculum also aimed at ensuring that students learned science in a more conducive environment. For this reason, bodies such as the National Board for Professional Teaching Standards were set up to ensure that standards in the

teaching and learning of science that make for successful learning outcomes at various level of the education sub-sector were maintained. This requires that various activities that take place in the classroom be continuously assessed, and the results used as feedback to carry out improvements when and where necessary. In Nigeria, although these same needs are paramount, the teaching of science has continued to suffer major setback due to inadequate number of qualified science teachers whose teaching behaviour facilitates the learning of science as well as other numerous problems related to the socio-cultural environment.

2.2.4Roles of the Teacher in classroom interaction

Parallel and inclination roles can be pointed out in the classroom among the teachers and learners as they interact (Liu and Elicker, 2005). For teachers, behaviours such as clarification and development of ideas suggested by the students, allowing students to ask questions and showing their experiences were regarded parallel role, and behaviours such as lecturing, giving direction, justifying authority were regarded as the inclination role. Techniques such as constructive correction, remodifications are expected to be adopted by the teacher to redefine the ideas suggested by the learners. (Rosemberg and Silva, 2009).

Teachers perform a very important function in building the lives of their students. Teachers are experts in the aspect of educating the students that are put under them. In addition, teachers perform several other important functions in the course of instruction delivery. Teachers dictate the direction and design of lessons build a warm environment, serves as models for students,and guide them on the steps to take in the classroom. Some of the roles expected from a good teacher include:

a. **Teaching Knowledge:** One important function of a good teacher is to transfer knowledge to students. It is expected that teacher should have adequate mastery of what to teach. The curriculum content serves as guide for teachers to know what to teach. Every teacher is expected to adhere strictly with the content of curriculum throughout the school calendar year.

b. **Creating Classroom Environment**: Environment where students learn can either facilitate or hinder learning. Teachers are therefore expected to prepare a conducive classroom setting that would encourage students to learn.

Learning environment should facilitate learning activities such that it encourages students to learn.

c. **Role Modeling**: By and large, through the way teacher teach, act, and talk to students during teaching and learning process, this could serve as models for learners to emulate. It therefore imperative for teachers to take special cognizance of the way they dress, and talk before their students.

d. **Mentoring**: Teachers are supposed to be mentors to their students. Teachers are expected to exemplary in their conduct because they do and say are being observed by the students. When teachers exhibit the virtues of hard work, honesty, sincerity and good moral, learners also will want to do the same. This is a way to mentor the students.

Stronge (2002) described some of the affective characteristics of teachers to include: caring and being supportive of students, demonstrate that you care for them both within and outside the school, understanding of students' concerns and questions and knowing students both formally and informally. Other affective attributes are: promotion of enthusiasm and motivation for learning, demonstration of fairness and respect in relating with students. Generally, teachers are more involved in choosing the "how" of teaching than determining the "what".

There are some professional bodies that specifically recognize and reward teacher quality. They include National Board for Professional Teaching Standards (NBPTS), National Council for Accreditation of Teacher Education (NCATE), and National Board Certified Teachers (NBCT). It is very important to regulate how teachers are trained and certified before entry into teaching profession. This will promote quality in teacher delivery techniques and consequently improve student's academic performance.

Wholesome responsibility saddled with professional body of teachers is basically to train and educate young children. This act will boost the credibility of teaching profession and enhance its dignity in the education practice in the international community.

2.2.5 Flanders System and Verbal Interaction Category System (VICS)

In Flanders system of interaction analysis, all teacher statements are categorized into indirect or direct. These two main divisions allow varying degree of freedom the teacher grants to the student. He can be direct, that is, reducing the liberty of the student to respond. The Flanders system also gives more information on student talk category. The other aspect of the system is tagged silence which gives allowance for other behaviour exhibited by teacher or students outside the first two stated categories. Every classroom activities are placed as teacher, student or silence. Verbal behaviour for teachers has two levels which are direct and indirect teacher influence depending on the degree of freedom given to students by the teacher. Indirect influence consists of four observation categories. (1) accepting feeling of students, (2) praising or encouraging, (3) accepting ideas suggested by students (4) asking questions from students. Direct influence is subdivided into three sections: (5) lecturing (6) giving directions and (7) criticizing or justifying authority. Student talk has only two divisions: (8) responding to teacher question, (9) initiating talk. (10) Silence or Confusion.

2.2.5.1 Indirect Teacher Behaviour

Category 1, Acceptance of Feeling: When teacher shows keen interest in how students feel without abusing them when they try to express their feelings. Students have right to show their feeling about a particular situation in the classroom while learning is going on. In our society people often react to expressions of negative feelings by offering negative feelings in return. Acceptance of these emotions, in the classroom is not common since teachers do not always believe in emotional behaviour that is negative. On the contrary, it is not easy for teachers to believe in positive feelings. Feelings expressed by students may also, be ignored by the teacher if he considers the classroom as a place for ideas rather than feelings.

Category 2, Praise or Encouragement: When teacher uses words such as "good**"**you can do better, yes I am listening, and so on; these tend to help students speak during the classroom interaction. This brings out the hidden potentials in them."

Category 3, Accepting Ideas. Sometimes teachers may re-modify ideas suggested by the students to suit the desires of the teacher. Teachers use such words as "I seewhat you mean". "Ok...You mean..."The teacher is trying to take from what the students

said and build on it until it comes out the way the teacher originally wants. Such students feel important and highly esteemed in the class.

Category 4, Asking Questions: This category involves questions which are expected to be answered by the students to which the teacher expects an answer from the pupils. If a teacher asks a question and then follows it immediately with a statement of opinion, or if he begins lecturing, obviously the question was not meant to be answered. A rhetorical question is not categorized as a question. An example of another kind of question that should not be classified in category 4 is the following: "What in the world do you think you are doing out of your seat. John?" With proper intonation the question is designed to get John back in his seat; if such is the case, it must be categorized as criticism of the student's behavior (category 7). Questions that are expected to be answered are of various forms. There are questions that are direct in the sense that there is a right and wrong answer. The question, "What are 2 and 2?" is a question that limits the freedom of the student to some extent. Although he "can refuse to answer, give the wrong answer, or make a statement of another kind, in general, this kind of question focuses the student's answer more than does a question such as, "What do you think we ought to do now?" All questions, however broad ornarrow, which require answers and are not commands or criticism, fall into category 4.

2.2.5.2 Direct Teacher Behaviour

Category 5, Lecture: When teacher is talking continuously to students in an attempt to explain a concept as well as provide concrete examples to corroborate his explanation, this section is used. Questions asked by teacher which do not require answer from students are also part of this category**.**

Category 6, Giving Directions: During instruction delivery, sometimes teachers may use some commanding words to tell students what to do. Such words include, "Will all of you sit down?" or "Joy, go to the board and paint the goat drawn.

Category 7, Criticizing or Justifying Authority: A statement of criticism one that is designed to change student behavior from non-acceptable to acceptable. For example, statements such as "I don't want that boy here. Let him go away." These statements are particularly difficult to detect when a teacher appears to be explaining a lesson or the reasons for doing a lesson to the class. Other kinds of statements that

fall in this category are those of extreme self-reference or those in which the teacher is constantly asking the children to do something as a special favor to the teacher.
Categories 1 through 4, those of indirect teacher influence, and categories 5 through 7, those of direct teacher influence, have been described. They are all categories of teacher talk. Whenever the teacher is talking, the statements must be categorized in one of the first seven categories. If the observer decides that with a given statement the teacher is restricting the freedom of the children, the statement is tallied in categories 5, 6 or 7. If, on the other hand, the observer decides that the teacher is expanding freedom of children, the category used is 1, 2, 3, or 4.
There are three additional categories for use in classroom interaction:

2.2.5.3 Student Behaviour

Category 8, Student Talk: This section is used when students answer questions asked by the teacher. Or when students speak to respond to command the teacher has given.Anything that the student say's that is clearly in response to initiation by the teacher belongs in category 8.
Category 9, Student Talk: Initiation: sometimes during teaching-learning process, students on their own ask questions from the teacher about what has been taught**.**

Distinguishing between Categories 8 and 9 is often, difficult. Predicting the general type of response that the student will give in response to a question from the teacher is important in making this distinction. If the answer is one that is of a type predicted by the observer (as well as the teacher and class), then the statement comes under Category 8. When in response to a teacher-question the student gives an answer different from that which is expected for that particular question, then the statement is categorized as 9.

2.2.5.4 Other Behaviours

Category 10, Silence or Confusion: When disorder happens in the class and it is difficult to clearly differentiate who is really talking among students or teacher, this category is appropriate.

Verbal interaction in the classroom is important. A mechanism for assessing verbal interactive classroom behaviour was developed by Flanders (Amidon and Flander, 1963) in the 1950s. The verbal interaction Category System (VICS) contains five

categories which are used to explain classroom verbal behavior. They are: (1) Teacher-initiated talk, (2) Teacher response, (3) Pupil response (4) Pupil-initiated talk (5) other.

Teacher-Initiated Talk: This is further broken to four sections:

1. Presents information or Opinion: short statements forms may be used to present opinion of explanations to the students. When this is done, this category is used. It includes rhetorical questions too.
2. Gives direction:Sometimes, teacher may give order to students to be carried out in the class. For example “move your seat to the front” “stand up and remain in your seat” “touch the number five elements in periodic table” and so on. When this kind of command are given to students to follow strictly. This category is used.
3. Asks narrow question: At times the teacher may pose questions that require yes or no answer, when this kind of situation arises in the classroom, this category is used. For example, the teacher may ask “what is 2 times 2” this require one word answer.
4. Ask broad question: questions which require deep thinking are asked from the students or questions that require long explanations. For example “describe how an elephant lookslike” “why is Abuja the capital city of Nigeria?” when teacher asks these kind of questions, it falls under this section.

Teacher-Response Talk: Teacher-response talk is divided into two major categories; Acceptance and rejection.

Acceptance

5a. Accept ideas: sometimes suggestions and ideas from students are welcomed by the teacher. And the teacher tries to develop such students’ idea. Saying, “Good,” “Yes” are some examples

5b. *Accepts behaviour:*When a student respond to teachers’ question in class, that is a behaviour,then teacher give response to student as a way of accepting students idea and suggestion. This teachers’ response verbally will encourage students to talk in class in subsequent occasion. For example “I love your answer to that question”“ Joy really know how to play the guitar,”

5c. *Accepts feeling:* understanding student’s feelings even when student did not say it out. Then the teacher uses such words as“Kola,I know that you don’t have an English text that is why you were not contributing to class

discussion," "Of course you refuse to eat because you did not perform well in your last mathematics assignment,"

Rejection

6a. *Rejects ideas:* sometimes, teacher ignores suggestions made by the students and students would not be happy because they would regard such teacher action or response as criticism. For example, when teacher say "No," " is that what I taught you just now?" "That's very wrong ," " Who on earth gave you such a bad answer!"

6b. *Rejects behavior:*Students behaviour could be discouraged by the teachers comment in class. For example, teacher might say "I told you to remain standing!" "what do you think you are doing?" The tone of voice is the difference from "giving direction"

6c. *Rejects feeling:*Saying the feeling students have is not right. Sometimes teacher refuse to acknowledge the feeling the students are having or deliberately ignoring students' feeling. For example, "Aren't you going to stop lamenting over your failure in English test.?" "Just because you are physically challenged doesn't mean you should always be sad,"

Pupil-Response Talk: Student-response talk has two divisions: response to teacher and response to another pupil:

Response to teacher

7a. *Responds to teacher predictably:* when teacher gives a short reply to the student. When teacher gives a question that is narrow. for example, teacher says, " Kenneth pronounce the word on the last page of the book"

7b. *Responds to teacher unpredictably:* When student give an answer to teachers question which is unpredictable. For instance, "What was the cause of this conflict?" a pupil may reply', "It seems to me that there wasn't any one cause—I think there were many factors at work."

Response to another pupil

8. *Responds to another pupil:* Discussions which ensue between students, their response is place in this category. When student reacts to suggestions raised from another student.

Pupil-Initiated Response: Student-initiated response is divided into two major categories; initiation to teacher and initiation to pupil

:

Initiation to teacher

9. *Talks to teacher:* sometimes, students initiate and give direction of classroom activities. For example the student may say let us do almighty formulae today, it is the aspect I found difficult." "Here's a cardboard I brought for our fine art assignment.

Initiation to pupil

10. *Talks to another pupil:* discussion between students. The student begins such talk.
11. *Silence:* short interval within the lesson when the teacher is thinking of what to do next. If the class is so silent for a long time due to class exercise given by the teacher, the observer will stop clerking and take note such period on the margin.

Z. *Confusion:* some activities may be happening simultaneously in the class, noise in class, confusion everywhere in class. Students are talking, at the same time teacher is giving instructions.

2.2.5.5 Some Differences between the Flanders System andtheVerbal Interaction Category System

Perhaps the primary difference between the Flanders system and the system discussed here is that. Does the teacher use more direct or indirect influence in his teaching? Although the point is made that no value is implied, there is argument about whether direct or indirect behavior is more desirable. Direct teacher influence as opposed to indirect is not a dimension of the VICS. The teacher categories are considered in terms of initiation and response. The Flanders analysis does not give an approach for differentiating the type of teacher question. There is only one category, "Asks questions." .The VICS, the other hand, allows for the division, of teacher questions into "narrow," which bring forth predictable responses, and "broad," which elicit unpredictable responses.

Another difference is in the aspect of pupil talk. The VICS adds the dimension of predictable or unpredictable response. The Flanders system has one category to

indicate silence or confusion, while the VICS separate these two. In addition, the VICS encourage the recorder to use the confusion category simultaneously with other categories when the interaction in the classroom can still be followed but when some disruption of order is occurring.

The VICS has three for each, accepting or rejecting pupils' *ideas, behavior,* or *feeling.* The Flanders system indicates the teacher's acceptance of feeling, behavior, and ideas, but rejection or criticism is not further defined.

The VICS has seventeen categories rather than the Flanders ten, and thus is more unwieldy and harder to learn and use. However, previous experience by Withall (1949) and Bales (1950) indicates that seventeen categories (of which eight are really subheadings) is not a difficult number for trained recorders to use.

2.2.5.6 Modified Flanders 16 Category Interaction System (MFCIS)

Teacher-Talk

1. **Praise and Encouragement:**Some encouraging words or signs are given by the teacher to students especially when students do well in the class during teaching learning process. For example "continue" "very good" "teacher nod his or her head in agreement to what students are saying" all these belong to this category**.**
2. **Clarification and Development of ideas suggested by students:**Some ideas are students which the teacher builds upon and shapes such ideas until it fits in to what the teacher wants. When this happens, this category is used.
3. **Ask questions:**Sometimes the teacher ask question directly from the student and expect an immediate response from the student. This is the appropriate category**.**
4. **Answers student's questions:** gives time to respond to student's questions**.**
5. **Lectures :**When teacher is talking continuously in an attempt to explain some concepts with relevant examples. Rhetorical questions which requires no answer from the students are also part of this category.
6. **Gives feedback :** when teacher respond to student questions
7. **Gives directions**: when teacher gives command to students to be carried out in the class.

8. **Justifies authority or criticizes student**: When teacher uses a statement that critizes in an attempt to transform student behaviour to the accepted one. For example " I don't like the way you are sitting " "Please sit properly"

Student- Talk

9. **Response:** when student respond to teacher's question
10. **Emitted:** this category is tallied when student initiate talk by himself or herself without being told by the teacher. (spontaneous, self-initiated talk). Student declarative statements emitted but not called for by teacher questions.
11. **Ask questions:** when student ask question from the teacher which are related to the topic being taught.

Silence

12. **Directed activity:**Activities teacher and students engage in during the lesson without necessarily talking. For example reading from textbook as directed by the teacher. For example, when teacher gives order to student " do exercise number 1 to 5" with this, the whole class will be silent, students will only be doing the work as directed by the teacher.
13. **Contemplation:**Period when teacher is still thinking of the next step to take during the lesson.
14. **Demonstration:** Using material to explain concept without necessarily talking. When is using hands to explain or following a specified procedure or guideline without talking and students are quietly watching what the teacher is doing. Such period of silence is categorized here.
15. **Grading student work:** teacher going round to mark students' note without talking

Non Functional

16. **Irrelevant behaviour:**Activities not related to teaching and learning in the classroom. When the noise or disorderliness such that one is not able to identify whether the teacher or student is really talking. This kind of confusion is under this section.

2.2.6 Types of Classroom Interactions

Various authors and scholars in classroom interaction have given several forms of classroom interaction in literature. It will be important to discuss other forms of classroom interaction. In teaching-learning process, classroom interaction pattern is

the way a teacher discusses, converses, talks and expresses verbally and non-verbally to students during learning activities. It is the verbal communication pattern or style of the teacher and the students in a classroom activity. Krat and Kratcoski (2004) opined that classroom interaction is a two-way action between the teacher and the students which may affect learning depending on the clarity of the message. An interaction that occurs in a classroom forms a communication context for learning.

Van Lier (1988) presented four fundamental kinds of classroom interaction:

a) when teacher does not take charge of the topic and the classroom activity;
b) when teacher is in charge of the topic being taught but does not control class activity;
c) when the teacher takes charge of both the topic and classroom activity;
d) whenthe teacher is in charge of class activity but not the topic;

Classroom interaction is the aggregate ofall interactions which occur in the classroom between the instructor, the learner as well as interaction with available teaching aids during learning process (Okoye, 2011). An interaction between the teacher and student during teaching – learning process changes student behaviour, assist them to socialize, build desired attitude and interest, and bring about an atmosphere that aid problem – solving skills (Okoye, 2011). Aggarwal, (2006) maintained that classroom Interactions helps in improving students active participation and involvement during teaching learning process. Then the teacher may react either verbally or non-verbally in an encouraging or disapproving manner (Onimisi, 2006). Pattern refers to the way of doing something (Hornby, 2001). An interaction that occurs in a classroom forms a communication context for learning. Thus, in teaching-learning process, classroom interaction pattern is the way a teacher discusses, converses, talks and expresses verbally and non-verbally to students during learning activities. It is the verbal communication pattern or style of the teacher and the students in a classroom activity. Copper and Robinson (2000), classified classroom interaction pattern into a four dimensional character involving interaction between teacher and student, student-student, teacher-material and student-material.

Allwright (2010) explains the five aspects of interaction: management of turn, topic, task, tone, and code(1984: 161-163).

Interaction Patterns

1. **Group work**

   Some classroom tasks may require teacher to put students in group of fours in order to achieve his objective and promote team learning.The teacher only move round to see students walk and ready to offer help when need arises.

2. **Closed-ended teacher questioning (IRF)**

   Many guessing may come up, but only one is the right answer. Students blindly predicting what the teacher wants.

3. **Individual work**

   This entails personal work given to each student. The teacher expects that it should be done independently. Teacher checks what the students are doing as individual work progresses.

4. **Choral responses**

   The teacher provides gives a model and every student in the class echo it repeatedly as the teacher directs.

5. **Collaboration**

   The students are allowed to work in twos in order to do an assignment given by the teacher. (This is not group work itself as discussed above.)

6. **Student initiates, teacher answers**

   The students engage in task of thinking to guess correctly while the teacher is in position to decide who gets the correct answer.

7. **Full-class interaction**

   A topic may be thrown open to the entire class to argue for or against. The whole class may be divided into two groups with a leader in each group and the debate begins. Once in a while teacher may come in to control the noise level.

8. **Teacher talk**

   Sometimes teacher may decide to dictate note, student only respond to this by copying the note without talking at all. Teacher is the one that begin the exercise.

9. **Self-access**

   Students are given liberty to make personal choice on the type of learning task they want to perform.

10. Open-ended teacher questioning

Correct "answers" are more than one thus increasing the number of students that can get it correct.

Classifying Forms of Interaction

From different kinds of interaction pattern presented above, check the varying degree of involvement of the teacher and students; classify them using the following code interpretations:

TT = instructor is active, learners are only passive

T = instructor is active, learners mainly passive

TS = instructor and learners fairly equally active

S = learners active, instructors mainly passive

SS = learners very active, instructor only passive

2.2.6.1 Teacher-Student Interaction

Teacher – Student interaction pattern consist of where the teacher initiates, guides and direct classroom talk with students, (Viiri and Saari, 2006). This talk is directed towards a specific target or problem. The talk pattern is related to the problem-solving method, because their characteristics are similar (Akuma, 2005). Teacher-student interaction pattern consist of where the teacher initiates, guides and directs classroom talk with students (Viiri and Saari, 2006). The uniqueness of teacher-student interaction pattern is not the same as that of the student-student interaction pattern.

Teacher and student interaction has become a fundamental discourse in the field ofeducation. An analytical mechanism was put up by Flanders (1970) which indicated clearly the seven sections of teachers' classroom. The breakdown of teachers' behaviour include: clarifying feelings of students, praising students when he respond correctly, using idea suggested by student, asking questions from the students, lecturing, giving directions to students on the step to take, and criticizing the action of students. Students felt more save and confident to express their minds when teacher asks for students' suggestion or seek for ideas from the students (Liu and Elicker ;2005)

Teachers that show understanding as regards the feeling of their students always results in the kind of learners who are active and participatory. Many other teachers take offense easily at slight mistake on the part of students and therefore lose grasp over students' interest. It is the responsibility of the teacher to see that students are treated with respect especially among themselves.

Students who disturb the peace of the class are being encountered by the teacher on the daily basis, teachers supposed to do something about this so that such students will not think the way he is behaving is the best. Teachers cannot afford to keep quiet at this kind of behaviour. It is part of the duty of teacher to correct erring students and put things right. Though, it is understandable learning is a voluntary process on the part of the students. It can take place at home or in the school.

Individual differences exist among the students in term of their learning pace. There are fast learners, there are set of students who are just above average academically while others are slow learners. Yet teachers will look for ways to bridge the gap between the students. Sometimes he teaches again and again to ensure that students attain mastery in the subject matter under discussion.

2.2.6.2 Student-Student Interaction

Student-student interaction pattern enables students to talk with their peers in a group to solve a common problem (Viiri and Saari, 2006). This discourse pattern involves the participation of all member of the group. This is used to implement the cooperative/collaborative learning strategy because they are similar. Student-student interaction pattern enables students talk with their peers (Classmate) in a group to solve a common problem (Viiri and Saari, 2006).This discourse pattern involves the involvement of every member of the group. The teacher, after teaching, divides the students into 6 students per group, each group with a peer leader, who is trained by the teacher to lead the group. The students discuss assignments given to them by their teacher in groups, while the teacher coordinates them. Low level ability students are helped by their colleagues who know better and can cope with the discussion as they learn cooperatively.

Student–student interaction in the classroom is very essential in teaching – learning process. It involves how students talk with one another during the lesson. This

depends on the freedom given them by the teacher. Sometimes the teacher might decide to limit the degree of student participation and at other times he may decide to increase the freedom of students. Both direct and indirect teacher influence has advantages and disadvantages. Generally it is good if teacher gives some tasks to students to carry out after dividing the students into group of 4s. Teachers do not have to give all their control to the students in order to control the noise and excesses from the students. Sometimes students disabuse the freedom given them by the teacher. Therefore teacher must be the classroom at all time to check and control what the students are doing.

2.2.6.3 Teacher-Material Interaction

Teacher–material interaction pattern involves how the teacher illustrates teaching with instructional materials in the classroom (Jaja, 2002). Instructional materials are potent tools, which can be used to effectively communicate science, while enriching the learning experiences of the learners (Okoye, 2010). Other interaction patterns have been used in teaching and learning processes as a mean of facilitating achievement in science.

It is obvious that teachers do make use of certain instructional materials to aid teaching and learning. This is very essential because students tend to understand better when taught using teaching aids.The usual idea is that for new instructional materialsto be developed by curriculum designers in compliance with innovations given by policymakers, then teachers will carry out the implementation without allowing others to suggest their own idea.

Instructional materials choice is based on the content of curriculum in operation. As the content is changing, the method of instructional delivery also keeps on changing. And therefore teachers are expected to learn new ways of teaching which will be in accordance with the new content. Teachers will then adjust to the new vision, imbibe the innovations, be ready to acquire new techniques of instruction that will make them fit in to 21st century manner of pedagogy. (Shulman & Shulman, 2004).It therefore evident that teachers need to be involved in the planning and designing new instructional materials.(Schwab, 1983; Marsh, 2004), via a so-called symbiotic implementation strategy (Altrichter, 2005). Bringing teachers in to development of

instructional materials has two purposes. First, it will bring about a kind of instructional materials which are known by the teachers and they can easily operate. It will be the type they trust and relied upon. Therefore teachers will no longer have the thinking that they are being mandated to change their classroom practice all the time.

Learning materials tend to have small scope. Textbooks in different subjects, workbooks in different subjects, and available worksheet are always provided in secondary schools. Also, mathematical set for construction in mathematics, maps are always available to teach some aspect of Geography, some bench reagents are available to explain theoretical and practical aspect of chemistry. Charts placed on the walls and other multimedia video are always used to compliments learning. Some visual and audio visuals are needed to fit in with modern technology of teaching pedagogy in the 21st century, but the fund needed to procure these equipments are no available especially in some rural schools. Students with special needs are taken care of by providingtheir peculiar learning materials.

2.2.6.4 Student-Material interaction

Student-material interaction pattern enables an individual or a class to work with science equipment, preserved organisms or life Specimens'. This involves students' active participations and acquisition of manipulative skills (Okoli, 2011). Student-material interaction pattern enables an individual or a class to work with instructional materials. Other examples of student-material interaction pattern include: reviewing and expanding lecture notes, reporting practical work, carrying out experiments, searching the internet and reading materials on a website (Smith, 2000). It involves students' active participation and acquisition of manipulative skills (Okoli, 2006). It is very important for students to make use of some selected teaching aids as directed by the teachers. This will facilitate understanding and active participation.

2.3 Empirical Review

2.3.1 Classroom interaction patterns and students' achievement in Chemistry

Past studies have assessed the effect of classroom interaction pattern on students' achievement.For example, Adegoke 2007 carried out a study on patterns of teacher-pupils interaction in the classroom and learning outcomes in primary science. He used 28 primary six science teachers and 437 primary six pupils randomly selected from 28 primary schools in Ibadan educational zone ii, Oyo State, Nigeria. He used the

modified form of Flanders interaction Analysis Categories System (FIACS). His findings showed that, on the average, pupils taught by teachers whose classroom behaviour was classified as being integrative performed better in primary science achievement test and showed more positive attitude towards primary science than pupils taught by teachers whose classroom behaviour was classified as being dominative. Also, in their study, Turner et al., (2002) found that pupils performed better when the teacher maximized pupils' chance to be actively involved in classroom events while learning mathematics.

Owodunni (2015) carried out a study on influence of classroom interaction patterns on student achievement in Basic Electricity at Technical Colleges in Federal Capital Territory, Abuja. He used 123 students of Basic Electricity students in Government Technical Colleges in Federal Capital Territory. The result revealed that classroom interaction patterns significantly influenced students' achievement in Basic Electricity. Also Kalu (2015) carried out a study titled classroom interaction patterns and students' learning outcomes in Physics. The sample consisted of 516 SS1 students and 15 Physics teachers drawn from 15 selected secondary schools in Calabar Education Zone of Cross River State, Nigeria. The results revealed a significant relationship between interaction pattern and students' post-instructional attitude and low academic task achievement.

Similarly, Odinko and Williams (2006), examined language of instruction and interaction patterns in Pre- primary classrooms in Nigeria. The pupils were observed in numeracy class at pre- primary level (ages 3–5). The findings revealed that the major language of instruction was English language rather than the language of the pupils' immediate community. Also Adegoke (2005), carried out a study on Effect of integrative teaching approach and students level of Proficiency in English Language on Students' achievement in senior secondary School Mathematics. The sample consisted of 116 senior secondary school two students. The findings pointed out that students learning can be improved when they are allowed to ask questions during lesson and express their opinion when the lesson is on. Also, Isiugo-Abanihe and Longjohn (2000) carried out a study titled an observational study of classrooms of science student-teachers in Port Harcourt, Nigeria. The study made use of 33 pre-service science teachers and used a modified version of Flanders interaction Analysis

Category (FIACS) system. The result indicated that students' talk in the science classes was very minimal as teachers dominated the classroom interaction. There was a significant difference in the type of talk engaged in by students. They engaged mostly in more passive response-type of talk rather than in spontaneous, self-initiated talk.

Liu et al (2013), carried out a pilot study titled "analysis of teacher-student interaction patterns in a Robotics Course for Kindergarten Children in Taiwan"the findings of sequential analysis and content analysis of the videotaped learning process showed that teacher's guide assisted the learners to put together topobo bricks. Questions thrown to the students from the teachers serve as a source of encouragement for students to share their ideas or solve problems.

Okoye and Onwuachu (2018) conducted a study on the influence the influence of classroom interaction patterns on achievement in biology among Senior Secondary School Students in Anambra State. A population of 10, 206 SSII Biology students in government owned Secondary Schools in three education zones were used. Result showed among others that classroom interaction patterns significantly influenced students' achievement in biology. Also,Okafor (1993) found a positive relationship between classroom interaction behaviour and students' level of achievement. Moreover Kalu (2015) carried out a study on classroom interaction patterns and students' learning outcomes in Physics. He used 516 senior secondary school one students and 15 physics teachers from 15 selected secondary schools in Calabar Education Zone of Cross River State, Nigeria.

Each teacher and classroom was observed for four lesson periods which spread through 8 weeks and the interaction style was coded by science interaction Categories. The findings indicated that there was a significant difference between interaction pattern and students' post-instructional attitude and low academic task achievement. These assertions indicate that classroom interaction patterns are essential in teaching and learning situation and would be classified to identify the various types.Copper and Robinson (2000) pointed out that classroom interaction are in fourdimensionalpattern involving interaction between teacher- student, student-student, teacher-material and student-material. The following are the characteristics of

each of the patterns as revealed by literature. Teacher-student interaction pattern consist of where the teacher initiates, guides and directs classroom talk with students (Viiri and Saari, 2006).

The uniqueness of teacher-student interaction pattern is not the same as that of thestudent-student interaction pattern. Student-student interaction pattern enables students talkwith their peers (Classmate) in a group to solve a common problem (Viiri and Saari, 2006).This discourse pattern involves the participation of every member of the group. The teacher, after teaching, divides the students into 6 students per group, each group with a peer leader,who is trained by the teacher to lead the group. The students discuss assignments given tothem by their teacher in groups, while the teacher coordinates them. Low level abilitystudents are helped by their colleagues who know better and can cope with the discussion asthey learn cooperatively.

The student-student interaction pattern is used to implement the cooperative/collaborative learning strategy because they are similar characteristics (Muodomugo, 2005). Student-material interaction pattern enables an individual or a class towork with instructional materials. Other examples of student-material interaction patterninclude: reviewing and expanding lecture notes, reporting practical work, carrying outexperiments, searching the internet and reading materials on a website (Smith, 2000). It involves students' active participation and acquisition of manipulative skills (Okoli, 2006).

Inthe teacher-material interaction pattern the teacher illustrates teaching with instructional materials in the classroom (Jaja, 2002). Obodo (2004) found out that instructional resources are potent tools, which can be used to effectively communicate, while enriching the learning experiences of the learners. Also, Obioha (2005), found out that classroom interaction patterns can rotate from teacher to learner, learner to teacher, learner to learner, individually or in groups, verbal expression to chalkboard demonstration, sensory to tactical, visual to audio-visual and listening to performance.

In the context of this study, classroom interaction patterns in teaching and learning process is a communication style used to pass information to the learner or simply

teacher- student talk pattern in the classroom. The aim is to ensure that learning takes place through the pattern that prevails (Okafor, 2000). The extent of learning taking place in a classroom depends to a great extent, on the magnitude and mode of the teacher's interaction with the learner, the learning materials and the environment. This implies that teachers should provide an interactive teacher-student setting to increase students' cognitive development.

2.3.2 Classroom Interaction Patterns and Student Attitude to Chemistry

Studies have revealed that attitude is very significant in the teaching and learning outcome (Falade, 2001; Papanastasiou, 2001).Fazio and Roskes (1994), assert that attitudes are important to educational psychology because they strongly influence social thought, the way an individual thinks about and processes social information. The interactions style adopted by the teacher may determine the attitude of students towards the subject being taught by the teacher. When teacher allows students to ask questions during the lesson, welcomes ideas suggested by the students and prune them to the desirable such that the students feel important, give room to students to express their feelings and opinion, such learning environment may promote students interest and subsequently bring about positive attitude to the subject. Some empirical studies have been carried out on the effect of classroom interaction patterns on students' attitude . For example Kalu (2015) observed the interaction patterns during physics lessons and related the identified patterns to students' post-instructional attitude towards physics and achievement in low and high academic tasks. The sample consisted of 516 SS1 students and 15 physics teachers drawn from 15 selected secondary schools in Calabar Education Zone of Cross River State, Nigeria. The results indicated that a significantly positive relationship exists between interaction pattern and students' post-instructional attitude and low academic task achievement. The result imply that the more teachers used indirect teaching (teacher praise students, welcome and clarify ideas suggested by the students, ask questions from students, answer student questions), the more students developed positive attitude towards physics. In other words, students' development of positive attitude towards physics significantly increased with teachers' indirect influence of classroom activities.

2.3.3 Teacher Behaviour and Student Achievement in Chemistry

Teachers have different classroom behaviour and attitude which can also determine the tune of interaction with the students.Some teachers are very hard on students and others very nice and accommodating. Certainly, the teacher's behavior pattern determine the style of students' behavior which eventually determine student achievement. Adegoke (2007) classified the teacher's classroom behavior into two categories - Dominative and Integrative. He carried out a study on patterns of teacher-pupils interaction in the classroom and learning outcomes in primary science. He used 28 primary six science teachers and 437 primary six pupils randomly selected from 28 primary schools in Ibadan educational zone ii, Oyo State, Nigeria. The results revealed a significant relationship between classroom interaction pattern and student achievement in primary science. Students taught by teacher whose classroom behaviour is classified as being integrative performed better than students taught by teachers whose classroom behaviour was classified as being Dominative.

Mckinney, Mason, Perkerson and Clifford (1975) investigated the relationship between classroom behaviour and academic achievement using multiple regression procedures in which the frequencies of twelve behaviours were used to predict the achievement of 90 second – graders from 5 classes in 3 public schools. They obtained multiple correlations of .63 and .51 for Fall and Spring data respectively.

Few studies have worked on effect of teachers' interaction patterns on student achievement. For example, Adegoke 2007 carried out a study on patterns of teacher-pupils interaction in the classroom and learning outcomes in primary science. He used 28 primary six science teachers and 437 primary six pupils randomly selected from 28 primary schools in Ibadan educational zone ii, Oyo State, Nigeria. He used the modified form of Flanders interaction Analysis Categories System (FIACS). His findings showed on the average, pupils taught by teachers whose classroom behaviour was classified as being integrative performed better in primary science achievement test and showed more positive attitude towards primary science than pupils taught by teachers whose classroom behaviour was classified as being dominative. Also, in their study, Turner et al., (2002) found that pupils performed better when the teacher maximized pupils' opportunities to participate in class activities while learning mathematics.

The earliest systematic studies relating directly to classroom climate were done by Anderson et al (1939, 1945, 1946). The studies observed teacher-pupil interactions and identified two patterns of teacher influence as either dominative or integrative.Teaching behaviour occurs in the context of classroom interaction. Behaviour of teachers vary in the classroom and it gives various style of teacher-student interaction. The teacher's behaviour tends to create an atmosphere which is described as classroom climate. We may classify the teacher's classroom behaviour into two categories -(1) Dominative and (2) Integrative.

A dominative teacher's style is characterized by teacher commanding the students, talking continuously without allowing students to participate, and shout students down when he is trying to make contribution in the class. However, a teacher is integrative when he accepts ideas suggested by the students during lesson, encourages students to talk, praise students' response during the lesson. It is, therefore, the teacher's behaviour which dictatesthe pattern for learning atmosphere or climate in the classroom. If the teacher is friendly, welcomes questions from students without abusing them, he promotes an integrative classroom environment. On the other hand, if the teacher is the kind that makes abusive words at the expense of the students, shout students down when they try to make contribution or talk continually for greater lesson period, such a style is domineering approach.

Integrative teaching approach is a well – organized approach which has basis on real life situation that include learners' interests and needs creating different level of activities and learning experiences (Abechuela;2009). To sustain learners' interest one needs engage learners in series of classroom activities which will definitely lead to teacher interacting with the students and students will interact among themselves. The objectives of integrative teaching strategies according to Abechuala(2009) include:

a. To promote security and satisfaction
b. To facilitate team learning among students.
c. To assist in developing sense of values.
d. To develop self – direction.
e. To enhance creativity among students.
f. To give room for social interaction among students.

g. To provide a platform where learning could be evaluated easily.

Rules guiding integrative teaching strategies (Abechuala, 2009) include

a. Developing learners' entire personality is more important than the subject matter

b. Long term plans and large units should be prepared to daily and isolated tasks

c. Learning activities should be recognized around real – life problems of the student, their needs and interests.

d. Some of the features of learning are group planning, group work, and group assessment.

e. Teaching – learning activities should give room for students' freedom to ask questions.

f. Individual differences among the learners must be considered.

g. The environment where learning take place should be friendly and conducive.

According to Abechuala(2009) the diagram below explains further other extension of integrative teaching strategy.

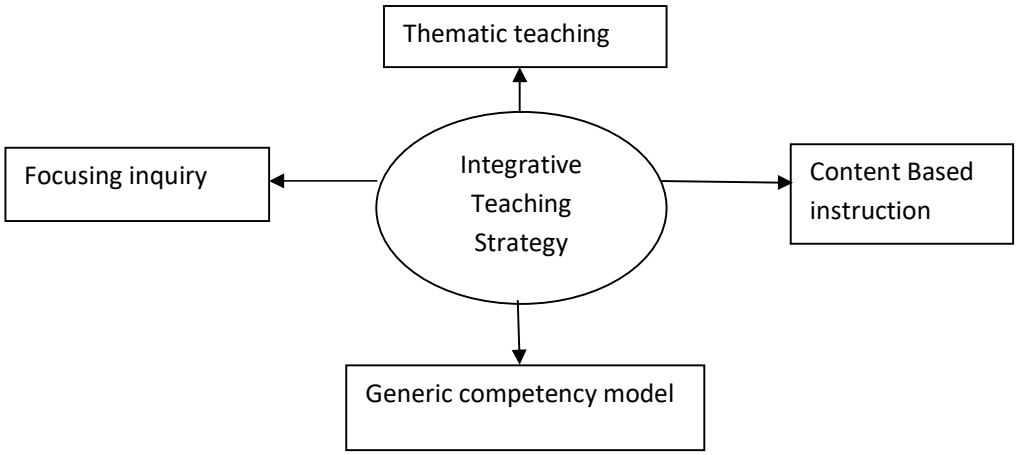

Fig 2.1 Sub-division of integrative approach

Source:Abechuala, 2009.

Active learning is generally defined as any instructional method that engages students in the learning process as shown below.

A

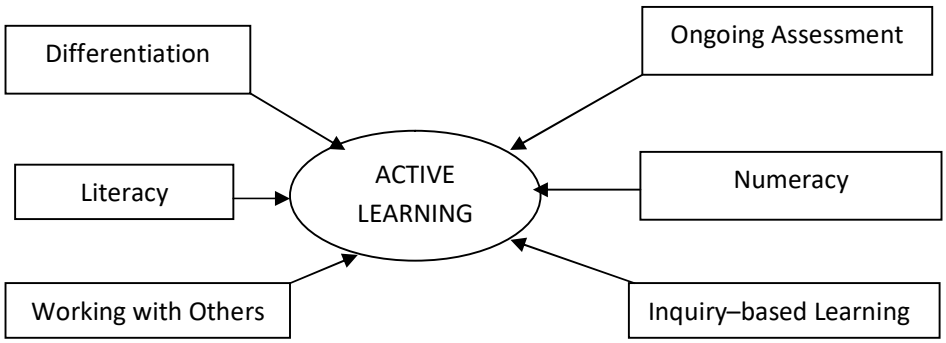

Fig 2.2 Interconnectivity involved in active learning

Source: Professional Development Service for Teachers (PDST) An integrated Approach to Learning, Teaching & Assessment, Dublin 2017.

Dominative and Integrative Teaching Approaches.

Many research works on teacher classroom behaviour (integrative and dominative) were carried out by Anderson (1939), Amidon and Flanders (1967), Amidon and Hough (1970), and Dunkin and Biddle (1974). Some of the new researches in this area include Adegoke (2003), Kings and Rosenshine (1993), Rodriques and Bell (1996), and Turner, Midggley, Meyer, Gheen, Anderman, Kang, and Patrick (2002). For instance, Amidon and Flanders (1967) investigated the effect of integrative and dominative teaching method on students' achievement in geometry in America. Turner, et al (2002) found out how students' involvement in classroom teaching and learning processes affected their academic performance.

According to Anderson (1939), dominative behaviour of the teacher is clear when he refuses to listen to the ideas suggested by students, scolds students, give abuse at the expense of students, talkcontinuously during lesson. However, a teacher who has integrative behaviour always welcome the ideas suggested by the students, allows students to talk in the classroom during the lesson, ask questions from students and allow them to respond, praise good response from the students.

It is assumed psychologically that the teachers decide what and how classroom activities should be done. The kind of students produced from a dominative classroom is used to memorization and cramming of concepts. In a classroom climate where a teacher uses an integrative approach, he engages students more often in questions and

answer, and allows students to contribute maximally in the class. Since integrative behaviour of the teacher helps some slow learners in the class and bridge the unusual gap between the fast learners and slow learners. (Adegoke, 2003; Turner, et al,2002;)

Empirical works (Adegoke,2003; Amidon and Flanders, 1967; King and Rosenshine, 1993; Turner et al, 2002,) have lend credence to the fact that students whose teacher uses integrative and student-centred approaches perform far better in terms of output than their counterparts. For example, Adegoke (2003) found that dependent-prone students who learnt mathematics in the class where the teacher adopted integrative teaching method performed significantly better than their colleagues who learnt mathematics in the classroom where the teacher adopted dominative teaching method.Adams and Biddle (1970) concluded from their study of first, sixth and eleventh grade teachers that teachers were the most popular actors in 84 per cent of classroom communication episodes and that less than one half per cent of classroom verbal behaviour was spent in discussion of feelings and interpersonal relations. This seems to reinforce Flanders' (1963) "law of the two-thirds which operates in almost every classroom".

According to Flanders, teachers spent two-thirds of their teaching-learning time either disciplining or organizing classroom activities, hence leaving students little opportunity to participate actively in their own learning process. But studies by Jackson and Wolfson (1968) and Burkhart (1969) showed that teachers were generally not aware of this pattern, nor did they want to monopolise classroom learning. They believed that teachers perhaps behaved in this way because they simply did not know the style of engaging students during class activities. Brophy and Good (1970,1972) said that in most cases, teachers grossly underestimated the amount of time they talked in the classroom. They also showed that teachers were unaware of certain aspects of classroom behaviour.

2.3.4Teacher Behaviour and Student Attitude to Chemistry

The way a teacher administers his classroom (restricts students from participating or allowing students to talk during lesson) has effect on the attitude of students towards the subjects. Many studies have been carried out. For instance, Eggen and Kauchak (2001) are of the view that positive teachers' attitudes are fundamental to effective

teaching. The teacher is expected to use methods that should arouse and sustain the interest of the learners. These could be achieved better when teachers are enthusiastic, caring, firm, and democratic, among others. Brunning (1999) established that teachers' characteristics such as personal teaching efficacy, modeling and enthusiasm, caring and high expectation promote learners' motivation and are also associated with increase in students' attitude.

Similarly, Adegoke 2007 carried out a study on patterns of teacher-pupils interaction in the classroom and learning outcomes in primary science. He used 28 primary six science teachers and 437 primary six pupils randomly selected from 28 primary schools in Ibadan educational zone ii, Oyo State, Nigeria. He used the modified form of Flanders interaction Analysis Categories System (FIACS). His findings showed that, on the average, pupils taught by teachers whose classroom behaviour was classified as being integrative performed better in primary science achievement test and showed more positive attitude towards primary science than pupils taught by teachers whose classroom behaviour was classified as being dominative.

2.3.5 Teacher-Student interaction and Academic Achievement in Chemistry

Teacher-student interaction and its influence on students' achievement. Students can safely work and gain maximally if the environment is friendly and they can have confidence to learn. Specifically, the kind of stimuli and support given to students in the classroom will determine how better they will learn under the introduced situation. (Nielson and Lorber, 2009). Students are more confident and free to learn in an atmosphere that is safe. The teacher will interact more easily and a good result will occur.

Cordial teacher-student interaction is a necessity for a healthy classroom and student success. Matters on classroom management are connected to bad interactions between the students and teacher. This is one of the reasons why some leave teaching job. (De Jong, Van Tartwijk, Verloop, Veldman, andWubbels, 2012; Walker, 2009). Various research works have been done in the Netherlands, Canada and Indonesia to assess the effect of good teacher-students interaction on students' performance. The various findings indicated that a good classroom relationship between teacher and students account greatly for overall success in Education.

The relationship between teachers and students influences the level of students' readiness and experiences in class between teacher and students. According to Davis (2003), teachers can influence students' social and intellectual experiences through their power to imbibe values in students. Moreover, good interaction between teacher and students may play an essential function when students are being sent to middle school.

The emotional balance give confidence to students and enable students to be participatory in class. Ideally, teachers serve a crucial responsibility over the success of their students. The way and manner in which teacher leads and communicate with her students is a strong determinant of the success of the students. Students become more interested in classroom business when teacher proof love, care and supportive.
Teachers are expected tohave liberty to interact with their students and being friendlier instead of frowning face always. However one is not disputing discipline on the part of the teacher, the teacher needs to be methodogical in administering punishment to students so that it will not scare them away completely and therefore the essence of learning would not have been achieved. The most important partners that constitute meaningful classroom are teachers and students. Flander were of the opinion that the two third rules which implies that about 70% of lesson period are being used by the teacher while students only talk within the remaining 30%. This has a bad effect on students because it makes student passive during classroom discussion.

The kind of learning atmosphere designed by the teacher can facilitate good teacher-student interaction. The data gathered from classroom observations by trained observers can provide sufficient evidence on both positive and negative aspects of teacher-student interactions. This is to extract and use only the positive part.

2.3.6 Teacher-student Interaction and Student Attitude to Chemistry

Teacher-student interaction and its influence on students' attitude to Chemistry. Attitudes towards Chemistry or science denote interests or feelings towards studying Chemistry orscience. It is the students' disposition towards liking or disliking' science while attitudes in science mean the scientific approach assumed by an individual for solving problems, assessing ideas and making decisions. Student

beliefs and attitudes have the potential to either facilitate or inhibit learning (Yara, 2009). Many factors could contribute to a student's attitude toward studying science (Chemistry).

.

Cordial teacher-student interaction is a necessity for a healthy classroom and positive attitude towards the subject. The various findings indicated that a good classroom relationship between teacher and students account greatly for cognitive, psychomotor and more importantly affective domain of the student.

The relationship between teachers and students influences the level of students' readiness and experiences in class between teacher and students. According to Davis (2003), teachers can influence students' social and intellectual experiences through their power to imbibe values in students. The emotional balance give confidence to students and enable students to be participatory in class. This could promote a positive attitude on the part of the students. Ideally, teachers serve a crucial responsibility over the success of their students. The way and manner in which teacher leads and communicate with her students is a strong determinant of the success of the students. Students become more interested in classroom business when teacher proof love, care and supportive. The kind of learning atmosphere designed by the teacher can facilitate good teacher-student interaction and further encourage good attitude from the students.

2.3.7 Student-Teacher Interaction and Academic Achievement in Chemistry

Pianta (1999) described classroom interaction as the kind of classroom experience that contain some personal emotions which is a result of teacher –student continuous interaction. When students understand, cooperate, trust and have confidence in their teacher, students tend to build connection with their teacher, see their teacher as a guidance, protector, who will do everything to ensure that they are safe in the learning environment and teach them well to the point of satisfaction. Darling and Civikly (1987) lend credence to his findings in the sense that when teachers interact with their students in an interactive way, a kind of classroom climate which is beneficial to both students and teacher will be built. This kind of classroom will have less of distraction, confusion, less of non-facilitating learning activities.(Cited in Myers at al., 2012 p. 389). However, Rosenfeld, 1983 maintained that when teachers interact with students

such that teacher is trying to defend him or herself during the lesson or the teacher exercises authority as he presents his lesson, the atmosphere in such classroom usually show threat, rebellion and defiance." (cited in Myers et al., 2012 p. 389).

Koplow (2002) stated that effective student-teacher interactionbrings about confidence and classroom engagement just in the same way good parenting promotes sense of security and confidence. Students learn better when they are motivated and have belief in their teacher. It is important to have a cordial relationship with their teacher. Students also can gain maximally from their teachers when they realize that the teacher love them and are passionate about what he is teaching them.Students' relationships with supportive teachers are expected to enhance good interaction between the teacher and the students in the class which should result in less problematic behaviour and enhanced prosocial behaviour (Jennings and Greenberg, 2009).Student misbehavior is one of the most significant stressors and causes of burnout among teachers (Boyle,Borg, Falzon, and Baglioni, 1995; Byrne, 1995;Travers and Cooper, 1996; Evertson and Weinstein, 2000; Friedman, 2006;). Disturbance to the smooth flow of classroom interaction by the students, they become passive, and therefore achieve less.(Finn, Pannozzo, and Voelki, 1995; Freiberg, Huzinec and Templeton, 2009).

2.3.8 Student-teacher Interaction and Student Attitude to Chemistry

The kind of student-teacher relationship may engender either positive or negative attitude on the part of the students.Pianta (1999) described classroom interaction as the kind of classroom experience that contains some personal emotions which is a result of teacher –student continuous interaction. When students understand, cooperate, trust and have confidence in their teacher, students tend to build connection with their teacher, see their teacher as a guidance, protector, who will do everything to ensure that they are safe in the learning environment and teach them well to the point of satisfaction. This kind of classroom environment may promote student interest in the subject and be more willing to learn. This may bring about positive attitude on the part of the students. Student misbehavior is one of the most significant stressors and causes of burnout among teachers (Boyle,Borg, Falzon, and Baglioni, 1995; Byrne, 1995;Travers and Cooper, 1996; Evertson and Weinstein, 2000; Friedman, 2006;). Disturbance to the smooth flow of classroom interaction by the students, they become

passive, and therefore achieve less.(Finn, Pannozzo, and Voelki, 1995; Freiberg, Huzinec and Templeton, 2009).

2.3.9 Teacher Qualification and Student Achievement in Chemistry

The qualification of a teacher is likely to affect the way he teaches the learners. It has shown from relevant literature that students gain more from teachers with high academic skills than they do from teachers with low academic skills (Ballou, 1996; Ferguson and Ladd, 1996). In a different dimension, other researchers are of the view that teacher quality play less role in determining how well teachers perform on standardized tests than with how they perform in the classroom (Darling-Hammond, 1998). It is evident that some other traits in a teacher cannot be measured by giving them test. Such skills include communication and creative thinking, and for working with children. These attributes can be measured through formal classroom observation.

Brewer (1994) found an improvement over a period of two years in the performance of learners when taught by teachers who attended institutions of higher quality. He further went ahead to check the relationship between teachers kin of institution and academic skills. His findings reveal that teachers that attend good quality institution produce students who are sound academically. Clotfeltler, Ladd and Vigdor (2007) carried out a study titled "Teacher Credentials and Student Achievement." Their results showed that there is a positive relationship between teacher qualification and academic achievement. Also, Goldhaber and Brewer (2000) found that students' achievement in mathematics was higher when the students were taught by teachers who had standard certification in mathematics than when they were taught by teachers without standard certification in mathematics. This in support with finding of Darling-Hamond's (2006) whose study revealed that teachers with good certification produced high achieved student than teachers with lower qualification. Similarly, Wayne (2003) argue that there was a positive effect of teacher certification on students' achievement only when the teacher's area of specialization is on the teaching subject. Labo-Popoola in 2002 carried out a study on "Teacher and school variables as determinants of students' achievement in comprehension and summary writing aspects of English Language". The findings laid credence to previous studies which indicated that teacher qualification had a positive effect on students' achievement. Owolabi and

Adebayo (2012) studied the effect of teacher qualification on the performance in Senior secondary school Physics and found that students taught by teachers with higher qualification performed better than those taught by teachers with lower qualifications.

In another study carried out by Opara (2007) on the relationship between teacher qualification and students' performance in technical subjects in selected schools in the Northern part of Nigeria. The findings revealed that teacher qualification affected students' performance. Also, Akinsolu (2010) investigated Teachers and Students' Academic Performance in Nigerian Secondary schools: implications for Planning National institute for Educational Planning and Administration in Nigeria. The results showed that teacher qualification had a positive effect on the academic achievement of students.Several studies have shown positive correlation between teacher qualification and student achievement; however, a contrary result was obtained by Andrews (2004) who conducted a study on teacher certification. Teaching Style, and Student Achievement in Arizona and found no significant effect of teacher certification status on students' achievement. From the review of these studies and having known the strength and direction of their result, it appears not many studies have related teacher qualification with classroom interaction patterns of the teachers especially chemistry teachers.

2.3.10 Teacher Qualification and Student Attitude to Chemistry.

The qualification of a teacher is likely to affect the way he teaches the learners. For example if a teacher holds a degree in Education and exhibits the knowledge gained among the students by allowing every student to participate in class discourse, understand that there is individual differences among the students, take time to re teach the slow learners, praise students when they respond correctly in class, listen patiently to the ideas from the students, such students are likely to develop right attitude toward the subject and show interest in the teacher. Such students will always look forward for the next occasion to have the teacher's class or subject. This may promote positive attitude on the part of the students. On the other hand, if the teacher is such that he or she frowns face all the time during lesson, use abusive words on students, calla students different names when they make mistakes, it is very likely that students will gradually loose interest in the subject and the teacher and eventually

develop negative attitude towards the subject. It may also lead to poor performance of students in the subject. It has shown from relevant literature that students gain more from teachers with high academic skills than they do from teachers with low academic skills (Ballou, 1996; Ferguson and Ladd, 1996). In a different dimension, other researchers are of the view that teacher quality play less role in determining how well teachers perform on standardized tests than with how they perform in the classroom (Darling-Hammond, 1998). It is evident that some other traits in a teacher cannot be measured by giving them test. Such skills include communication and creative thinking, and for working with children. These attributes can be measured through formal classroom observation.

Brewer (1994) found an improvement and change of attitude over a period of two years in learners when taught by teachers who attended institutions of higher quality. He further went ahead to check the relationship between teachers kin of institution and academic skills. His findings reveal that teachers that attend good quality institution produce students who are sound academically and excellent in attitude. This in support with finding of Darling-Hamond's (2006) whose study revealed that teachers with good certification produced high achieved student and students with positive attitude to learn than teachers with lower qualification.

2.3.11 Teacher Gender and Achievement in Chemistry

In the school system, teachers are essential elements especially how their gender affects students learning outcomes. Some teachers have gender-stereotyped expectations of boys and girls (Legewie et al, 2012). There are contradictory results from studies about teacher gender and students performance. Thomas (2005) study confirmed that teacher gender do have large effect on students' performance, teachers' perception of students and student engagement with academic materials. This implies that girls have better educational outcomes when taught by a female teacher and boys are better off when taught by a male teacher. Kaplan (2010) and Mack (2010) assert in their studies that teacher gender shapes communication between teachers and students. On the contrary, the other school of thought says the teacher acts as a gender-specific role model, irrespective of what he or she says or does.Dee (2006) states that teacher gender does not have large effects on student test performance. Which means teachers do not treat and percieve boys and girls

differently. Olatoye and Ogunkola (2008) find no significant difference between male and female students' academic achievement in science.

However, the role of gender in education cannot be overstated. Research studies reveal that male teachers use more computers in their teaching and learning processes than their female counterparts (Kay, 2006; WozneyVenkatesh, &Abrami 2006). Adams (2002) asserts that female teachers applied Computer Studies facilities more than the male teachers. This study confirms report by Yukselturk and Bulut (2009) that gender difference and disparity has been minimized in Nigeria.

On teacher's gender and students achievement, Okoruwa (1999) discovered that a significant difference exist between teacher gender and pupils achievement in science. Male teachers were found to be more efficient than female folks. Also, his findings showed that when teachers of varying age bracket teach the pupil, there is no significant difference.

In a study by Abuseji (2007) titled Student and Teacher Related Variables as Determinants of Secondary School Students Academic Achievement in Chemistry, it was discovered that teacher gender was significant on students' achievement in chemistry. This is in line with research conducted by Okoruwa (1999), Orosan (1992), Reap (1992) and Smith (1992) who reported that teacher gender is a strong predictor of student achievement.

2.3.12 Teacher Gender and Student Attitude to Chemistry

In the school system, teachers are essential elements especially how their gender affects students' attitude to learning. Some teachers have gender-stereotyped expectations of boys and girls (Legewie et al, 2012). It has been observed that student attitude to science and mathematics improves when being taught by female teachers. Female teachers tend to be more accommodative, patient and less aggressive. On the hand, another school of taught maintain that students attitude is better when being taught by male teachers. There are contradictory results from studies about teacher gender and students attitude to learning.

On teacher's gender and students achievement, Okoruwa (1999) discovered that a significant difference exist between teacher gender and pupils achievement in science. Male teachers were found to be more efficient than female folks. Also, his findings

showed that when teachers of varying age bracket teach the pupil, there is no significant difference.

2.3.13 Threshold Time and Achievement in Chemistry

Another issue that concerns the teacher-student interaction in the chemistry classroom climate is the threshold time of each of the chemistry teachers. Threshold time has been found to be significant during teacher-student classroom interaction. In a study by Akinsola and Okpala (2001), it was discovered that the threshold time value of 12 minutes was most frequently used by the mathematics teacher trainees in exposing their classroom interaction patterns. The researchers further assert that the first five frequently used threshold time value by the mathematics teacher trainees in displaying their classroom interaction patterns are 12 minutes, 7 minutes, 17 minutes, 9 minutes and 14 minutes as these values are associated with 29.9%, 18.5%, 11.4%, 10.9% and 10.3% of the trainees respectively. In addition, Akinsola and Okpala found that the threshold time was also found to be sensitive to the trainees' gender and years of teaching experience. Thus, it can be inferred from these findings that the threshold time for a teacher to have meaningful student-interaction in a chemistry lesson is important.

Siedentop, Birdwell and Metzler (1979) have proposed the academic learning time model which focuses on student engagement in relevant subject matter. To solve the problem of threshold time for classroom interaction (Grahain and Siedontop 1978; Pieron and Haan, 1980) advanced that, in physical education, academic learning time (ALT-PE) can be used as a process measure of effective teaching. Onocha and Okpala (1988) went a step further by examining "Time on Teaching Tasks" as discriminant of perceived instrumental needs of integrated science teachers. The study revealed that Time on Teaching Task" is a good discriminant of perceived instrumental needs of teachers. In particular, the amount of time spent 'making students' integrated science assignments tends to be more powerful discriminant of the teachers' needs than the amount of time spent teaching and 'planning instruments' respectively. Thus the findings seem to suggest that teachers who spend more time to regularly mark students assignments perceive less needs for improved instruction.

2.3.13.1 The Concept of Threshold

Meyer and Land came up with “threshold concepts” framework to help faculty focus theirteaching on essential aspects of disciplinary knowledge (Meyer and Land, 2005). It can simply be explained as crossing a boundary of a particular threshold enables significant new disciplinary learning, often learning that was impossible before.Minimum or maximum time value (established for an attribute, characteristics or parameter) which serves as a benchmark for comparison or guidance and any breach of which may call for a complete review of the situation. Threshold is the level or point at which one start to experience something or at which something starts to happen or change. In this study, ten minutes was established to serve as a benchmark for assessing patterns of teacher-student interaction in chemistry lesson. it is just like the concept of opportunitycost in economics, once a student’s grasp the principle underlying the concept, she can now apply same in advance economics concepts

2.3.13.2 Engaged time and allocated time

Furthermore, it is important to understand components of instructional time. The instructional time could be likened to homeostasis in biology, reinforcement in psychology, or gravity in physics. Aspects of instructional time include allocated time, engaged time and academic learning time.Allocated time is the time the teacher provides the student for instruction. It is the whole lesson period assigned to the teachers. It is the total amount of time available for learning; e.g. the length of the school day or a class period. ”. According to the California Beginning Teacher Evaluation Study (BTES), it is good to allocate specific time or apportion time to specific part of the lesson content, it was observed that students taught with class that has specific content time allocation perform better than class where teacher just teacher without any specification of time being allocated to a specific content.

Engaged time **(**time on task**)** is defined as the time that students appear to be paying attention to materials or presentations that have instructional goals.Academic learning time (ALT**),**is defined by Berliner (1990) is a proportion of allocated time in a subject-matter area in which a student is engaged successfully with the materials to which he or she is exposed (Berliner, 1987; Fisher et al., 1980).

2.4 Conceptual framework

Teaching students to understand and apply scientific knowledge in science education is a basic activity in science education. Nevertheless, students' understanding of science concepts is still a far cry from what it should be as evidenced from literature (Demerouti, Kousathana and Tsarpalis, 2004; Demircioglu, 2005: Yilmaz and Alp, 2006). Conceptual understanding, a term more synonymous with constructivist studies of the epistemological inclination must be well conceived and appropriately operationalised for it to effectively function as measure of students' academic performance usually for diagnostic purposes.

Operationalising conceptual understanding may vary from one context to another such as how problems are characterised (Bodner and Herron, 2003; Tsarpalis.2005). A method of characterising chemistry problems according to Taasobishirazi and Glynn (2009) is quantitative or qualitative. Quantitative problems are tasks or activities requiring numerical manipulation usually involving consideration for equations in chemistry. Qualitative problems probe for explanations from students' cognitive schema which may also involve situating links or connections among sub-concepts thereby constructing meaning from it. Other forms of characterisation of problems have been documented in literature (Bodner, 2003; Lynn and Robinson, 2001).

Conceptual Understanding is a function of the internal knowledge structures of an individual in which knowledge structures can be conceptualized as organized networks of concepts with their interrelations (Bunde, 2007). Rich, interrelated and integrated knowledge are characteristic features of conceptual understanding. Measuring conceptual understanding can also be achieved by assessing the features of the knowledge structure of the individual. This requires assessment strategies that would capture rich, dynamic, interrelated and integrated domain of concepts (Anderson and Schunn, 2000).

Conceptual framework is applied in researches to give likely courses of action or to give a preferred method to an idea. Due to the fact that there are some similarities between conceptual frameworks and empirical inquiry, they assume different forms depending upon the research questions or problem (Odinko,2014). Here, the conceptual framework for this study takes the form of models of operations research. In this conceptual perspective, the concepts and variable in the study are identified

and how these concepts are connected is shown in form of a diagram. Therefore, a framework which guided this study is shown in Fig. 2.1. It showsa conceptual diagram which links what was happening before i.e. mode of delivery of chemistry instructional content and teacher characteristics, how they can predict student achievement in chemistry. Thisis diagrammatic mechanism of how the variables of the study are interconnected. It explains how instruction delivery mode and teacher characteristics can predict student achievement in and attitude to chemistry.

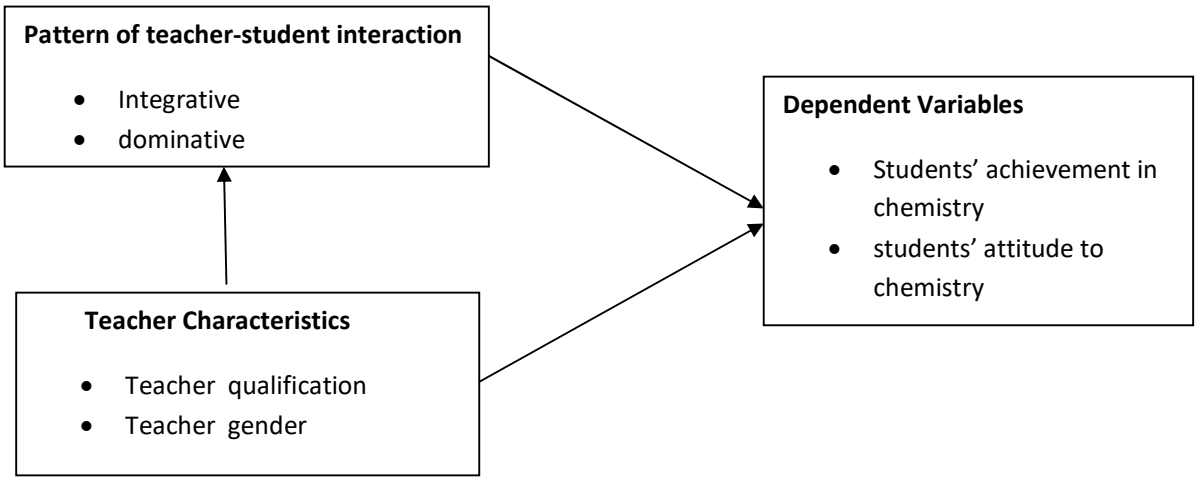

Figure 2.1: Conceptual Framework of Teacher-Student Interaction and Learning Outcomes

2.5 Appraisal of Literature and Gaps Filled

Literaturerevealed that students' achievement in chemistry has been poor over the years. Factors identified as responsible for this include: inadequate chemistry laboratories and insufficient chemistry practical.Literature also revealed that Classroom Interaction Patterns (CIP) exhibited by the teachers have influence on the student achievement.These studies found the relationship between classroom interaction patterns and achievement. It appears attention has not been given to assessing combined effect of classroom interaction patterns and teachers demographics on students' achievement and students' attitude to learning. The studies focused on influence of classroom interaction patterns on Biology, Primary science, Basic electricity, Physics. Only few studies have been done in the subject area of chemistry.

Several studies have established that inexperienced teachers (those with less than five years of experience) are typically less effective than senior teachers, those with higher years of experience. Contrarily, some authors argue that very well prepared or certified beginning teachers are highly as effective in teaching as senior teachers.It appears most of the studies did not combine attitude as dependent variable but only looked at how it affects students' achievement. It seems the studies did not look at how patterns of classroom interaction and years of teaching experience jointly affect achievement and student attitude. Several studies also revealed that teacher qualification had impact on students' academic achievement. On the contrary, other study revealed inverse relationship between teacher qualification and gain in students' attitude and achievement. Other studies showed no significant difference in student achievement based on teacher qualification. It seems the studies were limited to relationship between teacher qualification and students' achievement but none focus specifically on combine effects of pattern of teacher-student interaction and teacher qualification on both the student achievement and attitude.

Literature revealed that teacher gender had influence on classroom interaction and significantly affects student achievement and attitude. Male teachers are more effective in classroom interaction than the female teachers. On the contrary, some studies claim that female teachers tend to be more productive in teaching profession than their male counterparts. However, other studies find no significant effects of teacher gender on effective classroom interaction. None of the studies related pattern of teacher-students interaction(integrative or dominative) and teacher gender with student achievement and attitude.

Summarily, literature reviewed identified pattern of teacher-students interaction as a factor that may influence student achievement. It has also been documented the direction of effects of selected teacher demographics on students' achievement. This study, therefore, assessed the contributions (composite and combined) of the independent variables: pattern of teacher-student interactions (integrative or dominative), teacher qualification and teacher gender to dependent variables (students' achievement in chemistry and students' attitude to chemistry). Furthermore, the study assessed the mediating effect of teacher qualification and

teacher gender on the kind of teacher-student interaction pattern exhibited by the teachers. If a teacher is integrative or dominative, does it have anything to do with his/her qualification and gender?

In addition, the study found average threshold time (minimum time required by a teacher to show his/her typical classroom interaction pattern to the observer).Only few studies reported on time analysis of classroom dynamics, reviewed studies had shown that greater percentage of instructional time was being used for teacher talk (teacher domination), but did not went further to report/explain on time spent on use of instructional materials by the teacher and students, time given to students to interact among themselves, time allowed for teachers to interact with students. Only few studies broke lesson into four segments of 10, 20, 30, 40 minutes and analyze what happens during chemistry lesson along these divisional segments which provided information not just on time spent on each of instructional components during chemistry lesson but further provided information on sequence of classroom activities as time progresses from first ten minutes, twenty minutes till last ten minutes of the lesson.

CHAPTER THREE
METHODOLOGY

This chapter contains research design, target population, sampling technique and sample, instrument and instrumentation and procedure that were used for data collection and analysis.

3.1 Research Design

Descriptive survey design was used for this study. The choice of this design was due to the fact that this kind of study requires comprehensive and detailed field information about what actually transpires between the teacher and the students. This kind of design served as a guide or workplan which helped to get full classroom dynamics of what happened, how it happened and frequency with which it happened during teaching and learning process. Survey design was appropriate because the study did not involve manipulation of variables but only depended on existing information obtained from students and their respective teachers.

3.2 Variables of the Study

Independent Variables

The Independent variables are:

i. Pattern of teacher-student classroom interactions – integrative or dominative.
ii. Teacher qualification
iii. Teacher gender

Dependent variable

The dependent variables are:

(i) Students' achievement in chemistry (ii) students' attitude to chemistry

3.3 Population

The target population consists of all chemistry teachers and students in Senior Secondary School Two (2) in all public secondary schools in Oyo state.

3.4 Sampling Technique and Sample

Multi-stage sampling technique was used to select participants for this study. In Oyo state, as table 3.1 shows, there are thirty-three (33) Local Government Areas (LGAs) which are divided into eight educational zones. First, Two educational zones were

randomly selected from the eight educational zones in Oyo –state. Secondly, simple random sampling technique was used to select three local Governments from each selected educational zones making a total of six Local Governments used for the study. Thirdly, three schools were randomly selected from each of the six selected Local Governments to make a total of eighteen schools used for the study. However, efforts were made to select schools in such a way that there was nearly equal number of male and female chemistry teachers. This was to ensure fairness and avoid being gender biased.

Table 3.1: Distribution of Public Senior Secondary Schools across the Eight (8) Educational Zones in Oyo State.

S/N	Educational Zones	No of local Govts	No of Public School
1	Ibadan City	5	96
2	Ibadan less City	6	100
3	Oyo	4	36
4	Ogbomosho	5	74
5	Irepo	3	13
6	Ibarapa	3	25
7	Kajola	4	42
8	Saki	3	31
Total	**8**	**33**	**417**

Source: Oyo State Ministry of Education, 2018

Finally, from each selected school, an arm of only senior secondary school two chemistry classes was selected making a total of 18 classes and the study made use of a chemistry teacher teaching in each class making a total of 18 SS2 chemistry teachers. In a school where there was more than one arm of SS2, only one arm was selected for the study. An intact class was used for the study. The choice of SS2 was because they must have been exposed to some reasonable chemistry contents.

In all 18 chemistry teachers and 1004 students participated in the study. There were 449 male and 555 female students. Their age ranged from 14 years to 17 years. (The mean age 15 years (SD = 1.3 years). There were eight male and 10 female chemistry teachers. Their age range was between 40 years to 55 years. Table 3.2 shows the

sampling frame for selection of schools, teacher and students that participated in the study

Table 3.2: Sampling frame for the selected local governments areas and public schools

Education zones	Local government area	No of schools selected	No of classes selected from each school(SS2)	No of teachers	No of student
A	1	3	3	3	136
	1	3	3	3	269
	1	3	3	3	115
B	1	3	3	3	118
	1	3	3	3	225
	1	3	3	3	141
Total = 2	6	18	18	18	1004

3.5 Research Instruments

The following instruments were used.

1. Modified Flanders 16 Category Interaction System (MFCIS)
2. Classroom Interaction Sheet (CIS)
3. Chemistry Achievement Test (CAT)
4. Students' Attitude to the learning of chemistry Questionnaire (SALOCQ)

3.5.1 ModifiedFlanders 16 - Category interaction system (MFCIS)

The research instrument wasthe modified 16-category Flanders Interaction Analysis for observing and determining classroom interaction patterns. This instrument was developed by Hough in 1966 and has been used widely in many studies regarding classroom interaction (Amidon and Flanders, 1970; Adegoke, 2013). It consists of two sections; section A gives demographic information of teacher's age, year of teaching experience, qualification and gender as well as number of students in the class, name of school, topic taught, duration, time lesson starts and time lesson ends. Section B consists of 16 items measuring teacher talk (8 items), students talk (3

items), silence (4 items) and Non-functional (1 items). The clerking was done at intervals of sixty (60) seconds.

3.5.2 Classroom interaction sheet (CIS)

This was adapted from classroom observation instrument developed by the Institute of Education, University of Ibadan. It is one of the instruments being used for the training of Graduate students in Observational Techniques in the Institute of Education, University of Ibadan Section A contains date, subject taught, class, time lesson start and time lesson end, Teacher qualification, teacher gender, teacher's year of teaching experience. Section B contains nine main headings and 65 categories: teacher centred activity (10 categories), individual student activity (9 categories), teacher–student activity (11 categories), teacher material activity (8 categories), student-material activity (7 categories), student-student activity (3 categories), Non – facilitating learning (8 categories), confusion (6 categories), and others.

Teacher-centred activity contains items which describe what the teacher does to prompt learning. Individual student activity contains items which describe what the students do as the teacher directs. Teacher-student activity contains items which describes activities the teacher engages with the students. Teacher-material activity contains items which explain how the teacher uses instructional materials to aid learning. Student- material activity contains items which describes when students make use of learning materials as the teacher directs. Student-student activity contains items which describe activities students do with one another. Non-facilitating learning behaviour contains items which describe activities in classroom which do not support learning. Confusion contains disorganize student activities. Others contain items which do not fall into any of the categories above.

3.5.3 Chemistry Achievement Test (CAT)

The Chemistry Achievement Test (CAT) was developed by the researcher. The CAT contained 50 multiple choice items for SS 2 class. Each of the items consists of a stem and four options of which only one was correct answer. The options are labeled A, B, C and D. This appendix was used to determine the students' attainment of achievement in Chemistry in all the schools sampled. The items were in line with the topics in the chemistry curriculum prepared by the NERDC. The achievement test

contained topics taught in 1st term of 2018/2019 academic session of Oyo state school calendar. The table of specification is as shown in Table 3.3. The face and content validity were determined. The instrument was given to experts in chemistry education for their comments after which it was trial tested and validated using a sample of 100 SS 2 chemistry students from co-educational public schools that were not part of the sample that participated in the study. Fifty (50) questions were selected from the 100 questions after validation. Kuder-Richardson (KR-20) was used to calculate the reliability.The reliability index of the CAT was 0.86 (KR-20). The difficulty indices of the items ranged from 0.51 to 0.78. The discriminating indices ranged from 0.18 to 0.21. The table of specification was used to establish the content validity of CAT. The behavioural objectives considered were knowledge, comprehension and application.

Table 3.3: Table of Specification for Chemistry Achievement Test

Content	**Knowledge 18%**	**Comprehension 26%**	**Application 28%**	**Analysis 28%**	**Total**
Chemical reaction **24%**	**2**(4,15)	**3**(29,32,36)	**4**(25,43,45,33)	**3**(22,39,46)	**12**
Chemical Equilibrium **18%**	**2**(7,48)	**2**(20,41)	**3**(5,26,34)	**2**(18,42)	**9**
Periodic Table **42%**	**3** (1,3,37)	**6** (2,6,12,13,24, 50	**5** (21,23,28,47, 49)	**7** (8,9,11,17,19,31, 38)	**21**
Water **16%**	**2**(27,35,)	**2**(10,30)	**2**(16,44)	**2**(14,40)	**8**
Total	**9**	**13**	**14**	**14**	**50**

After scoring, the students' scores' were categorized into "high" versus "low"; where those whose scores were at or above the 50th percentile were denoted as high achievers and those below the 50th percentile were denoted as low achievers.

3.5.4 Students' Attitude to the Learning of Chemistry Questionnaire (SALOCQ)

The Students' Attitude to the Learning of Chemistry Questionnaire (SALOCQ) was developed by the researcher. This questionnaire consists of two parts. Part A consists of the bio-data of the respondents, such as name of school, sex, class and age. Part B has items measuring attitude of students to the learning of chemistry. This comprised 30 items using scale of Very true of me (VTM) = 1, Much true of me (MTM) = 2, Fairly true of me (FTM) = 3 and Not true of me (NTM) = 4. Construct and face validity were determined by the researcher's supervisor and other experts in questionnaire development. Cronbach Alpha was used to determine the reliability of the instrument and the reliability index was 0.89.

After scoring, the students' scores' were categorized into "positive attitude" versus "negative attitude"; where those whose scores were at or above the 50th percentile were denoted as having positive attitude and those below the 50th percentile were denoted as having negative attitude.

3.6 Data Collection Procedure

Firstly, a letter of introduction was obtained from the Institute of Education, University of Ibadan, to the Ministry of Education, Oyo state to obtain permission for the use of their schools. The schools were visited prior to the exercise to acquaint the school authority of the reason for the exercise. By this the researcher familiarized himself with the school authority, teachers and students. The researcher employed the services of eight research assistants to observe some of the schools the researcher could not cover. The administration of all the instruments lasted for 5 weeks. Eighteen schools were observed using modified 16-category Flanders interaction system and the classroom interaction sheet (CIS).

Eight research assistants who were graduate students of the Institute of Education were employed. They were trained in the act of coding and clerking. Every activity that occurs during classroom interaction was captured using both audio recording and

normal clerking. Each observation lasted for. There were two observation instruments for this study; the researcher used the modified 16-category Flanders interaction system and classroom interaction sheet (CIS) simultaneously to observe chemistry lessons.

The reason being that some classroom activities (teacher-material activities, student-student activities, student-material activities) which could not be captured by the content of first observation instrument were captured by second observation instrument. During the teaching sessions, whenever the teacher or student talks, each statement was classified every 60 seconds. The sessions in each class was videotaped and verbatim transcripts were later analyzed to check if observations clerked were in conformity with what really happen in the classroom. The validity and reliability of the observations were done by studying the video recordings that was carried out. The reliability indices of the observations were determined using Scott's coefficient "pi" method which gave the value of 0.96. Frequency of activities as contained in the observation sheet was analyzed using percentages, frequency count and mean. In each of the 18 schools, 10 teaching sessions were observed. This means that each of the teachers was observed twice a week. Five weeks were used for observations. The achievement test and attitude scale were administered to students at the end of fifth week. The researcher ensured that the topics set for achievement test were topics which the teacher had been teaching the students within first five weeks. Out of one thousand hundred (1100) questionnaires given to students, one thousand and four (1004) copies (91.3%) were retrieved and used for the analysis.

Table 3.4: Breakdown of the Field work Activities

s/n	Week	Activities
1	1st	Training of Research assistants especially how to use observation schedule instrument
2	2nd, 3rd, 4th,5th, 6th,	Administration of observation schedule instruments.
3	7th	Administration of other instruments.
4	8th and 9th	Collating, analyzing the data

3.7 Data Analysis Procedure

Data was analyzed using frequency, percentages, percentiles, mean and standard deviation, Logistic Regression was used to analyse the influence of the independent variables on the dependent variable of the studyat 0.05 level of significance.

Table 3.5: Research Questions and Method of Analysis

Questions	Relevant statistical tools
1a. Using modified Flanders 16-category interaction System,what is the pattern of teacher-student verbal interactions in terms of: i. Teacher talk? ii. Student talk? iii. Silence? iv. Non functional Behaviour?	Frequency and Percentage, bar chart
b. Using Modified Flanders 16-category interaction system, is there any significant difference in the pattern of teacher-student verbal interaction between male and female chemistry teachers, as well as in terms of teacher qualification	
c. If the interaction patterns of the teacher-student interactions are dichotomized into dominative and integrative, is there any group differences along: i. Teacher gender? ii. Teacher qualification?	t-test, One way ANOVA
2. What is the pattern of verbal and non verbal teacher-student interactions using classroom interaction sheet in terms of: i. Teacher centred activity? ii. Individual student activity? iii. Teacher-student activity? iv. Teacher-material activity? v. Student-material activity? vi. Student-student activity? vii. Non facilitating learning behaviour?	Frequency and Percentage, bar chart
3a. What is the average threshold time required by a chemistry teacher to show his typical classroom interaction pattern using: i. Modified Flanders interaction 16 Category system? ii. Classroominteraction sheet?	Frequency counts Cross tabulation

Table 3.6: Hypotheses and Method of Analysis

Hypothesis	Statistical tool
1. Students' highachievement in chemistry can be reliably predicted from measures of pattern of classroom interaction, teacher gender, teacher qualification and teacher experience	Logistic regression
2. Students' positive attitude to chemistry can be reliably predicted from measures of pattern of classroom interaction, teacher gender, teacher qualification and teacher experience	Logistic regression

3.7 Methodological Challenges

The researcher intended to use twenty four schools for the study but as a result of reluctance of some chemistry teachers, the researcher used eighteen schools. Furthermore, the researcher intended to video-taped all sessions but due to financial constraints, the researcher only video taped about 50 % of the lessons. The researcher intended to usea more sophisticated software such as STATA but it was not available and where available there was no good analyst, therefore the researcher used the most common such as SPSS.

This study faced some methodological challenges when statistical data were collected. Anxiety posed a problem to the researcher, research assistants, and the students. This problem was overcome because the researcher had visited the schools before the actual observation took place. Another challenge was the likelihood of reluctance on the part of the school administration in allowing access to the use of the school claiming that the exercise will disrupt the teaching and learning programme of the students. This problem wasovercome by formally seeking permission from the Ministry of Education and the State Teaching Service Commission.

Finally, the selected schools felt that the research study would expose the inadequacies of their schools and also the class teachers whose class lessons were observed taught that the observations would lead to passing summative judgments on the teaching and learning activities in their classes. To overcome this problem, research ethics with respect to confidentiality was ensured. Intra – rater error occurred

as different observer (research assistant) carried out the exercise. This was dealt with by providing training and retraining and several rehearsals for the assistants to ensure uniformity and consistency before the exercise commenced. Another challenge was that the teacher to be observed decided not to appear in their natural self, broughtin element of pretense or presented the best of them, altered natural classroom setting to suit the observer expectation. This was overcome by not giving prior notice on when the observer visited the school.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

This chapter presents the results and discussion of the results. The research questions are answered in the sequence in which the research questions were stated. For the inferential statistics, interpretations are made at $p < 0.05$.

Research question 1a: Using Modified Flanders 16-Category Interaction System (MFCIS), what is the pattern of teacher-student verbal interactions in terms of:

i. Teacher talk?
ii. Student talk?
iii. Silence?
iv. Non-functional behaviour?

To answer this research question, descriptive statistics (percentage, frequency and bar chart) were used.

Table 4.1: **Pattern of teacher-student verbal interaction analysis**

S/N	Category	Frequency	Percentage (%)
A.	**TEACHER-TALK**		
1.	Praise and Encouragement	206	2.86
2.	Clarification and development of ideas suggested by student	394	5.46
3.	Ask Question	454	6.30
4.	Answers student's question	211	2.93
5.	Lectures	3318	46.02
6.	Gives feedback	272	3.77
7.	Gives direction	278	3.86
8.	Justifies authority	189	2.62
B.	**STUDENT-TALK**		
9.	Response	435	6.03
10.	Emitted	58	0.80
11.	Asks question	183	2.54
C.	**SILENCE**		
12.	Directed activity	257	3.56
13.	Contemplation	169	2.34
14.	Demonstration	44	0.61
15.	Grading student work	225	3.12
D.	**NON FUNCTIONAL**		
16.	Irrelevant behavioure.g making noise	517	7.17
	Grand total	7210	

Table 4.1 presents the summary of frequencies and percentages of teacher-student talk during all chemistry classes observed using modified Flanders 16 category interaction

system. During teaching-learning activities, on the average, teacher talk which comprises categories 1-8, constitutes 73.82 % of all the verbal interactions in the classroom. The table shows that student talk constitutes 9.37 % of the verbal interactions in the classroom while silence which comprises of categories 12 – 15, constitutes 9.63 % of the verbal interactions in the classroom. Non- functional behavior aspect of teacher-student verbal interaction in the classroom constitutes 7.17 %. Figure 4.1 shows the pictorial representation of teacher-students verbal interaction in terms of teacher- talk, student-talk, silence and non functional activities.

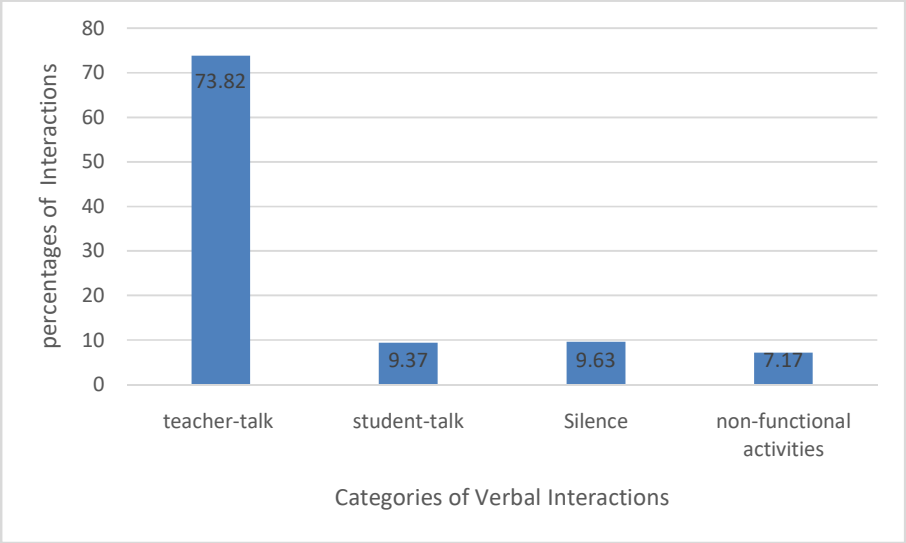

Figure 4.1: Pattern of Teacher-student Verbal Interaction

In more explicit terms, out of the teacher talk, Table 4.1 shows that lectures constitute 46.02 %. This implies that, generally, chemistry teachers dominated teaching-learning activities in the classroom. This is even reflected in the percentage of student talk, which is just 9.37 %. Irrelevant behaviours such as making noise, teacher answering phone calls and teacher attending to visitors and colleagues constitute 7.17 % of the allocated time. From the analysis of the results as shown in table 4.1, talking either by the teacher or the students constituted 83.19 % of the allocated time.

In the categorization of teacher talk, by means of climate index, as shown in table 4.1, of the 7210 frequency counts of interactions, 73.82 % were teacher-centred (Dominative) while 9.37 % were student-centred (Integrative). An Integrative – Dominative ratio of approximately 0.13 (1: 13). This implies that for every 13

statements uttered by the chemistry teachers there was only one statement from the students.

Discussion of Findings

The results of the study indicate that the frequency of category 5 (teacher lectures) is 3318 (46.02%) of the entire learning time. This implies that teachers talked continuously during chemistry lessons and used greater part of learning time to explain the topic to the students and give examples thereby allowed less participation of the student. It then means that students listened patiently to teacher while explaining and asked few questions about the topic being discussed.

The result shows that majority of the teachers observed adopted dominative method of teaching which is characterized by teacher giving lectures, giving directions and justifying authority. However, the results reveal that, the most pronounced and glaring sub category of teacher talk is category 5 (teacher lectures) using the modified Flanders 16 Category interaction system. The result of the study is in line with findings of Adegoke (2007) and lsiugo-Abanihe and Longjohn (2005). For example Isiugo-Abanihe and LongJohn (2005) found that teacher-student talk constituted about 83.5% of the instructional time in a typical science lesson in junior secondary schools in Port Harcourt, Nigeria. The finding also corroborated Adams and Biddle (1970) who found from their study of first, sixth and eleventh grade teachers that teachers were the most popular actors in 84 per cent of classroom communication episodes and that less than one half per cent of classroom verbal behaviour was spent in discussion of feelings and interpersonal relations. This seems to reinforce Flanders' (1963) "law of the two-thirds which operates in almost every classroom". According to Flanders, teachers spent two-thirds of their teaching-learning time either disciplining or organizing classroom activities, hence leaving students little opportunity to participate actively in their own learning process. But studies by Jackson and Wolfson (1968) and Burkhart (1969) showed that teachers were generally not aware of this pattern, nor did they want to monopolise classroom learning. They believed that teachers perhaps behaved in this way because they simply did not know how to involve students in discussion. Brophy and Good (1970, 1972) said that in most cases, teachers grossly underestimated the amount of time they talked in the classroom. They also showed that teachers were unaware of certain

aspects of classroom behaviour. This is contrary to the findings of Liu and Elicker (2005) who found that when teachers asked specific questions or asked for students' help, student felt more confident and secure.

Research question 1b. Using Modified Flanders 16-Category interaction system MFCIS, is there any difference in the pattern of teacher- student verbal interaction between male and female chemistry teachers as well as in terms of teacher qualification?

A. Differences in the Pattern of Interaction between Male and Female Teachers

To answer this research question,frequency, percentages,mean of frequency counts of tallies in each of the categories (standard deviation) and t-test were used. Table 4.2 presents pattern of teacher-student verbal interaction analysis along gender.

Table 4.2: **Pattern of teacher-student verbal interaction analysis along gender**

S/N	Category	Frequency, Percentage and Mean of Frequency						T
		Male (N= 8)			Female (N=10)			
A.	**TEACHER-TALK**	F	%	$\bar{x}$	F	%	$\bar{x}$	
1.	Praise and Encouragement	90	2.81	11.25 (7.51)	116	2.90	11.60 (10.15)	-0.081^{ns}
2.	Clarification and development of ideas suggested by student	125	3.90	15.62 (12.83)	269	6.72	26.90 (20.20)	-1.369^{ns}
3.	Ask Question	215	6.70	26.88 (14.37)	239	5.97	23.90 (11.73)	0.484^{ns}
4.	Answers student's question	87	2.71	10.88 (8.11)	124	3.10	12.40 (8.30)	-0.391^{ns}
5.	Lectures	1494	46.57	186.75 (31.79)	1824	45.58	182.40 (39.91)	0.251^{ns}
6.	Gives feedback	118	3.68	14.75 (13.39)	154	3.85	15.40 (10.02)	-0.118^{ns}
7.	Gives direction	90	2.81	11.25 (9.88)	188	4.70	18.80 (21.87)	-0.901^{ns}
8.	Justifies authority	106	3.30	13.25 (14.65)	83	2.07	8.30 (9.78)	0.859^{ns}
B.	**STUDENT-TALK**							
9.	Response	171	5.33	21.38 (11.31)	264	6.60	26.40 (14.03)	-0.820^{ns}
10.	Emitted	15	0.47	1.88 (4.22)	43	1.07	4.30 (10.54)	-0.610^{ns}
11.	Asks question	62	1.93	7.75 (6.43)	121	3.02	12.10 (8.23)	-1.224^{ns}
C.	**SILENCE**							
12.	Directed activity	168	5.24	21.00 (14.18)	89	2.22	8.90 (7.01)	2.372*
13.	Contemplation	92	2.87	11.50 (10.50)	77	1.92	7.70 (5.69)	0.982^{ns}
14.	Demonstration	16	0.50	2.00 (3.89)	28	0.70	2.80 (3.26)	0.000^{ns}
15.	Grading student work	100	3.12	12.50 (7.09)	125	3.12	12.50 (9.72)	0.921^{ns}
D.	**NON FUNCTIONAL**							
16.	Irrelevant behaviour e.g. making noise	259	8.07	32.37 (17.34)	258	6.45	25.80 (12.98)	0.887ns
	Grand total of Tallies	3208	100%	----	4002	100%	----	

Note: Number in parenthesis represents percentages.

For male chemistry teachers, during teaching-learning activities, on the average, teacher talk which comprises categories 1-8, constitute 72.48 % of all the verbal

interactions in the classroom. The table shows that student talk constitutes 7.73 % of the verbal interactions in the classroom while silence which comprises of categories 12 – 15, constitute of 11.73 % of the verbal interactions in the classroom. A look at table 4.2 shows that non functional aspect of teacher-student verbal interaction in the classroom constitutes 8.07 %. In the categorization of male chemistry teacher talk, by means of climate index, as shown in table 4.2, of the 3208 frequency counts of interactions, 72.48 % were teacher-centred (Dominative) while 7.73 % were student-centred (Integrative). An Integrative – Dominative ratio of approximately 0.10 (1: 10). This implies that for every 10 statements uttered by the male chemistry teachers there was only one statement from the students.

For female chemistry teachers, during teaching-learning activities, on the average, teacher talk which comprises of categories 1-8, constitute 74.89 % of all the verbal interactions in the classroom. The table shows that student talk constitutes 10.69 % of the verbal interactions in the classroom while silence which comprises of categories 12 – 15, constitute of 7.96 % of the verbal interactions in the classroom. A look at table 4.2 shows that non functional aspect of teacher-student verbal interaction in the classroom constitutes 6.45 %.In the categorization of female chemistry teacher talk, by means of climate index, as shown in table 4.2, of the 4002 frequency counts of interactions, 74.89 % were teacher-centred (Dominative) while 10.69 % were student-centred (Integrative). An Integrative – Dominative ratio of approximately 0.14 (1: 14). This implies that for every 14 statements uttered by the chemistry teachers there was only one statement from the students.

Figure 4.2 shows the pictorial representation of teacher-student verbal interaction along gender. The figure shows that female chemistry teachers dominated teaching-learning activities (74.89 %) more male chemistry teachers (72.48 %). A look at the figure shows that on the average, percentage of student talk in female chemistry teachers lessons, is higher (10.69) than in male chemistry teachers lessons (7.73 %).

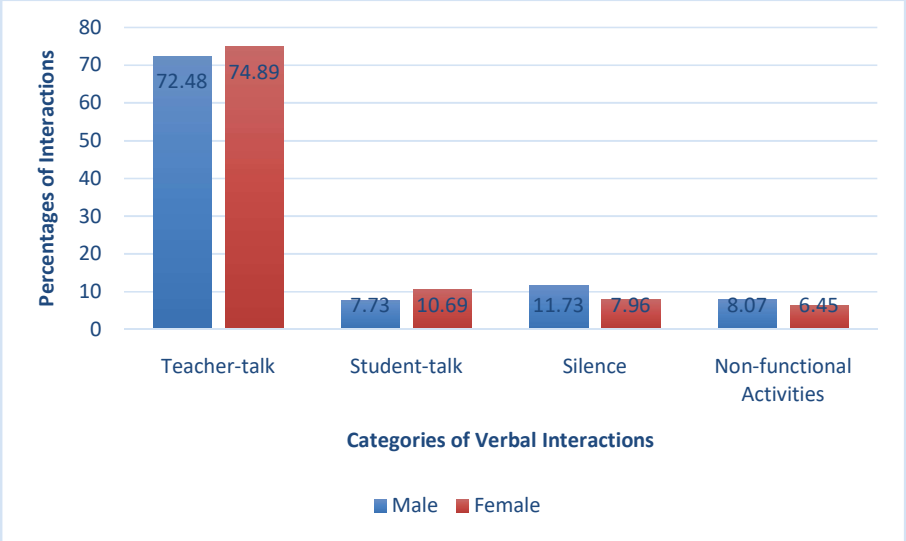

Figure 4.2: Pattern of teacher-student verbal interaction along gender

1c. Differences

The average value of frequency counts in each categories of the four main domains (that is teacher talk, student talk, silence and non-functional behavior) were obtained. The mean difference for each of the four categories were then subjected to t-test. This was to determine if significant differences existed in the pattern of teacher-students interactions between male and female teachers. From Table 4.2, under Teacher talk, it is clear that, on the average, there was no statistically significant difference between male and female chemistry teachers. For example, looking at category 5 (lectures) the mean value for male teachers was 186.75 (SD = 31.79) while the mean value for female teachers was 182.40 (SD = 39.95), $t(16) = 0.0251$, $p > 0.05$. This implies both male and female chemistry teachers were dominative in their approach to teaching chemistry. Under student talk, although female chemistry teachers on the average gave more opportunities for students to participate in the lesson, the mean difference is not statistically significant.Under silence, on the average, male chemistry teachers used more time for silent activities than female chemistry teachers, especially for directed activities such asnonverbal behaviour requested by the teacher. $t(16) = 2.372$, $p < 0.05$. Under non-functional behavior, male teachers used more time for non-functional activities than female chemistry teachers, however the difference is not statistically significant $(16) = 0.921$, $p > 0.05$.

Discussion of Findings

It was observed from the field work that both male and female teachers were dominative in their method of instruction delivery. It means there is no statistically significant difference in teacher gender in terms of their classroom interaction patterns. This may be due to the fact that both gender no longer give their best to their profession or no longer give passion to their job. In the recent past, teaching profession is seen as female profession. It was assumed females were better teachers. Experience has shown that female teachers tend to teach disciplines like arts, nursing, catering, languages and literature more effectively in terms of instructional delivery while male teachers are proficient in sciences, engineering and mathematics. The results of this study corroborate the findings of Joshua et *al*. (2005) who found no significant effects of teacher gender on effective classroom interaction. Similarly, Olatoye (2006), Adegbile and Adeyemi (2008) and Adeola (2011) reveal that female and male teachers are not different in their teaching effectiveness.

The behaviour of explaining the topic from the beginning of the class and writing note for students towards the tail end of the lesson spread across both male and female chemistry teachers. This attitude applied to both male and female chemistry teachers. This is not in line with the findings of Rashidi and Naderi (2012) which showed that although male and female teachers have some characteristics in common, the style of their classroom interaction with the students differs significantly. Female teachers were more patient with students during lessons, gave opportunity to students to talk and were more supportive than their male counterparts. They asked more referential questions, gave more compliments and used less authoritative words during lessons.

Also the results of this study negate the findings of Osafehinti (1995); Ifamuyiwa and Lawani (2008); Ajayi, 1987; Smith, 1992; Adetayo, 2008; which reveal that male teachers are more effective in classroom interaction than the female teachers.

B. Differences in the Pattern of Teacher-Students Interaction along Teacher Qualification

Table 4.4 presents pattern of teacher-student verbal interaction analysis along teacher qualification.

Table 4.4: Pattern of teacher-student verbal interaction analysis along Teacher Qualification

s/n	**Teacher talk**	BED CHEM (N=6)			BSC CHEM (N=3)			Others (9)		
		F	%	Mean	F	%	Mean	F	%	Mean
1.	Praise and Encouragement	92	3.79	15.33 (10.03)	13	1.08	4.33 (6.65)	101	2.82	11.22 (7.80)
2	Clarification and development of ideas suggested by student	132	5.44	22.0 (5.25)	103	8.59	34.3 (42.59)	159	4.44	17.67 (11.18)
3	Ask question	193	7.96	32.17 (9.60)	27	2.25	9.0 (13.89)	234	6.53	26.0 (9.54)
4	Answer student's question	87	3.59	14.5 (7.94)	17	1.42	5.67 (9.81)	107	2.98	11.89 (7.29)
5	Lectures	987	40.68	164.5 (42.39)	577	48.12	192.33 (31.89)	1754	48.93	194.89 (29.42)
6	Gives feedback	120	4.95	20.0 (9.49)	27	2.25	9.0 (8.71)	125	3.49	13.89 (12.70)
7	Gives direction	118	4.86	19.67 (21.64)	104	8.67	34.67 (18.45)	56	1.56	6.22 (5.47)
8	Justifies authority	29	1.20	4.83 (6.18)	79	6.59	26.33 (17.07)	81	2.26	9.0 (9.55)
	Student talk									
9	Response	209	8.62	34.83 (15.26)	43	3.59	14.33 (12.89)	183	5.10	20.33 (4.72)
10	Emitted	34	1.40	5.67 (13.88)	0	0	0 (0.00)	24	0.67	2.67 (3.84)
11	Asks question	81	3.34	13.5 (10.17)	7	0.58	2.33 (4.04)	95	2.65	10.56 (4.75)
	Silence									
12	Directed activity	88	3.63	14.67 (13.29)	12	1.00	4.0 (2.65)	157	4.38	17.44 (12.23)
13	Contemplation	47	1.94	7.83 (5.56)	51	4.25	17.0 (16.52)	71	1.98	7.89 (5.23)
14	Demonstration	12	0.49	2.0 (2.89)	6	0.50	2.0 (3.46)	26	0.73	2.89 (4.11)
15	Grading student work	82	3.38	13.67 (10.21)	24	2.00	8.0 (9.16)	119	3.32	13.22 (5.29)
	Non Functional									
16	Irrelevant behavioure.g making noise	115	4.74	19.17 (12.78)	109	9.09	36.33 (19.03)	293	8.17	32.55 (13.31)
	Total Tallies	**2426**	----	----	**1199**	----	----	**3585**	----	----

For B.Ed chemistry teachers, during teaching-learning activities, on the average, teacher talk which comprises categories 1-8, constitute 72.48 % of all the verbal

interactions in the classroom. The table shows that student talk constitutes 13.36 % of the verbal interactions in the classroom while silence which comprises of categories 12 – 15constitute 11.73 % of the verbal interactions in the classroom. A look at Table 4.2 shows that non-functional aspect of teacher-student verbal interaction in the classroom constitutes 4.35 %. In the categorization of B.Ed chemistry teacher talk, by means of climate index, as shown in table 4.3, of the 2426 frequency counts of interactions, 72.48 % were teacher-centred (Dominative) while 13.36 % were student-centred (Integrative). An Integrative – Dominative ratio of approximately 0.18 (2: 9). This implies that for every nine statements uttered by the B.Ed chemistry teachers there were twostatements from the students.

For B.Sc chemistry teachers, during teaching-learning activities, on the average, teacher talk which comprises of categories 1-8 constitute 78.97 % of all the verbal interactions in the classroom. The table shows that student talk constitutes 4.17 % of the verbal interactions in the classroom while silence which comprises of categories 12 – 15 constitute 7.75 % of the verbal interactions in the classroom. A look at table 4.2 shows that non-functional aspect of teacher-student verbal interaction in the classroom constitutes 9.09 %, In the categorization of B.Sc chemistry teacher talk, by means of climate index, as shown in table 4.3, of the 1199 frequency counts of interactions, 78.97 % were teacher-centred (Dominative) while 4.17 % were student-centred (Integrative). An Integrative – Dominative ratio of approximately 0.05 (1: 20). This implies that for every 20 statements uttered by the B.Sc chemistry teachers there was only one statement from the students.

For chemistry teachers with other qualifications (other than B.Ed and B.Sc), during teaching-learning activities, on the average, teacher talk which comprises of categories 1-8 constitute 73.01 % of all the verbal interactions in the classroom. The table shows that student talk constitutes 8.42 % of the verbal interactions in the classroom while silence which comprises of categories 12 – 15 constitute 10.41 % of the verbal interactions in the classroom. A look at table 4.2 shows that non-functional aspect of teacher-student verbal interaction in the classroom constitutes 8.17 %.In the categorization of the teacher talk of teachers with other qualifications, by means of climate index, as shown in table 4.2, of the 3585 frequency counts of interactions, 73.01 % were teacher-centred (Dominative) while 8.42 % were student-centred

(Integrative). An Integrative – Dominative ratio of approximately 0.12 (1: 12). This implies that for every 12 statements uttered by the chemistry teachers there was only one statement from the students.

Figure 4.3 shows the pictorial representation of teacher-student verbal interaction along teacher qualification.

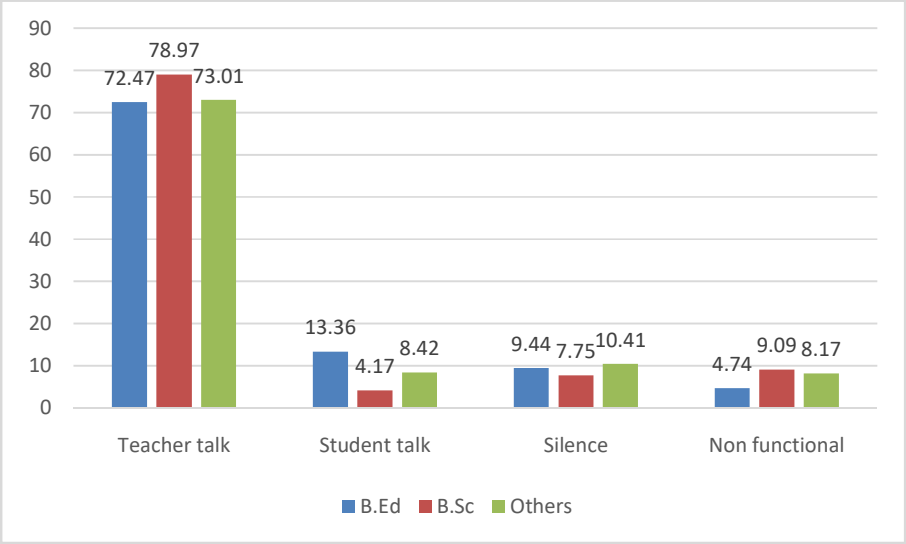

Figure 4.2: Pattern of Teacher-student Verbal Interaction along Teacher Qualification

The average value of frequency counts in each categories of the four main domains (that is teacher talk, student talk, silence and non-functional behavior) were obtained. The mean difference for each of the four categories were then subjected to One-way Analysis of Variance. This was to determine if significant differences existed in the pattern of teacher-students interactions among the categories of teaching qualification. Table 4.4 presents the results of ANOVA

Table 4.4: One-way ANOVA of Teacher Qualification

Categories		Sum of Squares	df	Mean Square	F	Sig.	Remarks
1. teacher praise and encouragement	Between Groups	242.889	2	121.444	1.687	.218	Ns
	Within Groups	1079.556	15	71.970			
	Total	1322.444	17				
2. clarification and development of ideas suggested by student	Between Groups	625.111	2	312.556	.984	.397	Ns
	Within Groups	4766.667	15	317.778			
	Total	5391.778	17				
3. teacher asks question	Between Groups	1084.278	2	542.139	4.962	.022	Sig
	Within Groups	1638.833	15	109.256			
	Total	2723.111	17				
4. teacher answers student question	Between Groups	156.556	2	78.278	1.256	.313	Ns
	Within Groups	935.056	15	62.337			
	Total	1091.611	17				
5. teacher lectures	Between Groups	3554.944	2	1777.472	1.486	.258	Ns
	Within Groups	17945.056	15	1196.337			
	Total	21500.000	17				
6. teacher gives feedback	Between Groups	268.889	2	134.444	1.065	.369	Ns
	Within Groups	1892.889	15	126.193			
	Total	2161.778	17				
7. teacher gives direction	Between Groups	1980.889	2	990.444	4.555	.028	Sig
	Within Groups	3261.556	15	217.437			
	Total	5242.444	17				
8. teacher justifies authority	Between Groups	965.000	2	482.500	4.807	.024	Sig
	Within Groups	1505.500	15	100.367			
	Total	2470.500	17				
9. student response	Between Groups	1105.000	2	552.500	4.946	.022	Sig
	Within Groups	1675.500	15	111.700			
	Total	2780.500	17				
10. student emitted	Between Groups	69.778	2	34.889	.484	.626	Ns
	Within Groups	1081.333	15	72.089			
	Total	1151.111	17				
11. student asks question	Between Groups	252.111	2	126.056	2.589	.108	Ns
	Within Groups	730.389	15	48.693			
	Total	982.500	17				
12. silence (directed activity)	Between Groups	408.056	2	204.028	1.462	.263	Ns
	Within Groups	2093.556	15	139.570			
	Total	2501.611	17				
13. silence (contemplation)	Between Groups	208.556	2	104.278	1.701	.216	Ns
	Within Groups	919.722	15	61.315			
	Total	1128.278	17				
14. silence (demonstration)	Between Groups	3.556	2	1.778	.133	.877	Ns
	Within Groups	200.889	15	13.393			
	Total	204.444	17				
15. silence (grading student work)	Between Groups	73.611	2	36.806	.489	.623	Ns
	Within Groups	1128.889	15	75.259			
	Total	1202.500	17				
16. irrelevant behaviour e.g. making noise, fighting etc.	Between Groups	853.889	2	426.944	2.164	.149	Ns
	Within Groups	2959.722	15	197.315			
	Total	3813.611	17				

From Table 4.4, under Teacher talk, it is clear that, on the average, there was no statistically significant difference among the teachers when one looks at categories 1, 2, 4, 5, and 6. However, there were statistically significant differences in the mean scores among the teachers when one looks at categories 3, 7, and 8. For example, looking at category 3 (teacher asks questions) the mean value for B.Ed teachers was 32.17 (SD = 9.06), the mean value for B.Sc teachers was 9.00 (SD = 13.89), while the mean values for teachers with other qualifications was 26.00 (SD = 9.95) $F(2, 15) = 4.96$, $p < 0.05$.

Under student talk, there were no statistically significant differences in the mean values in categories 10 and 11. However, there was a statistically significant difference in the mean values in category 9. A look at table 4.4 shows that the mean value for B.Ed teacher was 34.83 (SD = 15.26) for B.Sc it is 14.33 (SD = 12.89) while for teachers with other qualification it is 20.33 (4.72). The mean difference among the teachers is statistically significant $F(2, 15) = 4.92$, $p < 0.05$.Under silence, on the average, there were no statistically significant difference in the categories 12, 13, 14, and 15. Similarly under irrelevant behavior, there was no statistically significant difference in category 16.

Research question 2: What is the pattern of verbal and non verbal teacher-student interactions using classroom interaction sheet in terms of:

i. Teacher-centred activity?
ii. Individual student activity?
iii. Teacher-student activity?
iv. Teacher-material activity?
v. Student-material activity?
vi. Student-student activity?
vii. Non facilitating learning behaviour?

To answerthis research question, descriptive statistics (frequency, percentage, bar chart) were used.

Table 4.5 shows total tallies for each sub category when classroom interaction sheet was used to observe the chemistry class.

Table 4.5: Analysis of verbal and non-verbal teacher-student Interaction

s/n	Category	frequency	Percentage (%)
1.	Teacher centred activity	4041	56.82
2	Individual student activity	410	5.76
3	Teacher-student activity	1248	17.55
4	Teacher-material activity	216	3.04
5	Student-material activity	203	2.85
6	Student-student activity	86	1.21
7	Non facilitating learning behavior	451	6.34
8	Confusion	441	6.20
9	Others	16	0.22
	Total	7112	

Teacher centered activities had total of 4041 which represented 56.82 % of the entire time spent to teach the student. It showed teacher centredactivities such as teacher talk continuously, explaining, writing note for students dominated the class. Individual student activities were limited, the frequency was 410 which represented 5.76 % of the total time students were engaged. Activity that involved interaction between teacher and students was minimal; it had the frequency of 1248 which represented 17.55 % of the total time spent in the class. The amount of time teacher interacted with instructional materials was small compared with the entire period of instruction delivery. Teacher material activity had 216 which represented 3.04 % of the total time used to teach the students. Student interacted with instructional materials only 203 times which represented 2.85 % of the engaged time. Student-student activity only happened only 86 times which represented 1.21 % of the total spent for teaching. Activities which do not support learning occurred 451 times which represented 6.34 % of the entire time of teaching. Others activities which do not belong to any of the above category had 16 which represented 0.22 % of the engaged.

Figure 4.3 presents the bar chart of the pictorial representation of the teaching-learning activities in the classroom.

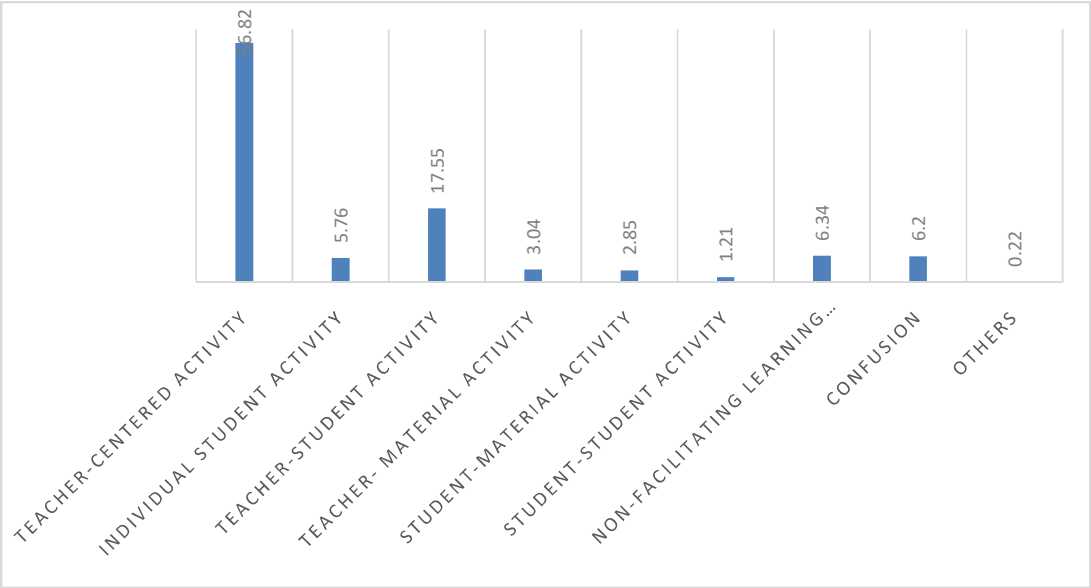

Figure 4.3: Bar chart showing verbal and non-verbal classroom interaction

Figure 4.3 shows different bars which differentiated among various activity which happened in the using classroom interaction sheet. It was obvious that teacher centred activity dominated the class which has the tallest bar and frequency of 4041. Teacher student activity was the next with frequency of 1248. And the least was other activities which were not represented above.

Discussion of findings

Results showed that teacher centred activity dominated the class. Sub category include teacher explaining the concept, giving examples, writing note for the students, demonstrating, talking non-stop. The findings of teacher behaviour using classroom interaction sheet further confirmed the findings when modified Flanders 16 category interaction system was used to observe the teachers.This findings corroborates finding of Uzoechi (2008) who reported that teacher – centred instruction lead to weak classroom discourse based onrole memorization and no provision for development of intellectual and creative thinkingskills among students.

Similarly, Adegoke (2005) who reported that students who were given maximum opportunity to participate in teaching and learning process (integrative group) had higher achievement score in Mathematics than their colleagues in the dominative group. Further results of teacher-student interaction revealed that category 3 (teacher-student activity) was very low in term of its percentage. Little or very minimal activities were carried out for category 4 (teacher-material activity), category 5 (student-materials activity) and category 6 (student-student activity). These results show that teachers did not make use of instructional or learning aids to a very large extent. The teaching aids are important to assist student to further understand the concept being taught. Teachers did not guide the students to touch or manipulate learning aids during chemistry lessons.

Also the rate at which student interacted with fellow students to carry out a task as directed by the teacher during the lesson was very low. All these class activities which were not properly carried out during chemistry class could have adverse effects on learning pace of the student and ultimate student achievement. This may not be unconnected with the fact that teachers lacked adequate preparation before coming to class. This was confirmed by the experience the researcher had while doing field work.

A trained teacher supposed to have an imaginary picture of how the class will be arranged, prepare what task will be given among students to solve, prepare what instructional material matches the topic to be discussed and so on. Experience from the field showed that many teachers come to class without preparation and thereby allowed teaching-learning process to take any form which lacked direction. Since there were no prepared instructional materials to be displayed before the students which can facilitate learning, teachers talked almost throughout the lesson as well as copy note on the chalkboard. The results of this findings is in line with Odinko and Williams (2006) who found that pre-primary classrooms spent a larger proportion of lesson period (51.2 %) on interacting (prompting learning) with the whole class (e.g. explaining, talking continually, questioning pupils, giving directives to pupils,writing, giving learning materials to pupils, etc) whereas less proportions of the lesson period were used for learning-enhancing events that centred on groups of pupils (19.8 %) and individual pupils (12.3 %).

On the student-student interaction during lesson, the result showed that very small time is given to students to engage in group work among themselves, some teachers did not assign group work for students for a whole term, this means coordination leadership ability in some students are being killed instead to nurture them. Inferiority complex of low self-esteem may set in some students because they were denied interaction with other peers. Experience has shown that some kind of students who could not talk or address the entire class mates as a whole are helped to overcome their fears and express his/her mind when distributed into groups of four's.On the time allocation for student-material interaction, the findings showed that only small time was spent on student using material to aid learning while many lessons did not feature student-material interaction at all. Implication of this on educational system in Nigeria andOyo state in particular is that learning may be more of rote type because instructional material which supposed to concretize and make lesson last longer in memories are no longer being used during instruction delivery. If students are allowed to touch, use and manipulate these materials under teacher guidance, students will understand the topic well without cramming.

Research Question 3a: What is the average threshold time required by a chemistry teacher to show his typical classroom interaction pattern using:

i. Modified Flanders interaction 16 category system?

To answer the research question, descriptive statistics was used, the observations in the classroom were broken down into four segments of ten minutes each. The observations in the first ten minutes are as presented in Table 4.6a

Table 4.6a: First Ten Minutes Modified Flanders Classroom Interaction Analysis (1-10 minutes)

Sc	TG	TQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	F	BOT	1	10	10	4	41	6	0	0	6	0	0	0	6	0	0	9
2	F	BEC	3	9	13	0	43	8	0	0	8	0	0	0	0	0	6	10
3	M	BOT	4	11	17	0	37	3	0	0	12	0	3	0	0	0	11	2
4	M	BSC	0	0	0	0	41	0	0	4	0	0	0	5	14	0	6	30
5	F	BSC	0	22	0	0	23	0	21	3	10	0	0	0	0	0	0	21
6	M	BEC	7	11	17	0	29	11	0	0	5	0	0	0	8	0	4	8
7	F	BEC	5	1	14	0	37	0	5	0	11	0	1	0	5	0	11	10
8	F	BOT	2	9	17	0	35	2	0	0	10	0	0	0	9	0	10	5
9	M	BOT	0	0	8	0	51	0	5	1	3	0	0	10	5	0	2	15
10	M	BOT	2	4	4	0	45	0	5	5	5	0	0	0	0	0	5	20
11	F	BEC	7	28	23	13	29	0	0	0	0	0	0	0	0	0	0	0
12	F	BOT	0	0	8	0	45	7	4	3	4	0	0	5	1	4	7	13
13	M	BEC	0	4	5	0	59	5	5	5	7	0	0	0	0	0	6	3
14	F	BOT	5	6	6	2	45	0	0	3	3	0	1	1	9	0	4	15
15	M	BOT	0	3	12	0	35	0	0	3	7	0	4	0	0	0	10	26
16	F	BEC	2	3	5	0	62	3	0	0	3	0	0	0	2	0	6	14
17	M	BOT	0	5	6	0	50	1	2	0	2	0	2	5	6	1	7	13
18	F	BSC	1	3	8	0	35	3	13	7	4	0	0	2	7	2	7	8

Legend :BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline. Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (a. teacher talk, 1 = Praise and encouragement, 2 = clarification and development of ideas suggested by students, 3 = ask questions, 4 = answer student's questions, 5 = lectures, 6 = gives feedback, 7 = gives direction, 8 = justifies authority; b. student talk, 9 = Response, 10 = emitted, 11 = ask questions; c. Silence, 12 = directed activity, 13 = contemplation, 14 = demonstration, 15 = grading student work; d. non functional, 16 = irrelevant behaviour)

From the table, it can be observed that in most of the schools observed, category five (teacher lectures) dominated the activities of the chemistry teachers in the first ten minutes. This shows that chemistry teachers in most schools visited, even at the beginning minutes of the lesson, adopted lecture method. It is quite interesting to know that even in the first ten minutes irrelevant activities such teachers attending to calls and greeting colleagues also happened. Moreover in the first ten minutes, as reflected in categories ten and eleven, students were not given opportunity to ask questions or initiate their own ideas about the topic being taught.

Table 4.6b: Second Ten Minutes Modified Flanders Classroom Interaction Analysis (11-20) minutes

Sc	TG	TQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	F	BOT	0	0	12	5	63	5	3	0	8	0	5	0	0	0	0	0
2	F	BEC	0	11	10	7	38	10	0	0	11	0	14	2	0	0	0	0
3	M	BOT	0	0	16	9	48	10	1	0	6	3	0	2	0	0	0	5
4	M	BSC	0	0	0	0	55	0	3	13	0	0	0	2	7	0	0	21
5	F	BSC	2	33	1	0	37	0	14	9	3	0	0	0	0	0	0	0
6	M	BEC	9	2	13	2	48	8	0	0	15	0	1	0	0	0	0	1
7	F	BEC	8	15	7	4	33	0	1	5	14	0	3	0	0	0	10	0
8	F	BOT	2	7	0	2	37	12	0	0	4	0	5	13	0	0	9	11
9	M	BOT	0	0	8	0	44	0	3	8	11	0	0	13	3	0	2	8
10	M	BOT	13	8	7	0	47	0	3	0	5	0	0	1	0	0	4	11
11	F	BEC	0	0	1	6	56	16	18	3	0	0	0	0	0	0	0	0
12	F	BOT	2	0	8	0	53	1	4	0	9	3	0	7	6	3	0	5
13	M	BEC	0	9	14	3	33	11	5	5	14	0	0	0	2	0	0	4
14	F	BOT	0	0	10	4	54	2	0	5	4	4	5	2	2	0	2	6
15	M	BOT	3	3	0	4	60	0	0	2	5	0	1	8	0	4	0	9
16	F	BEC	2	2	2	0	73	0	0	0	2	0	0	5	7	2	1	3
17	M	BOT	1	1	14	0	22	9	5	1	14	2	5	13	1	4	0	8
18	F	BSC	0	2	8	5	44	7	1	4	8	0	7	0	6	0	5	4

Legend :BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline, Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (a. teacher talk, 1 = Praise and encouragement, 2 = clarification and development of ideas suggested by students, 3 = ask questions, 4 = answer student's questions, 5 = lectures, 6 = gives feedback, 7 = gives direction, 8 = justifies authority; b. student talk, 9 = Response, 10 = emitted, 11 = ask questions; c. Silence, 12 = directed activity, 13 = contemplation, 14 = demonstration, 15 = grading student work; d. non functional, 16 = irrelevant behaviour)

Table 4.6b presents the observations in the second 10 minutes of the classroom interaction analysis using modified 16-category Flanders Interaction System. Table shows in most of the schools observed, teacher did less of praise and encouragement and did not reinforce students or did not welcome ideas suggested by the students. This was shown from categories 1 and 2 (praise and encouragement, clarification and development of ideas suggested by the students). It was also observed that category 5 (teacher lectures) still dominated the classroom instruction even when classroom interaction progressed to the second ten minutes and there was less silence. The observations for the second ten minutes was presented in table 4.6b

Table 4.6c: Third Ten Minutes Modified Flanders Classroom Interaction Analysis (21-30) minutes

Sc	TG	TQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	F	BOT	0	3	1	20	48	0	0	4	7	1	11	2	0	0	0	4
2	F	BEC	0	0	19	5	40	11	3	0	6	0	10	0	0	0	0	4
3	M	BOT	9	15	9	5	27	15	8	0	2	0	7	2	0	0	0	1
4	M	BSC	0	0	1	0	56	3	7	25	0	0	0	0	7	0	0	0
5	F	BSC	0	23	1	0	36	2	16	6	3	0	0	3	0	0	0	10
6	M	BEC	2	3	5	17	51	3	0	0	2	0	16	0	0	0	0	1
7	F	BEC	5	7	6	1	45	6	3	0	6	0	1	7	3	0	9	1
8	F	BOT	8	7	0	5	54	5	0	0	3	0	3	0	0	0	0	10
9	M	BOT	4	3	1	0	43	0	0	6	5	0	4	12	4	0	14	4
10	M	BOT	5	6	8	0	49	0	1	0	15	0	0	6	10	0	0	0
11	F	BEC	0	0	0	0	2	7	32	1	45	8	2	0	0	2	1	0
12	F	BOT	3	13	0	0	59	0	0	0	6	0	5	0	0	1	4	8
13	M	BEC	1	5	14	7	36	6	11	1	13	0	0	3	2	0	3	2
14	F	BOT	0	3	3	4	56	1	0	17	9	0	3	0	0	1	3	0
15	M	BOT	3	2	8	3	55	2	0	0	4	0	2	15	0	0	0	5
16	F	BEC	3	7	10	0	37	2	8	3	9	0	8	3	0	0	3	9
17	M	BOT	8	3	3	7	37	10	3	5	2	1	3	9	1	4	4	1
18	F	BSC	8	11	3	7	38	6	12	4	0	0	0	0	4	2	4	3

Legend: BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline, Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (a. teacher talk, 1 = Praise and encouragement, 2 = clarification and development of ideas suggested by students, 3 = ask questions, 4 = answer student's questions, 5 = lectures, 6 = gives feedback, 7 = gives direction, 8 = justifies authority; b. student talk, 9 = Response, 10 = emitted, 11 = ask questions; c. Silence, 12 = directed activity, 13 = contemplation, 14 = demonstration, 15 = grading student work; d. non functional, 16 = irrelevant behaviour)

Table 4.6c presents the observations in the third 10 minutes of the classroom interaction analysis using modified 16-category Flanders Interaction System. Table shows that in most schools, teacher did not ask much questions from the student and did not motivate or reinforce students but dominated the talking continuously as reflected in category 5 (teacher lectures). Irrelevant activities reduced when the lesson progressed to third ten minutes as shown by category 16. The observations in the third ten minutes are as presented in Table 4.6c

Table 4.6d: Fourth Ten Minutes Modified Flanders Classroom Interaction Analysis (31-40) minutes

Sc	TG	TQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	F	BOT	0	2	14	0	25	17	0	0	7	1	0	34	0	0	0	1
2	F	BEC	5	4	0	11	63	3	0	0	4	0	2	0	0	0	7	4
3	M	BOT	2	16	4	5	56	3	3	4	4	0	0	0	0	0	0	4
4	M	BSC	0	0	0	0	76	0	9	4	0	0	0	0	5	0	0	6
5	F	BSC	0	3	0	0	75	4	4	0	9	0	0	0	0	0	0	4
6	M	BEC	2	0	4	3	67	4	0	0	6	0	0	0	0	0	0	15
7	F	BEC	16	4	8	1	36	4	8	0	7	0	1	3	0	0	0	15
8	F	BOT	12	4	0	5	53	5	0	0	0	0	5	8	0	0	0	7
9	M	BOT	0	0	3	5	69	0	0	3	0	0	5	3	0	0	9	1
10	M	BOT	0	0	0	2	65	0	0	0	2	0	2	9	0	0	5	17
11	F	BEC	0	0	0	0	0	0	0	0	9	26	21	14	5	6	9	10
12	F	BOT	0	5	0	7	67	0	4	0	0	0	0	0	0	5	0	13
13	M	BEC	10	5	4	2	32	3	9	5	7	0	0	6	13	1	1	1
14	F	BOT	6	2	0	0	49	0	0	4	0	0	6	5	4	2	0	18
15	M	BOT	0	4	0	3	67	5	0	0	0	0	3	0	0	0	6	10
16	F	BEC	10	3	0	5	49	3	2	4	0	0	1	0	0	0	12	10
17	M	BOT	4	4	8	10	29	6	1	6	2	9	4	4	4	2	2	7
18	F	BSC	4	5	6	5	62	3	4	0	6	0	0	0	1	2	2	3

Legend :BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline, Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (a. teacher talk, 1 = Praise and encouragement, 2 = clarification and development of ideas suggested by students, 3 = ask questions, 4 = answer student's questions, 5 = lectures, 6 = gives feedback, 7 = gives direction, 8 = justifies authority; b. student talk, 9 = Response, 10 = emitted, 11 = ask questions; c. Silence, 12 = directed activity, 13 = contemplation, 14 = demonstration, 15 = grading student work; d. non functional, 16 = irrelevant behaviour)

Table 4.6d presents the observations in the forth 10 minutes of the classroom interaction analysis using modified 16-category Flanders Interaction System. Table shows in most schools, there was no much silence , there were irrelevant activities and the teacher still dominate the class by giving lecture and writing note for students. The observations in the forth ten minutes are as presented in Table 4.6d. Reviewing the four segments, it was generally observed that teachers dominated the lesson even from the beginning of the class to the end.

Discussion of findings

The pattern of classroom interaction observed in the study, where "teacher talk" (lectures) was predominant and where the teacher talked continuously and students only sat down to listen to the teacher may not support student learning and achievement. Breaking the lesson period into four segments of ten minutes each in order to comprehensively describe teacher and student behaviours as the lesson progressed from first ten minutes to last ten minutes. The findings revealed that, even in the first ten minutes of the chemistry lesson, teacher adopted dominative style of teaching as shown from category 5 (teacher lectures). This was predominant even in the first ten minutes of the lesson when it was expected that teachers should prepare the mind of the students for the new topic by asking question based on the last topic taught so that he can teach from known to unknown. The result also showed that teacher lectures was still predominant even in the second ten minutes of the lesson through third ten minutes which reoccurred during the last ten minutes of the lesson. This kind of teacher behaviour (teacher lectures) may not help to ascertain the extent to which students understand the topic being taught as the teacher did not ask questions or welcome questions from students.The findings of this study may not be unconnected to the fact that many teachers are yet to appreciate their profession as one which require some level of expertise. Experience from the field showed that even teachers who are professional (by certification) went to class unprepared in terms of preparing and use of teaching aids, did not prepare the task to give to students so as to get them involved in learning process and therefore talked continuously and wrote note for the students. Teachers are supposed to be pace setter or dictate the tune or direction of how teaching and learning will go, but due to unpreparedness on the part of the teachers prior to commencement of the class, classroom activities were dominated by lectures. This findings corroborate the findings of Isiugo-Abanihe and LongJohn (2005), Adegoke (2007) which revealed that teacher-talk constituted about 83.5% of instructional time.

However, findings showed few special cases. For example school 11, in the first ten minutes, teacher asked rhetorical questions and did not wait for students to answer before interjecting but welcomed few suggestions raised by the students. The findings further showed that, in the first ten minutes, throughout the whole period of observation, teachers of schools 4, 5, 9, 12, 13,15 and 17 did not praise or encourage

students at all. This kind of teacher behaviour does not facilitate learning and may have adverse effect on student achievement. The results also indicated that, in the first ten minutes, 15 out of 18 teachers did not answer student questions as shown in category 4 (teacher answer student questions). This is supported by category 11 (student ask questions), 13 out of 18 schools, students did not ask question at all.

Research Question 3a ii. What is the average threshold time required by a chemistry teacher to show his or her typical interaction pattern using classroom interaction sheet?

To answer research question and find the threshold time of the teacher when classroom interaction sheet was used to observe the class descriptive statistics was used. The observations in the classroom were broken down into four segments of ten minutes each. The observations in the first ten minutes are as presented in Table 4.7a

Table 4.7a: First ten Minutes (0 -10 Minutes) of Observations using Classroom Interaction Sheet

Sc	TG	TQ	1	2	3	4	5	6	7	8	9
1	F	BOT	70	0	10	0	0	0	9	11	0
2	F	BEC	82	0	7	0	0	0	6	4	0
3	M	BOT	78	0	9	3	0	0	11	1	0
4	M	BSC	47	0	0	0	0	0	22	31	0
5	F	BSC	42	9	25	6	0	0	1	20	0
6	M	BEC	75	10	0	0	0	0	15	0	0
7	F	BEC	54	21	6	0	0	0	10	9	0
8	F	BOT	75	0	0	0	0	0	21	5	0
9	M	BOT	66	5	2	0	0	0	11	13	0
10	M	BOT	57	0	2	0	0	0	23	18	0
11	F	BEC	50	5	10	4	6	10	20	10	5
12	F	BOT	62	5	4	4	3	7	21	12	1
13	M	BEC	53	7	8	5	4	8	8	5	0
14	F	BOT	55	6	5	5	3	3	8	12	2
15	M	BOT	43	4	6	6	5	2	21	10	3
16	F	BEC	56	4	12	5	5	2	2	10	2
17	M	BOT	45	6	13	2	5	5	8	12	2
18	F	BSC	45	4	14	2	7	2	13	11	2

Legend :BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline, Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (1 = teacher centred

activity, 2 = individual student activity, 3 = teacher-students activity, 4 = teacher-material activity, 5 = student-material activity, 6 = student-student activity, 7 = non-facilitating learning behaviour, 8 = confusion, 9 = others

From the table, in the first ten minutes of the lesson, it can be observed that in most of the schools observed, category one (teacher centre activity) dominated the activities of the chemistry teachers. This shows that chemistry teachers in most schools visited, even at the beginning minutes of the lesson, were explaining, talking alone, dictating or copying note for students. It is also important to know that non facilitating learning activities such as negative reinforcement, discipline, teacher being distracted with calls occurred in the first ten minutes of the lesson. The observations in the first ten minutes are as presented in Table 4.7a

Table 4.7b: Second ten Minutes (11 -20 Minutes) of Observations using Classroom Interaction Sheet

Sc	TG	TQ	1	2	3	4	5	6	7	8	9
1	F	BOT	78	3	19	0	0	0	1	0	0
2	F	BEC	66	0	33	0	0	0	0	1	0
3	M	BOT	48	0	34	4	0	10	0	4	0
4	M	BSC	60	0	0	0	0	0	18	23	0
5	F	BSC	61	0	22	8	0	2	0	0	0
6	M	BEC	67	0	29	4	0	0	1	0	0
7	F	BEC	61	35	0	0	0	0	4	0	0
8	F	BOT	60	13	15	0	0	0	5	9	0
9	M	BOT	78	3	2	0	0	4	10	6	0
10	M	BOT	84	0	2	0	0	0	7	7	0
11	F	BEC	56	10	10	2	8	3	2	9	0
12	F	BOT	37	8	29	3	5	0	13	7	0
13	M	BEC	63	10	13	1	3	3	2	5	0
14	F	BOT	68	7	7	7	5	5	6	5	2
15	M	BOT	52	9	11	5	8	3	2	9	2
16	F	BEC	63	4	4	5	4	5	5	8	2
17	M	BOT	38	9	22	10	7	7	4	4	2
18	F	BSC	38	7	27	5	8	2	2	3	0

Legend :BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline, Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (1 = teacher centred activity, 2 = individual student activity, 3 = teacher-students activity, 4 = teacher-material activity, 5 = student-material activity, 6 = student-student activity, 7 = non-facilitating learning behaviour, 8 = confusion, 9 = others

Table 4.7b presents the observations in the second 10 minutes of the classroom interaction analysis using classroom interaction sheet. The table shows that in most

schools, teachers still persist in dominating the class activities with less activity in the aspect of teacher –material interaction (category 4), student-material interaction (category 5) and student-student interaction (category 6). This shows that the class was not conducted in a way to allow students to interact with instructional material or teacher interacts with instructional material. And also students were unable to interact with one another. The observations in the second ten minutes are as presented in Table 4.7b

Table 4.7c: Third ten Minutes (21 -30 Minutes) of Observations using Classroom Interaction Sheet

Sc	TG	TQ	1	2	3	4	5	6	7	8	9
1	F	BOT	72	8	16	0	4	0	0	0	0
2	F	BEC	64	0	36	0	0	0	0	0	0
3	M	BOT	40	0	45	0	0	10	5	0	0
4	M	BSC	81	0	0	0	0	0	19	1	0
5	F	BSC	56	1	23	0	0	6	3	13	0
6	M	BEC	41	0	41	5	13	0	0	0	0
7	F	BEC	59	19	7	0	0	0	0	8	7
8	F	BOT	44	8	37	0	0	0	4	7	0
9	M	BOT	67	0	7	0	11	8	8	0	0
10	M	BOT	77	0	22	0	0	0	1	0	0
11	F	BEC	41	22	16	5	5	4	3	4	1
12	F	BOT	38	2	27	10	7	2	3	9	0
13	M	BEC	33	9	37	10	3	3	3	2	4
14	F	BOT	53	6	10	5	3	2	4	9	1
15	M	BOT	45	6	20	5	5	5	8	9	3
16	F	BEC	38	8	19	8	5	3	7	4	2
17	M	BOT	32	7	26	8	5	5	10	7	2
18	F	BSC	40	10	15	13	10	6	7	5	2

Legend :BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline, Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (1 = teacher centred activity, 2 = individual student activity, 3 = teacher-students activity, 4 = teacher-material activity, 5 = student-material activity, 6 = student-student activity, 7 = non-facilitating learning behaviour, 8 = confusion, 9 = others

Table 4.7c presents the observations in the third 10 minutes of the classroom interaction analysis using classroom interaction sheet. The table shows in most schools, teachers still persist in dominating the class activities and teacher-student activities were minimal. Most teachers did not interact with instructional materials

and students were given no opportunity to interact with one another. The observations in the third ten minutes are as presented in Table 4.7c

Table 4.7d: Fourth ten Minutes (30 -40 Minutes) of Observations using Classroom Interaction Sheet

Sc	TG	TQ	1	2	3	4	5	6	7	8	9
1	F	BOT	55	20	26	0	0	0	0	0	0
2	F	BEC	61	0	31	0	0	0	0	8	0
3	M	BOT	57	5	22	5	0	10	3	0	0
4	M	BSC	76	0	0	0	0	0	15	10	0
5	F	BSC	84	5	2	0	0	2	3	3	0
6	M	BEC	47	0	19	18	6	0	0	10	0
7	F	BEC	50	14	4	0	0	0	8	21	3
8	F	BOT	55	0	34	0	0	0	0	13	0
9	M	BOT	82	0	10	0	6	0	2	0	0
10	M	BOT	59	0	30	0	8	0	0	3	0
11	F	BEC	30	21	19	6	12	5	17	5	4
12	F	BOT	46	3	25	8	8	9	4	7	0
13	M	BEC	35	11	8	15	13	2	9	6	2
14	F	BOT	42	2	13	8	2	2	13	19	2
15	M	BOT	58	7	10	11	15	5	5	18	2
16	F	BEC	35	8	23	8	2	2	5	11	5
17	M	BOT	40	17	8	3	7	10	5	5	2
18	F	BSC	31	8	11	10	10	10	10	13	5

Legend :BEC – Bachelor of Education in Chemistry; B.SC – Bachelor of Science in Chemistry BOT – Bachelor Degree in other discipline, Sc – Schools, TG – Teacher gender, TQ – Teacher qualification. M = male teacher, F = female teacher, interaction categories (1 = teacher centred activity, 2 = individual student activity, 3 = teacher-students activity, 4 = teacher-material activity, 5 = student-material activity, 6 = student-student activity, 7 = non-facilitating learning behaviour, 8 = confusion, 9 = others

Table 4.7d presents the observations in the fourth 10 minutes of the classroom interaction analysis using classroom interaction sheet. The table shows that in most schools, there was a little of teacher-student activities. Teachers allowed student participation but to a little extent. Though greater part of the talking was still being done by the teachers as reflected in category 1 (teacher-centred activity). There was clear indication that instructional materials were not frequently used by both the

teachers and the students as shown in categories 4 and 5. The observations in the fourth ten minutes are as presented in Table 4.7d

Generally, therefore, going by the observation in progress of class activity from beginning of the class to the end, the chemistry lesson was characterised by teacher centred activities which almost spread throughout the entire forty minutes of the lesson with less usage of instructional materials on the part of teacher and students and low students participation.

Discussion of Findings

The findings using classroom interaction sheet, showed that, in the first ten minutes of the lesson, teacher-centred activities (teacher explaining, demonstrating, giving examples and writing note for students) predominated the class.This was shown by high frequencies of teacher activity recorded in category 1 of classroom interaction sheet. However, scanty activities were recorded in categories 4(teacher-material activity), 5 (student-material activity) and 6 (student-student activity). This order of teacher behaviours reoccurred as the lesson progresses; teacher-centred activities still predominated the lesson even in the second ten minutes through third ten minutes which happened also in the last ten minutes of the class. This finding is further affirming the results obtained when modified Flanders 16 category interaction system (MFICS) was used to observe teacher-student behaviour which revealed that teacher lecture predominated the chemistry class.

This results showed that , in secondary schools in Oyo state, especially chemistry classes, teacher centred activity and lecture are predominant style of delivery instruction to students with less chance for student to ask question or suggest their own ideas. This mode of instructional delivery where teacher talk continuously without necessarily using instructional aids to teach or plan a task where students can interact with one another, may be detrimental or dangerous to the ultimate goal of student achievement .

Teacher talked continuously during chemistry lesson, time given to students to answer teacher's question (student evaluation) is very small, time given to student to suggest their own ideas about the topic is relatively small, it then mean that student talent and

potentials which teacher could have developed in them if they are given time to express themselves during lesson were being left to diminish in the mind of the students. The findings are in line with the findings of Adegoke (2007) and Owodunni (2015) which showed that teacher coordinated activities were the major constituents of the lesson.

Hypotheses

1. Students' highachievement in chemistry can be reliably predicted from measures of pattern of classroom interaction (PCI), teacher gender (TG), and teacher qualification (TQ).
2. Students' positiveattitude to chemistry can be reliably predicted from measures of pattern of classroom interaction, teacher gender, and teacher qualification and teacher experience.

To answer these hypotheses, logistic regression was used. The decision to use logistic regression was borne out of the fact that in this study all the predictor variables (pattern of classroom interaction, gender and qualification) were categorical in nature. For uniformity, therefore, the dependent variables: students' achievement (scores in CAT) in chemistry were dichotomized into high achievement (upper 50^{th} percentile) and low achievement (lower 50^{th} percentile). Similarly students' scores in attitude scale were dichotomized into positive attitude (upper 50^{th}percentile) and negative attitude (lower 50^{th}percentile).

The two hypotheses are now tested

Hypothesis 1

Students' high achievement in chemistry can be reliably predicted from measures of pattern of classroom interaction, teacher gender, and teacher qualification.

Initial results of the enter method of the logistic regression analysis as provided by the Omnibus Tests for Model Coefficients showed that the overall model is significant when all the three predictor variables (pattern of teacher-student interaction, gender and qualification) were entered $\chi^2 = 10.33$, $df = 3$, N = 1004, $p < 0.05$.

For other results, Tables 4.8, 4.9 and 4.10 present the model summary, the final classification and variables in the equation respectively.

Table 4.8: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1377.172[a]	.010	.014

Table 4.8, the model summary includes two different ways of estimating R^2 (percent of variance accounted for) as was done in multiple regression. These "pseudo" R^2estimates (0.010 and 0.014) indicate that approximately 1.0 % and 1.4 % of the variance in whether or not students' high achievement in chemistry can be predicted from the linear combination of the three predictor variables.

Table 4.9: Classification Table

Observed			Predicted		
			Percentile Group of achievement		Percentage Correct
			low achievement	High achievement	
Step 1	Percentile Group of achievement	low achievement	289	246	54.0
		High achievement	206	263	56.1
	Overall Percentage				55.0

The classification table indicates how well the combination of the predictor variables predict high achievement. In this study, the emphasis was on predicting, from the three predictors, whether or not students would have high achievement in chemistry. From the classification table, overall, 55% of the participants were predicted correctly. The independent/covariate variables were better at helping in predicting students those who would have high achievement (56.1% correct) than at who would have low achievement (54% correct)

Table 4.10: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	PCI	-.406	.133	9.322	1	.002	.666	.513	.865
	GD	.033	.130	.064	1	.801	1.033	.802	1.332
	QA	-.016	.075	.046	1	.829	.984	.850	1.139
	Constant	.457	.371	1.513	1	.219	1.579		

Results in table 4.10 shows that only pattern of teacher-student classroom interaction (Integrative-Dominative) is significant. The Exp (B) shows that the oddsof predicting students' high achievement increases by about 0.67 for every one unit increase in the pattern of PSI. The results show that when the teacher adopts the integrative method of teaching; students are more likely to have high achievement in chemistry. Teacher gender and teacher qualification are not significant.

Hypothesis 2

Students' positiveattitude to chemistry can be reliably predicted from measures of pattern of classroom interaction, teacher gender, and teacher qualification.

Initial results of the enter method of the logistic regression analysis as provided by the Omnibus Tests for Model Coefficients showed that the overall model is significant when all the three predictor variables (pattern of teacher-student interaction, gender and qualification) are entered $\chi^2 = 11.31$, $df = 3$, N = 1004, $p < 0.05$.

For other results, Tables 4.11, 4.12 and 4.13 present the model summary, the final classification and variables in the equation respectively.

Table 4.11: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1377.172[a]	.011	.015

Table 4.11, the model summary includes two different ways of estimating R^2 (percent of variance accounted for) as was done in multiple regression. These "pseudo" R^2estimates (0.011 and 0.015) indicate that approximately 1.1 % and 1.5 % of the variance in whether or not students' positive attitude to chemistry can be predicted from the linear combination of the three predictor variables.

Table 4.12: Classification Table

Observed			Predicted		
			Percentile Group of attitude		Percentage Correct
			Positive attitude	Negative attitude	
Step 1	Percentile Group of achievement	Positive attitude	224	263	46.0
		Negative attitude	213	303	58.7
	Overall Percentage				52.5

The classification table indicates how well the combination of the predictor variables predict students' positive attitude to chemistry. In this study, the emphasis was on predicting, from the three predictors, whether or not students would have positive attitude to chemistry. From the classification table, overall, 52.5% of the participants were predicted correctly. The independent/covariate variables were better at helping in predicting students those who would have positive attitude (56% correct) than at those who would have negative attitude to chemistry (46% correct)

Table 4.13: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	PCI	.392	.133	8.611	1	.003	1.479	1.139	1.921
	GD	.273	.130	4.426	1	.035	1.314	1.019	1.694
	QA	.078	.075	1.090	1	.297	1.081	.934	1.252
	Constant	-1.101	.373	8.697	1	.003	.332		

Results in table 13 shows that pattern of teacher-student classroom interaction (Integrative-Dominative) and gender are significant. The Exp (B) shows that the odds of predicting students' high achievement increases by about 1.48 (48%) for every one unit increase in the pattern of TSCI and by about 1.31 (31%) for every one unit increase in teacher gender. From table 4.13, teacher qualification is not significant.
These results show that when the pattern of teacher-students interaction is dominative, more students tend to have positive attitude to chemistry. Similarly the results show

that female chemistry teachers are more likely to engender positive attitude among students in chemistry than male teachers. Teacher qualification is not significant.

Discussion of Findings

Results in table 4.13 shows that in predicting students' high achievement in Chemistry, pattern of teacher-student classroom interaction (Integrative-Dominative) is significant. The Exp (B) shows that the odds of predicting students' high achievement increases by about 0.67 for every one unit increase in the pattern of PSI. The results show that when the teacher adopts the integrative method of teaching; students are more likely to have high achievement in chemistry. Teacher gender and teacher qualification are not significant. This finding supports the research of Igberadja (2016) which revealed that the teachers' gender and qualification do not have any significant effects on students' performance in vocational technical Education.

This result corroborates the research findings of Adegoke (2005) which showed that students in the integrative group had higher achievement score in mathematics than their colleagues in the dominative group. This is also in line with findings of Owodunni (2015) which revealed that classroom interaction patterns significantly influenced students' achievements in Basic Electricity. The significant effect of pattern of teacher-student classroom interaction is explicable considering that when students are given maximum opportunity to participate in teaching and learning processes in the classroom (students ask question, respond to teacher question, accepts and develop ideas suggested by students, praise and encourage students when need be), the student will be able to express their feelings, there will be better comprehension and understanding of the concept, a better student achievement will be enhanced. Furthermore the work of Ganyaupfu (2013) also pointed out that the best approach that facilitates learning is teacher-student interactive method. In Ganyanpfu study, results showed that, the mean scores results demonstrate that teacher-student interactive method was the most effective teaching method, followed by student-centered method while the teacher-centered approach was the least effective teaching method.

On positive attitude, results in table 13 shows that pattern of teacher-student classroom interaction (Integrative-Dominative) and gender are significant. The Exp

(B) shows that the odds of predicting students' high achievement increases by about 1.48 (48%) for every one unit increase in the pattern of TSCI and by about 1.31 (31%) for every one unit increase in teacher gender. From table 4.13, teacher qualification is not significant. These results show that when the pattern of teacher-students interaction is dominative, more students tend to have positive attitude to chemistry. This finding corroborates the research findings of Kalu (2015) which reported that a significantly positive relationship exists between interaction pattern and students' post-instructional attitude and low academic task achievement. The significant effect of pattern of teacher-students interaction is explicable considering that when teacher exhibit direct teacher behaviour (lectures, giving direction, giving feedback, criticizes student behaviour) and restrict student participation in classroom, students tend to comport themselves and listen more to teacher explaining to them and therefore exhibit a positive attitude to learning. Similarly the results show that female chemistry teachers are more likely to engender positive attitude among students in chemistry than male teachers. Teacher qualification is not significant.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter highlights the summary of findings, conclusion, implications of the findings, recommendations based on the findings and suggestions for further studies.

5.1 Summary of Findings

The major findings of the study are summarized follows:

1. Lecture was the dominant feature among teacher-talk category.
2. Students' response to teachers' questions was dominant feature among student-talk category.
3. Teachers giving direction through non-verbal gestures was dominant feature among silence category.
4. There was no statistically significant difference between male and female chemistry teachers teaching styles.
5. Although female chemistry teachers, on the average, gave more opportunities for students to participate in the lesson than male teachers, the mean difference was not statistically significant.
6. Under silence category, male chemistry teachers used more time for silent activities than female chemistry teachers. The difference was statistically significant.
7. There was no statistically significant difference among the teachers with different qualifications under teacher praise & encouragement,clarification and development of ideas suggested by students, teacher answers students' questions,teacher lecturesand teacher gives feedback.
8. Significant differencesexisted in the mean scores among the teacher with different qualifications under teacher ask questions, teacher gives direction and teacher justifies authority.
9. There was no significant group difference along teacher gender when interaction patterns of teacher-student interactions were dichotomized into dominative and integrative.
10. There was no significant group difference along teacher qualification when interaction patterns of teacher-student interactions were dichotomized into dominative and integrative.

11. Teacher-centred activity was the dominant feature among verbal and non verbal teacher-student interactions.
12. Pattern of classroom interaction did not predict student high achievement in chemistry.
13. Pattern of classroom interaction did not predict student positive attitude to learning chemistry.
14. Most teachers did not make use of real life object to explain concepts.
15. The chemistry lessons were organized in such a way that they did not allow much of student-student classroom interaction as teacher did not assign group work to students.
16. Students did not use the learning materials to a greater extent. Only few cases were recorded.
17. The teacher engaged the students less to carry out learning activities during the chemistry lesson.
18. Irrelevant behaviours such as noise making, class disorganized, teacher receiving calls during lessons, students pressing phone during lesson characterized some chemistry lessons.

5.2 Conclusion

This study investigated teacher-student classroom interaction and students' learning outcomes in chemistry. It also investigated the average threshold time required by chemistry teacher to show his typical classroom interaction pattern. Based on the result, greater percentage of lesson periods were dominated by lecture method. Most of the teachers adopted dominative style of teaching. There was no statistically significant difference in the pattern of teacher-student interaction between male and female teachers. Teacher gender did not significantly predict whether a teacher was dominative or integrative in their method of instruction delivery. Learning and achievement could improve if teachers employ integrative style of teaching, make use of appropriate instructional materials to deliver instruction and design the class such that it allows interactions between student and fellow student as well as allow interaction between students and instructional materials. Some of the chemistry teachers did not adequately prepare for their weekly lessons in terms of readiness of instructional materials especially real life objects which can make learning concrete and meaningful to students.

5.3 Implication of Findings

The findings of this study have implications for chemistry students, chemistry teachers, school administrators, school supervisors, curriculum planners and the government.

Chemistry Students

Findings revealed that student were not given the opportunity to participate actively in the class.It implies that students' level of mastery was low. The finding also showed that student-student interaction during chemistry lesson was very low. This implies, that students experience low level of peer participation, team spirit and were unable to solve class problem in a group. The finding further revealed that students' usage of instructional materials was low. This implies that learning may be through memorization and rote. When students do not ask questions during the lesson, teacher will not be able to ascertain whether what is being taught is understood by the students. When students are passive during learning process, it does not facilitate learning. Students who could have make contribution during lesson were not allowed because of the approach, style and order in which instructional delivery was designed by the teacher. It implies that students are not able to put into use the critical thinking ability in them, which can facilitate instruction retention in student.

This situation where students are not allowed to take active role during lesson, it has serious implication on our education system in Nigeria. It implies that student will continue to depend largely on what teacher is bringing to class to read or copy for them, students would not be able to adapt to changes in the way public examinations questions are being set, and not being able to reason quickly during examination especially when the usual way their school (internal) teacher use to set exam changes. Moreover, individual differences in students are not taken into consideration, only fast learners who could comprehend at teacher pace would be carried along. There is no room for teach and re-teach, mastery learning could not be attained.

Interpersonal relations are not being developed in each student when not allowed to discuss or solve problem as a group.

Chemistry Teachers

Lectures dominated under teacher-talk. It implies that students were not given opportunity to talk during chemistry lesson.Teachers talked continuously during chemistry lesson. Both male and female teachers were dominative in their approach to teaching chemistry.Students were only at the receiving end. Ideas and suggestions from students were not welcomed. The findings revealed that teachers did not praise or positively reinforce students. It implies that students lacked motivation which can further enhance their performance. Teachers' level of instructional materials usage was very low. It then means that teachers did not prepare teaching aids before coming to class or lacked the knowledge of appropriate selection of instructional materials.

When teachers don't teach some topics with adequate teaching materials, it implies that some teachers don't have the knowledge of the right choice of materials to use;teachers may not have adequate content mastery. It also implies that some teachers don't know how to improvise using some locally available materials.

School administrators

Based on the findings of the study, it implies that school administrators have not been monitoring the teachers to know the methods they adopt in teaching. School administrators did not take note if teachers go to class with instructional materials or not. Schools principals are not aware of the methods being used by the teachers in delivering chemistry instruction.It implies some principals are not aware that chemistry teachers did not teach with teaching aids.

School Supervisor

Lecture was the dominant feature among male and female chemistry teachers even from first ten minutes to the last ten minutes. Teachers did not instructional materials in teaching chemistry. It implies that school supervisors are still lacking in their supervisory roles to schools. They did not visit schools regularly and reduce the rate at which lesson note is being checked.

Curriculum Planners

Strategies which will discourage the teachers from dominating the lesson or using dominating style should be included in the curriculum. The curriculum should be

designed in way that there will be a period during the lesson when students could interact with other students and with the instructional materials.

Government

Based on the findings, most teachers still use lecture method to deliver instruction which does not help the students to maximize their learning opportunities. It means the government should ensure that teacher should go for training where teachers could learn about modern student centred method of teaching such that student ideas and suggestion are encouraged and used by the teachers during lesson. This will make the students to participate next class. Government should insist that school supervisors should observe teachers in their classrooms while teaching and submit a periodic report to government on how teacher deliver instruction in the classroom.Government policy will shift towards adjusting school curriculum to specifically incorporate the issue of time period expected each part of instruction component ranging from introduction, lesson presentation, evaluation, assignment and also put a measure in place to monitor level of teacher adherence to government policy on lesson instructional component time allocation.

5.4 Recommendations

Based on the findings of the study, the following recommendations were made:

1. Chemistry students should endeavour to participate during chemistry lessons by asking questions based on the topic and even suggesting their own ideas to teachers to make use of.
2. Chemistry teachers should try to device and use teaching methods that facilitate learning by involving student at every stage of the teaching process.
3. Chemistry teachers should engage students to carry out some task that can facilitate learning among themselves while teaching process is going on.
4. Chemistry teachers should improvise and use some learning materials that is relevant to the topic being taught during the chemistry lessons.
5. Chemistry teachers should reduce amount of time spent on distractions such as receiving calls or greeting visitors during the teaching and learning session.
6. Chemistry teachers should design their lessons such that it accommodates student-student interaction and student-materials interaction.

7. Chemistry teachers should reduce the amount of time spent on lectures to allow more of student-talk.
8. School administrators should pay special attention to what happens in the class by observing both teacher and students while chemistry lesson is going on so as to know what is being done rightly and where teacher needs to improve.
9. School supervisors should try to intensify efforts by coming to schools regularly and entering the class to see what is going on and how teaching is done.
10. Curriculum planners should include aspect of student-student activity and student-material activity during chemistry lesson.
11. Teachers should further exercise full control over their lessons.
12. Teachers should have pre-planned class activities before going to class to teach.

5.5 Limitations

The results of the study were subject to the following limitations:

It was earlier planned to visit 40 schools, however as a result of cash crunch, only 18 schools were actually observed. Some chemistry teachers have not adequately covered the previous lessons and so were not at the same level with the 18 schools visited. In most of the schools male chemistry teachers were available.

5.6 Suggestions for Further Research

The following areas are suggested for further research:

1. A similar study can be carried out using other arms of senior secondary schools.
2. A similar study can be carried out which will involve observation of chemistry practical classes.
3. A similar study that involve school type (private and public schools) and school location (rural schools and urban schools) can be also be conducted.
4. To explain the teacher-student interaction, the lesson duration can be further broken into segments of every 5 minutes which will give eight segments.

5. This study can be replicated in other senior secondary school subjects such as Mathematics, Geography and Physics.

5.7 Contributions to Knowledge

Available literature has shown that not much work has been done on threshold time of teachers during teaching and learning process. Not many studies by way of observation had reported on how, when and what happens in chemistry classroom especially by dividing the learning time into four segment to know what the teacher and students are really doing as the lesson time progresses. This present study had contributed to knowledge by giving a vivid, valid and comprehensive analysis in sequential order of what happens in typical chemistry class in Oyo state within the first ten minutes when the lesson commences, second ten minutes, third ten minutes and last ten minutes of the lesson.

It appears most of the previous studies on classroom interaction examined the effect of teacher demographic such as teacher gender, teacher qualification and teacher experience on student achievement. Other past studies assessed the effect pattern of student – teacher interaction on student achievements. This present study contributed to the body of knowledge in the sense that it assessed the individual and combined effect of teacher demographics such as teacher gender, teacher qualification and teacher experience and pattern of teacher-student interaction on student achievement and attitude.

REFERENCES

Abechuala, C.M.L. 2009.An integrated Approach to learning, Teaching and Assessment. Professional Development service for Teachers (PDST).

Abuseji, F.A., 2007. Student and teacher related variables as determinants of secondary school students' academic achievement in chemistry. *Journal Pendidikan, 32: 3-18.*

Adams, N.B. 2002. Educational computing concerns of postsecondary faculty.*Research on Technology in Education, vol. 34, no. 3, pp. 285-303.*

Adams, R. and Biddle, B. 1970. Realities of Teaching: Explorations with video Tape. New York: Holt Rinehart and Winston

Adegoke, B.A 2003.Teacher influence as a determinant of dependent prone students' learning outcomes in senior secondary school geometry in Ibadan south-east Nigeria. An unpublished doctoral thesis, university of Ibadan, Ibadan,

Adegoke, B.A 2007.Patterns of Teacher-Pupils interaction in the Classroom and Learning Outcomes in Primary Science.*West African Journal of Education (WAJE), vol. XXVII.Pp 124 – 134*

Adekola, B.O. 2006. Influence of Teachers qualification, age and gender on Effective teaching of English language. J.Educ.Focus, 6: 97-99

Adeola, L. K. 2011. An assessment of the teaching effectiveness of prevocational subjects teachers in Ogun State. *International Journal of Vocational and Technical Education.* 3(1), 5-8. Retrieved March 17,2010 from at http://www.academicjournals.org/IJVTE

Adetayo, J. O. 2008. A Survey of Teaching Effectiveness and Attitudes of Business Studies Teachers.*International Journal of Labour Education.* Trade Unionism, 3:2

Aggarwal, J.C. 2006. Essentials of educational technology: teaching-learning innovation of education. Delhi: Vikas Publishing House PVT Ltd

Ajayi, K. 1987. Job Satisfaction among Secondary School Teachers in Nigeria.*African Journal of Educational Research.Vol.3 (112) p.98-99.*

Ajibola, M.A. 2008. Innovations and Curriculum Development for Basic Education in Nigeria.

Akinsolu, A.O. 2010. Teachers and Students' Academic Performance in Nigerian Secondary Schools: Implications for Planning National Institute for Educational Planning and Administration Nigeria, West Africa. *Florida Journal of Educational Administration and Policy, 3:2*

Akinsola.O.S. 2000.A Causal Model of Personal Factors and Threshold Time for Classroom Interaction Pattern of Mathematics Teacher Trainees in Two Nigerian States.Unpublished Ph.D Thesis, University of Ibadan.

Akinsola, O.S. and Okpala P.N. 2001. A Survey of Threshold Time for classroom interaction Patterns of Mathematics Teacher Trainees in Two Nigerian States. *A journal of the international centre for Educational Evaluation (ICEE), Institute of Education, University of Ibadan, and The Nigeria Association of Programme Evaluators (NAPE), Vol 1 No1. Pp 23-29*

Akuma, N. 2005. Effects of guided discovery method on senior secondary school students achievement in mapwork. The journal of world council of curriculum and instruction Nigeria chapter 5 (2), 185-194

Allwright, R.L. 2001.The importance of interaction in classroom language learning. Applied linguistics, 5(2), 156-171

Amidon E. and N. Flanders. 1967. Interaction Analysis as a Feedback System. *Theory: Research, and Application.* Addison-Wesley Reading, MA, USA Pp.121-140.

Amidon, E. and J. Hough. 1970 Interaction Analysis: *Theory, Research, and Application*. Addison-Addison-wesley. Reading, MA: USA P 52.

Anderson, H.H. 1939. The measurement of domination and socially integrative behaviour in contacts with children, child development, 10,73 - 89

Anderson, H.H. and Brewer J.E. 1946: Studies of teacher classroom personalities, I. Effect of Teacher Dominative and Integrative Contact on Children's Classroom Behaviour Applied Psychology Monography No 6.

Anderson, J.R., andSchunn, C.D. 2000. Implication of the ACT-R learning theory: No magic bullets. In R. Glaser (Ed). Advances in Instructional Psychology: Educational design and cognitive science.Mahwah Lawrence Erlbaum Associates Publishers.

Andrews, L.J. 2004. Teacher Certification, Teaching style, And Student Achievement In Arizona Chapter Schools. Unpublished PhD Thesis, Liberty University Lynchburg, VA. Retrieved from http://digitalcommons.liberty.edu/cgi/viewcontent.cgi?article=1197 and context=doctoral

Audu, T. A., and Achor, E. E. 2003.The role of questioning and wait-time interactional processes in science teaching and learning.*Journal of Science and Vocational Education, 2(2):53-56.*

Bales, R.F. 1950. Interaction process Analysis: A method for the study of small Groups. Cambridge, Mass: Addison-wesley.

Berliner, D. 1990. Whats all the fuss about instructional time?In Ben-Peretz & R.Bromme (Eds). The nature of time in schools: Theoretical Concepts, practitioner perceptions. New York: Teacher college Press. Retrieved April 2005, from http://courses.ed.asu.edu./berliner/reading/fuss/fuss.htm

Boyle, G.J; Borg, M.G, Falzon, J.M. & Bablioni, A.J. 1995.A structural model of the dimensions of teacher stress.*British Journal of Educational Psychology, 65, 49-67*

Brewer, B.W. 1994. Review and Critique of models of psychological adjustment to athletic injury. Journal of Applied sport psycho, 6, pp 87-100

Brewer, D.J. 2000. High school Teacher Certification and students achievement. Educ. Eval. Policy Anal, 22: 129-145

Brophy, J.E. and Good, T.L. 1970. Teachers' communication of differential expectations for children's classroom performance. Journal of Educational Psychology, 61: 365-374

Burkhart, R. (ed) 1969. The assessment Revolution: New viewpoints for teacher Evaluation. Buffalo, New York: New York State Education Department and Buffalo State University College.

Childolue, M. E. 1996. The relationship between teacher characteristics, learning environment and student achievement and attitude. ERIC, 97 - 1

Clotfelter, C.L., Ladd, H.F., and Viglor, J.L. 2007. "Teacher Credentials and Student Achievement: Longitudinal Analysis with Student Fixed Effects" *Economics of Education Review, 26. 6 : 263-82*

Cooper, J., and Robinson.P. 2000. Getting started: Informal small- Group strategies in large classess: In Macgregor, T.J., Cooper,K.T., Smith& Robinson P. (Ed), Strategies for Energizing large classes: from Small Groups to learning Communities; New Directions for Teaching and Learning, 81 Spring, 17-24

Darling, A.L. and Civikly, J.M. 1987. The effect of Teacher humor on students perceptions of classroom communicative climate. Journal of classroom interaction. 22, (1), 24 -30

Darling-Hammond, L. 2005.Preparing Teachers for a changing World: What Teachers should learn and be able to do. San Francisco:Josey-Bass.

Davis, H. A. 2003. Conceptualizing the role and influence of student-teacher relationships on children's social and cognitive development (pp. 207-234).N.p.:Educational Psychologist.

Dee, T.S. 2006. "A Teacher like Me".Does Race Ethnicity or Gender Matter?"*Understanding Teacher Quality, 95(2): pp 158-165.*

Demerouti,M., Kousathana,M. and Tsarpalis ,G. 2004. Acid-baseequilibra part 1: Upper secondary students' misconceptions and difficulties. *The Chemical Educator*.9: 122-131.

Demircioglu, G. 2005. Conceptual change achieved through a new teaching program on acids and bases. *Chemistry Education Research and Practice*.6: 36-51.

De Jong, R.J., Van Tartwijk, J., Verloop, N., Veldman, I. and Wubbels, T. 2012. Teachers Expectations of teacher-student interaction: Complementary and distinctive expectatancy patterns, teaching and teacher education. 28, 948-956. http://dx.doi.org/10.1016/j.tate.2012

Duffy, J., Warren, K., and Walsh, M. 2001. Classroom interactions: gender of teacher, gender of student, and classroom subject-Statistical Data included. Sex Roles: A journal of Research.Downloaded from the internet www.findarticles.com/p/articles.

Dunkin, M.J. , and Biddle, B.J. 1974. The study of teaching. New York: Holt Reinhart Winston

Eggen, P. and Kauchak, D. 2001. Educational Psychology: Windows on classrooms. New Jersey Prentice Hall, Inc

Evertson, C.M. and Weinstein, C.S. (Eds). 2006. Handbook of classroom management: Research practice and contemporary issues, manwah, NJ: Lawrence Erlbaum Associates.

Fajemidagba, O. 1986.A Study of Mathematics Components of the Mathematics Teacher Education Programmes in Nigeria Universities.*Ilorin Journal of Education. Vol.7 pp 70-77*

Fazio, R.H. and Roskes, D. 1994. Acting as we feel: when and how attitudes guide Behaviour. In S. shavitt & T.C. Brck (Eds.).Persuasion. Boston: Allyn & Bacon

Federal Republic of Nigeria. 2004. National Policy on Education (Revised): Lagos: NERDC.

Ferguson, R. and Ladd, H. 1996. How and why money matters: an analysis of Alabama schools in H. Ladd(Ed). Holding schools accountable: Performance based reform in education, 265-298. Washington, DC, Brookings institute.

Finn, J.D., Pannozzo, G.M. and Voelkl, K.E. 1995. Disruptive and inattentive-withdrawn behaviour and achievement among fourth graders.The Elementary school Journal, 95, 421-434.

Flander, N. 1970.Analyzing Teacher Behavior.Addison-Wesley. Reading, Mass: P.171

Federal Republic of Nigeria. 2004. National Policy on Education. Lagos. Nigeria: NERDC

Friedman, H.J., Huzinec, C. and Templeton, S.M. 2009. Classroom management. A pathway to students achievement. Elementary school Journal, 110 (1), 64-80

Friedman, I.A. 2006. Classroom Management and Teacher stress and Burnout. In C.M. Evertson & C.S. Weinstein (Eds). Handbook of classroom management: Research, practice and contemporary issues (pp 925- 944). Mahwah, NJ: Erlbaum

Ganyaupfu, E.M. 2016. Teaching Methods and Students Academic performance.*International Journal of Humanities and Social Science invention. Vol. 2, issue 9, pp29 -35*

Glasser, W. 1998. The quality School: Managing Students without Coercion. New York: Harper Collins (original work published 1992)

Goldhaber, D.D. and Brewer, D.J. 2000. Does Teacher Certification Matter? High school Teacher Certification status and student Achievement.A journal of American Educational Research Association. Vol 22, No 2, pp 129-145

Gongden, J.J., Gongden, E.J. and Lohdip, Y.N. 2011.Assessment of the Difficult Areas of the senior secondary school 2 (Two) chemistry syllabus of the Nigeria Science Curriculum. African Journal of chemical Education. Vol 1: No1 pp 48 - 61

Gwinbi, E. and Monk, M. 2002. A Study of the Association Between Classroom Practice and Philosophy of Science Amongst A-level Biology Teachers in Harare, Zimbabwe. African Journal of Research in Mathematics Science and Technology Education.

Honby, A.S. 2001.Oxford Advanced learners Dictionary of Current English. (6thed). Oxford university Press.

Igberadja S. 2016. Effects of Teachers gender and qualification on students performance in vocational technical education. *Journal of Technical Education and Training (JTET).Vol 8 No 1.*

Inamullah, M. 2005. Patterns of classroom interaction at different educational levels in the light of Flander's Interaction.Unpublished Ph.D Thesis.Nsukka: University of Nigeria.

Isiugo-Abanihe, I.M., & Longjohn, I.T 2005. An observational study of classrooms of science student teachers in Port Harcourt, Nigeria.*West Africa Journal of Education, XXV*, 161-176

Isore, M. 2009. Teacher Evaluation: Current Practices in OECD Countries and a literature Review. OECD Education Working paper No 23, OECD, Paris. Available from www.oecd.org/edu/working papers

Jackson, P. and Wolfson, B. 1968.Varieties of constraint in a nursery school. Young Children, 23: 358-367

Jaja, O.P. 2002. Assessment of Biology study support environment in our Schools. *43*annual conference Proceedings of science Teachers' Association of Nigeria.

Jayne, C.D. 1945. A study of the Relationship between Teacher procedures and Educational outcomes.Journal of Experimental Education. 14, 101 -134

Jennings, P.A. and Greenberg, M.T. 2009. The prosocial classroom: Teacher social and emotional competence in relation to student and classroom outcomes. Review of Educational Research, 79, 491-525

Johnstone, A.H. 2000. Teaching of Chemistry: Logical or Psychological? Chemical Education: Research and Practice in Europe. 1(1), 5-15.

Joshua, M.T., Ekanem, J.O., & Agborbechem, P.T. 2005. Assessment of professional roles performance of mathematics teachers in Nigeria.

Kalu, A. 2015.Classroom interaction Patterns Teacher and students characteristics and students' learning outcome in Physics.*Journal of classroom interaction, 39(2): 24-31*

Kaplan, K. 2010. *Female Teacher May Pass on Mathematics Anxiety to Girls, Study Finds.*Los Angeles Times. January, 26.

Kay, R. 2006. Addressing gender differences in computer ability, attitudes and use: The laptop effect.*Journal of Educational Computing Research, vol. 34, no. 2, pp. 187-211.*

King, A. and Rosenshine, B. 1993.Effects of guided cooperative- questioning on childrens knowledge construction. Journal of Experimental Education, 6, 127 – 148.

Kohn, A. 2006.Beyond discipline from compliance to community. Alexandria: Virginia: Association for Supervision and Curriculum Development.

Koplow, L. 2002. *Creating schools that heal*. New York: Teachers College Press.

Krat, K.B.andKratcoski, A. 2004. Teacher-student interactions in a ubiquitous computing environment learning within dyads & triads of interactions. *Journal of the Research Centre for Educational Technology. 1:306-410*

Lawani, A.O. Ifamuyiwa, S.A 2008. Interaction patterns in mathematics classroom in Ogun State secondary schools. *Academic Leadership online Journal Vol.6 issue 3*.

Legewie, J. and DiPrete, T.A. 2012.School context and the gender gap in educational achievement. American sociological review, 77(3), 463 - 485

Liu, J., and Elicker, J. 2005. Teacher-child interaction in Chinese kindergartens: An observational analysis.*International Journal of Early Years Education, 13(2), 129-143.*

Mack, K. 2010. Study: *Female Teachers Mathematics Anxiety Affects Girl Students.* Chicago Tribune, January, 25.

Marsh, J. 2004. The Techno-Literacy Practices of Young Children.Journal of Early childhood Research. Vol. 2, issue 1, pp 51-66

Matelo, A. 2006.Describing classroom interaction.Retrieved online.File://c:/document%20 and 20% setting/Administration my %20 Document/untitled tttm 20th Dec, 2017

McKinney, J.D., Mason, J., Perkerson, K. and Clifford, M. 1975. Relationship between classroom behaviour and academic achievement.Journal of Educational Psychology, 67 (2), 198 -203.

Mefun, F.E. 2018.Evaluation of implementation of new senior secondary school mathematics Curriculum in Ondo State, Nigeria.An Unpublished Ph.D thesis.University of Ibadan.

Meyer, J. H. F. and Land, R. 2005. Threshold concepts and troublesome knowledge (2):
Epistemological considerations and a conceptual framework for teaching and learning.*HigherEducation, 49*, 373-388

Myers, S. B., Sweeney, A.C., Popick, V., Wesley, K., Bordfeld, A. and Fingerhut R. 2012. Self-Care Practice and perceived stress levels Among Psychology Graduate students: Journal Of Training and Education in Professional Psychology 6(1), 55-66.

Nielson, K. A., andLorber, W. 2009.*Enhanced post-learning memory consolidation is influenced by arousal predisposition and emotion regulation but not by stimulus valence or arousal* (pp. 70-79). N.p.: Neurobiology of Learning & Memory, 92.Retrieved March 1, 2015

Obanya, P.A.I. 2004. Educating for the knowledge Economy. Mosuro Publishers, Ibadan , Nigeria.

Obioha, P.O. 2005. Maintaining peace and harmony through classroom *Organization and Management, Journal of Women in college of education. 9:256-257.*

Obioma, G.O. 2013. Overview and Philosophy of the New Senior Secondary Education Curriculum Structure, Implementation Strategies and Opportunities. A paper presented at the 4-day Capacity Building Workshop for Principals and Teachers on the new curriculum organized by the Ebonyi State Secondary Education Board, Abakaliki. 4th – 7th November.

Obodo, G. C. 2004. Generating students' interest in mathematics. A paper presented on the NMC/PTDF workshop for secondary school teachers from 8th – 14th February at Akwa, Anambra state held at Igwebuike grammar school.

Odinko M.N 2014:*Evaluation Research, theory and Practice*. (pp11,53). Giraffe books. Ibadan. Nigeria

Odinko M.N and Williams J. 2006.Language of instruction and interaction patterns in Pre-primary classrooms in Nigeria.*Journal of classroom interactions Vol. 41 No 1 pp 22-32*

Ogunyinka, E.K, Okeke, T.I. and Adedoyin, R.C. 2015. Teacher Education and Development in Nigeria: An Analysis of Reforms, Challenges and Prospects. *Education Journal. Vol.3 pp 111-122*

Okafor, L.C. 2000. Analysis of classroom interaction patterns in Biology In secondary schools in Anambra state. *Unpublished Ph.D, Thesis*, University of Nigeria Nsukka.

Okoli J.N. 2006.Effects of Investigative Laboratory Approach and Expository Method on Acquisition of Science Process Skills by Biology Students of different levels of Scientific *Literacy.Journal of Science Teachers Association of Nigeria. 41(2): 79-88*

Okoruwa, T. O. 1999. The Effect of Some Teachers' Characteristics on Pupils' Performance in Primary Science.Unpublished M. Ed Project.University of Ibadan.

Okoye, N.S. 2009. The effect of gender, socio-economic status and school location on students' performance in Nigeria Integrated Science. *Journal of Science Education. Vol.2: 23-34.*

Okoye, P.O. 2011. Influence of classroom interaction patterns and students cognitive styles on achievement in Biology in senior secondary schools in Anambra state. Unpublished PhD thesis report: University of Nigeria. Nsukka.

Okoye, P. and Onwuachu, W.C. 2018. Influence of Classroom Interaction Patterns on Achievement in Biology Among Senior Secondary School Students. *International Journal of Science and Technology .BuhirDar-Ethiopia.Vol 7(1). No15. 72-80*

Okpala,P.N and Onocha, C.O. 1988.: Classroom interaction patterns: Nigerian physics Trainees Physics Education.*A Journal of the British institute of physics vol.23, no.5, pp. 288-290*

Okwilagwe E.A.2011.*Teaching and Learning Secondary School Geography in Nigeria*.Stirling – Horden Publishers Ltd

Okwilagwe, E.A. 2002.Patterns of undergraduate attitude to academic work. Ibadan. *Journal of Educational Studies, 2(2), 551-*

Olatoye R. and Ogunkola B.J. 2008. Parental Involvement Interest in Schooling and Academic Achievement of Junior Secondary School Students in Ogun State, Nigeria.*College of Teaching Methods and Styles Journals 4.10: 33-39.*Available at www.Chiteinstitute.com

Olatoye, R.A. 2006. Science teacher effectiveness as a predictor of students performance in the senior secondary school certificate examination. Journal of Educational Studies, (6), 104 - 110

Onimisi, J.A.2006. Impact of type of Teacher Training on students Achievement and attitude towards integrated science in Kogi state.Unpublished PhD Thesis University of Nigeria, Nsukka.

Opara, M.F. 2004. Breaking Gender Barriers through Instructional Process.Journal of science Teachers Association of Nigeria.Gender STM Education. Series no 1

Orosan, P.G. 1992. Gender Differences in Academic and Social Behaviour of Elementary school Transfer students. Psychology in the school.29 (4).

Osafehinti, I.O. 1995. Sex related differences in mathematics secondary school. ABACUS, *Journal of Mathematics Association of Nigeria, 8(1), 82-87*

Owoeye, J.S. 2002.The effect of Integration of Location, Facilities and Class Size on Academic Achievement of Secondary Student' in Ekiti State, Nigeria.An Unpublished PhD. Thesis, University of Ibadan, Ibadan.

Owodunni A.S. 2015. Influence of Classroom Interaction Patterns on Student Achievement in Basic Electricityat Technical Colleges in Federal Capital Territory, Abuja. A paper presented at the international Conference on 21st Century Education at HCT Dubai Men's College, UAE. November 2015, Vol. 7, No 1. pp 144-153. ISSN: 2330-1236.

Owolabi, O.T. and Adebayo, J.O. 2012. Effect of Teacher's Qualification on the Performance of Senior Secondary School Physics.English Language Teaching, 5.6: 72- 77.Retrieved from www. Ccsenet.org/journal/ir

Pianta, R. C. 1999. *Enhancing relationships between children and teachers*. Washington, DC: American Psychological Association.

Pianta, R., La Paro, K.M. & Hamre, B.K. 2008. Classroom assessment scoring system manual: K-3. Baltimore, M.D: Brookes Publishing

Pieron, M. and Haan, J.M. 1980. Pupils Activities, Time on Task and Behaviour in High school physical Education Teaching. In FIEP Bulletin, 50 (3/4), 1980, 62-68

Rashidi, N. & Naderi, S. 2012. The Effect of Gender on the Patterns of Classroom Interaction.*Journal of scientific and Academic Publishing 2(3): 30 – 36*.

Reap, M.A. and Cavello, A.L. 1992. Students Meaningful understanding of science concepts: Gender differences. A paper presented at the annual conference of the national association for Research in science Teaching. Boston.

Rivers, W.M. 1987. Interaction as the Key to teaching language for communication. In a Wilga M. Rivers(ed) interactive language teaching, Cambridge University Press NY

Roorda, D.L., Koomen, H.M.Y., Spilt, J.L and Oort, F.J. 2011. The influence of Affective Teacher-student Relationships on students school Engagement and Achievement: A meta- Analytic Approach. A journal of American Educational Research Association. Vol 81, issue 4, pp. 493-529

Rosenberg, C. R., and Silva, M. L. 2009..Teacher-children interaction and concept development in kindergarten.*Discourse Processes, 46*, 572-591.

Rutherford, F.J. 1998. Reflecting on Sputnik: Linking the past, Present and Future of Educational Reform. A symposium hosted by the centre for science, mathematics and Engineering Education.

Saddler, R.E. 2001.Promoting discourse and argumentation in science teacher education. Journal of science Teacher Education 17, 323-346

Schwab, J. 1983. The practical 4: Something for Curriculum Professors to do. Curriculum Inquiry, 13 (3), 239-265

Shulman, L. and Shulman, J. 2004. How and what teachers learn: A Shifting perspective. Journal of Curriculum studies. 36 (2), 257-271

Skinner, B.F. 1960. The Technology of Teaching. New York: Appleton-century-crofts.

Siedentop, D.,Birdwell, D. and Metzler, M. 1979. A process approach to measuring teacher effectiveness in physical education. Paper presented at the annual conference of the American Alliance for Health, physical education, recreation and dance, New Orleans.(Not published)

Silvia, P. I. 2006. Exploring the Psychology of Interest. Retrieved October 1, 2014 from http://psycnet.apa.org/psycinfo/2006-03939-000

Simbo, T.C. 2003.Attitudes of Teacher towards teaching as a profession. Niger.J.Educ. Res. 1 (3)

Smith, K.L., 2000. 'Going Deeper; Formal Small-Group Learning in large Classes'. In J. MacGregor, J.L. Cooper, K.L. Smith & Robinson classes: From small Groups to learning communities New Directions for teaching and learning. 81, spring, 25-46

Stigler, O.S. and Hiebert, A. 2007. Students Evaluation of teaching effectiveness: A structural modeling approach. Journal of Educational Psychology, (68), 20-30

Stronge, J.H. 2002. Qualities of Effective Teachers(pp144). Association for supervision and Curriculum Development. Alexandria,VA

Thomas, S.D. 2005. *How a teacher gender affects boys and girls.* Pacific Research Institute. to Effective Teaching of Soil types and water holding effects of Soil on

Travers, C.J., and Cooper, C.L. 1996. Teachers under pressure: stress in the teaching profession. London: Routledge.

Treagust, D.F. and Chandrasegaran, A.F. 2009. The Efficacy of an Alternative Instructional Programme designed to enhance secondary students competence in the Triplet Relationship. In Gilbert, J.K. and Treagust, D.F. (eds.), Multiple representations in chemical education (pp. 151-168). Dordrecht, The Netherlands: Springer.

Turner, J.C., Midgley, C.,Meyer, D.K., Gheen, M., Anderman, E.M., Kang, Y., Patrick, H. (2002). The classroom environment and students' report of avoidance strategies in mathematics: A multi method study. *Journal of Educational Psychology, 94 (1). 88-106*

UNESCO, 2007. Evaluacion del Desempeno y carrera professional Docente: Una panoramic de America y Europa, Oficina Regional de Educacion para America Latina y el caribe, UNESCO Santiago, 2007

Upahi, J.E. 2015.Attitude and Ability of Undergraduate Chemistry Students in South-west Nigeria to open-ended Problem-solving. An unpublished Ph.D Thesis submitted to the University of Ilorin, Nigeria.

Uzoechi, B.C. 2008. Determinants of students Questioning, Attitudes in Science lesson.Unpublished PhD Thesis university of Nigeria, Nsukka.

Viiri, J. andSaari, H. 2006. Teacher talk patterns in science lessons: Use in 1 ea<-her Education. *Journal of Science Teacher Education. 17:347-365*

Walker, J.M.T. 2009. Authoritative classroom management: how control and nurturance work together. Theory into practice, 48, 122-129.http://dx.doi.org/10.1016./jtate. 2012-01.011

Watson, R.S. 1986. The named and the nameless: gender and person in Chinese society. *Journal of American Anthropological Association. Vol 13 No 4, pp 619-631*

Wayne, A.J. and Youngs, P. 2003. Teacher characteristics and students achievement Gains: A review. Journal of American Educational Research Association.Vol 73, No 1. Pp 89-122

Wei, M. Den Brok. P. and Zhou, Y. 2009. Teacher interpersonal behaviour and student achievement in English as a foreign Language classroom in China.Learning Environments Research. 12, 157-174. http: // dx.doi.org/10.1007/s.

Wentzel, K. 1998. Social relationships and motivation in middle school: the role of parents, teachers and peers. Journal of Educational Psychology, 90 (2), 202-209.

……., 2012. Teacher-student relationships and adolescent competence at school. In T. Wubbels P.DenBrok, J. van Tartwijk & J.levy (Eds). Interpersonal relationship in Education: An Overview of comtemporary research (pp19-36). Rotterdam. The Netherlands: sense publications

Wozney, L., Venkatesh V. and Abrami, P. 2006. Implementing Computer technologies: Teachers perceptions and practices.Journal of Technology and Teacher Education.Vol 14, No 1.

Wubbels, T., Creton, H.A. and Hooymayers, H.P. 1985. Discipline problems of beginning teachers, international teacher behaviour mapped out. Abstracted in Resources in Education, 20, 12 p. 153. ERIC document 260040

Yara, P.O. and Otieno, K.O. 2010. Teaching/Learning Resources and Academic Performance in Mathematics in Secondary Schools in Bende District of Kenya, Asian Social Science, 6 (12), pp 126-132

Yara, P. 2009. Students attitude towards Mathematics and academic achievement in some selected secondary schools in Southwestern Nigeria.

Yukselturk, E. and Bulut, S. 2009. Gender Differences in self-Regulated Online Learning Environment.*Journal of Educational Technology and Society, Vol. 12, 12-22*

APPENDIX I

International centre for Educational Evaluation, University of Ibadan, Ibadan.

MODIFIED FLANDERS 16 CATEGORY INTERACTION SYSTEM (MFCIS)

Section A

Date_____ School No_____ Subject Taught _____Class _____ Teacher Gender_____
Time Start _____ Time Stop_____
School Location _____ School Type_____ No. of students_____Teacher's Qualification B.Ed Chem( ), B.Sc Chem ( ), Others ( )Teaching Experience 1 – 5 ( ), 6-10 ( )

Section B

A. Teacher- Talk																													
1. Praise and encouragement																													
2. Clarification and development of ideas suggested by students																													
3. Ask questions																													
4. Answers student's questions																													
5. Lectures																													
6. Gives feedback																													
7. Gives directions																													
8. Justifies authority																													
B. Student Talk																													
9. Response																													
10. Emitted																													
11. Asks questions																													
C. Silence																													
12. Directed activity																													
13. Contemplation																													
14. Demonstration																													
15. Grading student work																													
D. Non functional																													
16. Irrelevant behavioure.g making noise, receiving calls																													

Instruction for the coding: Code the major occurring behavior in the column cells of only one main behavior category after each interval of 60 sec.

APPENDIX III

INTERNATIONAL CENTRE FOR EDUCATIONAL EVALUATION, INSTITUTE OF EDUCATION, UNIVERSITY OF IBADAN, IBADAN
CHEMISTRY ACHIEVEMENT TEST (CAT) SSS II

Name of School……
Name of student……
Student's Gender: Male ( ), Female ( ),
Instruction: answer all question Time Allowed: 1 hour

1. Given that $_{10}K$, $_{13}L$, $_{14}M$ and $_{18}N$ are elements of the periodic table, which of the elements belong to the same group? (A) K,M (B) K,N (C) L,M (D) L,N
2. In the periodic table, the position of an element is determined by its (A) atomic number (B) density (C) ionization energy (D) relative atomic mass.
3. Which of the following belongs to the alkali metal family? (A) Boron (B) Calcium (C) Chlorine (D) Sodium.
4. A reaction is endothermic if the (A) reaction vessel feels cool during the reaction (B) enthalpy change is negative (C) bond forming energy exceeds bond breaking energy. (D) Heat of formation of reactants exceeds heat of formation of products.
5. Consider the following equilibrium reaction: $2AB_2(g) + B_2(g) \leftrightarrow 2AB_3(g)$ $\Delta H = -XkJmol^{-1}$, the backward reaction will be favoured by (A) a decrease in pressure. (B) an increase in pressure (C) a decrease in temperature (D) an introduction of positive catalyst
6. The valence electrons of $_{12}Mg$ are in the (A) 3s orbital (B) $2p_x$ orbital (C) 2s orbital (D)1s orbital
7. Theposition of equilibrium in a reversible reaction is affected by (A) particle size of the reactants. (B) vigorous stirring of the reaction mixture. (C) presence of a catalyst (D) Change in the concentration of the reactants.
8. Which of the following statements about ionic radius is correct? Ionic radius (A) increases as nuclear charge increases (B) decreases as nuclear charge increases (C) decreases as nuclear charge decreases (D) remains constant as nuclear charge increases.
9. Which of the following electron configurations represents the transition element chromium ($_{24}Cr$)? (A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^4$ (B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$ (C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3d^4\ 4s^1$ (D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

10. Metalloids are also referred to as (A) semi-metals (B) metals (C) colloids (D) non-metals

11. What is the valence shell electron configuration of the element with atomic number 17? (A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ (B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ (C) $2s^2\ 2p^6$ (D) $3s^2\ 3p^5$

12. Which of the following periodic properties decreases down the group? (A) atomic radius (B) electron affinity (C) electronegativity (D) ionic radius

13. One of the main characteristic properties of transition metals is their ability to (A) ionize readily by electron loss (B) form basic oxides (C) react with water (D) exhibit variable oxidation states

14. The collision between gas molecules is perfectly elastic because (A) cohesive forces between the molecules are negligible (B) there is no loss of energy during collision (C) they are highly compressible (D) they move randomly in straight lines

15. The similarity between combustion and neutralization reactions is that they are (A) endothermic (B) exothermic (C) oxidation processes (D) reduction processes

16. When an ionic solid dissolves in water, the water molecules split the crystals into free ions. The energy required for this process is (A) kinetic energy (B) potential energy (C). hydration energy (D) lattice energy

17. An element Y has the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^4$. To what period does it belong in the periodic table? (A) 3 (B) 4 (C) 5 (D) 6

18. What will happen if more heat is applied to the following system at equilibrium? $X_2(g) + 3Y_2(g) \leftrightarrow 2XY_3(g)$; $\Delta H = -xkJmol\text{-}1$ (A) the yield of XY_3 will increase (B) more of XY_3 will decompose (C) more of X_2 will react (D) the forward reaction will go to completion

19. The element whose atomic number is 19 is (A) a non-metal (B) a noble gas (C) an alkali metal (D) an alkaline earth metal

20. Whichof the following conditions based on Le Chatelier's Principle would **not** favour the forward reaction in the system below? $N_2O_4(g) \leftrightarrow 2NO_2(g)$, ΔH is positive (A) increasing the temperature (B) removal of NO_2 (C) cooling of the equilibrium system (D) addition of N_2O_4 (E) reducing the pressure

21. Moving from left to right across a period, the general rise in the first ionization energy can be attributed to the (A) decrease in screening effect (B) increase in screening effect (C) decrease in nuclear charge (D) increase in nuclear charge

22. The stability of the noble gases is due to the fact that they (A) belong to group zero of the periodic table (B) are volatile in nature (C) have no electron in their outermost shells (D) have duplet or octet electron configurations.

23. The maximum number of electrons in the L shell of an atom is(A) 18 (B) 32 (C) 2 (D) 8

24. Elements in the same period in the periodic table have the same (A) chemical properties (B) physical properties (C) number of shells (D) atomic number

25. If a reaction is exothermic and there is a great disorder, it means that (A) there will be a large increase in free energy (B) there will be a large decrease in free energy (C) the reaction is static (D) the reaction is in a state of equilibrium

26. $2H_2(g) + O_2(g) \leftrightarrow 2H_2O(g)$ H = - ve. What happens to the equilibrium constant of the reaction above if the temperature is increased? (A) it decreases (B) it increases (C) it is unaffected (D) it becomes zero

27. How many orbitals are associated with the p-sub energy level? (A) 2 (B) 3 (C) 5 (D) 6

28. Which of the following electronic configurations **correctly** represents an element in period 3 of the periodic table? (A) $1s^2 2s^2 2p^3$ (B) $1s^2 2s^2 2p^6$ (C) $1s^2 2s^2 2p^6 3s^2 3p^4$ (D) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

29. An element **Q** forms a compound $\mathbf{QCI_5}$. In which group of the periodic table is **Q**? (A) I (B) III (C) V (D) VII

30. Which of the following statements about the behaviour of the atom is **correct**? (A) Atomic size decreases down the group (B) Atomic size increases across the period (C) Anions are smaller than the parent atom (D) Cations are smaller than the parent atom

31. Which of the following arrangements is in order of **increasing** ionization energy? (A) AI, Si, P, S (B) Si, AI, S, P (C) S, P, Si, AI (D) P, Si, S, AI

32. In a chemical reaction, ΔH is positive when (A) $H_{(product)} > H_{(reactant)}$ (B) $H_{(product)} < H_{(reactant)}$ (C) $H_{(product)} = H_{(reactant)}$ (D) $H_{(product)}$ = Zero

33. A catalyst increases the rate of chemical reaction by (A) decreasing the temperature of the reaction (B) decreasing the activation energy of the reaction

(C) increasing the surface area of the reactants (D) decreasing the surface area of the products

34. Which of the following reactions is applied to Le Chatelier's principle? (A) endothermic (B) exothermic (C) redox (D) reversible

35. Which of the following elements is a metalloid? (A) aluminium (B) calcium (C) carbon (D) silicon

36. The collision theory proposes that (A) reactants collide more frequently to bring about reduction in the reaction rate. (B) All collisions of reactants are effective (C) reactants must collide with a certain minimum amount of energy to form products (D) the fewer the collisions the faster the reaction rate.

37. Which of the following elements is a d-block element? (A) calcium (B) iron (C) lithium (D) silicon

38. Calcium and magnesium belongs to the same group in the periodic table because both (A) are metals (B) form cations (C) form colourless salts (D) have the same number of valence electrons

39. Consider the neutralization reaction represented by the following equation : $Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + H_2O + CO_2$. The stoichiometric ratio of acid to base is (A) 2:2 (B) 2:1 (C) 1:2 (D) 1:1

40. An element X has electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$. To which group of the periodic table does X belong? (A) I (B) II (C) III (D) IV

41. Which of the following electronic configurations represent that of a noble gas? (A) 2,8,8,2 (B) 2,8,2 (C) 2,8 (D) 2,6

42. The presence of impaired electrons in an atom of a d-block element accounts for its (A) ductility (B) lustre (C) malleability (D) paramagnetism

43. Which of the following processes is an endothermic reaction? (A) dissolving NH_4CI crystals in water (B) addition of concentrated H_2SO_4 to water (C) dissolving NaOH pellets in water (D) passing SO_3 gas into water

44. Which of the following properties is characteristic of the halogens? (A) ability to accept electrons readily (B) ability to donate electrons readily (C) ability to form basic oxide (D) formation of coloured compounds.

45. The activation energy of a reaction can be altered by (A) adding a reducing agent (B) applying a high pressure (C) using a catalyst (D) changing the temperature.

46. Which of the following factors does not affect the rate of reaction of $CaCO_3$ with HCI? (A) temperature of the reaction (B) solubility of the $CaCO_3$ (C) concentration of HCI (D) surface area of the $CaCO_3$

47. Which of the following statements is not true of Halogens? (A) they exist in different physical states (B) they exist as diatomic molecules (C) their ionic radii decrease down the group (D) their melting and boiling points increase down the group

48. Elements which belong to the same group in the periodic table are characterized by

(A) difference of +1 in the oxidation numbers of successive members. (B) presence of the same number of outermost electrons in the respective atoms (C) difference of 14 atomic mass units between successive members (D) presence of the same number of electron shells in the respective atoms

49. The electronic configuration of an element X is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$. It can be deduced that X

(A) Belongs to group 6 of the periodic table (B) belongs to period IV of the periodic table. (C) has 3 unpaired electrons in its atom (D) has relative molecular mass of 16

50. The following properties are characteristics of transition elements **except (A)** formation of complex ions (B) fixed oxidation states (C) formation of coloured compounds (D) catalytic abilities.

APPENDIX IV

INTERNATIONAL CENTRE FOR EDUCATIONAL EVALUATION
INSTITUTE OF EDUCATION,
UNIVERSITY OF IBADAN

STUDENTS' ATTITUDE TO THE LEARNING OF CHEMISTRY QUESTIONNAIRE (SALOCQ)

Dear Students,

This questionnaire is designed to elicit information from S.S. 2 students on their attitude towards learning of Chemistry. The information elicited will be used mainly for research purposes and will be treated in strict confidence. You are hereby requested to respond to the questionnaire as objectively as possible.

INSTRUCTION:

Please tick ( ) in the box that represents your opinion. Use the scale and indicate your response in the space provided to the left of each question.

SECTION A

School's name:

Sex: Male ( ) Female ( )

Age: Below 15 ( ), 15 – 18 ( ), 19 -21 ( ), 21 and above ( )

Class: S.S. 1 ( ), S.S.2 ( ), S.S.3 ( )

SECTION B

INSTRUCTION: Please tick ( ) in the box that best represents your opinion. Use the scale and record your response in the space provided to the left of each question.

Very true of me = **1,** Much true of me = **2,** fairly true of me = **3** Not true of me = **4**

S/N	LEARNING ATTITUDE STATEMENTS	4	3	2	1
1.	I do my chemistry class work with ease				
2.	I love chemistry as a school subject				
3.	I do my chemistry assignment regularly				
4.	Chemistry is my least favorite subject				
5.	Chemistry lessons are boring and uninteresting				
6.	I don't like to come to school because of chemistry				
7.	I display enough confidence when learning chemistry				

8.	I study and learn chemistry because I know how useful it is				
9.	I love that my chemistry teacher gives me enough assignments regularly				
10.	I love to be friendly with my chemistry teacher				
11.	I praise my chemistry teacher				
12.	I know I can handle more difficult chemistry topics				
13.	I have no time to do my chemistry assignments at home				
14.	I prefer watching television/video to practicing chemistry problems				
15.	I love to have a private chemistry teacher at home				
16.	I do not need to be encouraged in chemistry before I do well in it				
17.	I practice chemistry at home without being forced				
18.	I need a good understanding of chemistry for my work				
19.	I usually feel happy to be in chemistry class				
20.	I feel proud as a student of chemistry				
21.	I help to solve chemistry problems for my friends				
22.	I love chemistry teachers to be paid special salaries				
23.	I love to have access to chemistry text-books				
24.	I usually enjoy the discussion and in the chemistry class				
25.	The knowledge I have gained in chemistry is useful in other subjects I offer				
26.	Lessons taught in the chemistry class help me in my day to day life				
27.	I can pass chemistry even when I am not taught by a teacher				
28.	I usually find chemistry examinations easy to pass				
29.	I enjoy asking questions during chemistry class				
30	I enjoy discussion with mates on chemistry assignment				

APPENDIX V

Model answers for Chemistry Achievement Test

1. **B**
2. **D**
3. **D**
4. **D**
5. **A**
6. **A**
7. **D**
8. **B**
9. **A**
10. **A**
11. **D**
12. **C**
13. **D**
14. **B**
15. **B**
16. **C**
17. **A**
18. **C**
19. **C**
20. **C**
21. **D**
22. **D**
23. **D**
24. **C**
25. **A**
26. **A**
27. **D**
28. **C**
29. **C**
30. **C**
31. **A**

32. D

33. B

34. D

35. D

36. C

37. B

38. D

39. B

40. B

41. C

42. D

43. A

44. D

45. C

46. B

47. C

48. B

49. A

50. B