

**An Exploratory Study of Teachers' Classroom Interaction Patterns in Basic Science
Lessons in Junior Secondary Schools in Ekiti State, Nigeria**

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Abstract

This study explores classroom interaction patterns to address a gap in baseline knowledge and to assess the impacts of an intervention designed to improve teachers' classroom talk and thereby enhance students' engagement and learning. Previous literature shows a scarcity of data on teachers' interaction patterns in secondary schools in Nigeria: further study was needed to strengthen available evidence for policy implementation.

The current study adopts a mixed-methods case study design of 5 teachers and their students, using pre- and post-intervention lesson observations and interviews. Data were collected from 28 basic science lesson observations, 10 teacher interviews, and 5 student interviews. These were all transcribed; the lessons showed similar patterns on initial analysis, so two lessons per teacher (one pre- and one post-intervention), 10 teacher interviews, and 5 student interviews were deeply analysed. Thematic and discourse analyses, timeline analyses, and descriptive and inferential statistical analyses were used.

Baseline findings revealed the prevalence of teachers' talk. Discourse patterns showed repetitive initiation, re-initiation, recitation, and routine pseudo-questioning. Interview data revealed widespread problems hindering classroom interaction patterns in Nigeria. Students' responses revealed desires for more motivation, student talk, engagement, and ownership of their learning.

Post-intervention findings from discourse patterns, interviews, and quantitative data showed that the intervention was associated with significant improvement in patterns of talk and questioning, but not in non-verbal patterns or wait time. The exploratory nature of the case studies provides a clear picture of the issues for logical and analytical generalisation. The statistical analysis supports understanding of the situation, although generalisation would not be appropriate. Implications are considered for teacher educators to identify individual teachers' training needs. This could further support teachers in improving classroom interaction patterns, especially questioning. There is scope for school-based professional development interventions on classroom interaction patterns to support self-reflection and peer learning.

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Finally, I dedicate this thesis to the glory of the almighty Allah.

Author's Declaration

I, Rasheedah Olusola Agbaje, declare that this thesis is a presentation of original work, and I am the sole author. This work has not been previously presented for an award at this, or any other, University. All sources are acknowledged as References.

Abbreviations and Acronyms

ABL: Activity-Based Learning

BIAC: Basic Science Interaction Analysis Categories

BST: Basic Science and Technology

CPD: Continuing Professional Development

DfE: Department for Education

EFA: Education for All

FGD: Focus group discussion

FGN: Federal Government of Nigeria

FIAC: Flanders Interaction Analysis Categories

FISS: Focus Group Interview Schedule

FIST: Follow-up Interview Schedule for Teachers

FME: Federal Ministry of Education

GCSE: General Certificate of Secondary School Education

ICTON: Institute of Certified Teachers of Nigeria

IDZ: Intermental Development Zone

ILO: International Labour Organisation.

IST: Interview Schedule for Teachers

ITT: Initial teacher training programme

JSS: Junior secondary school

LTM: Long-Term Memory

MDG: Millennium Development Goals

NCATE: National Council for Accreditation of Teachers

NCCE: National Commission for Colleges of Education

NCE: National Certificate of Education

NCHE: National Council for Higher Education

NECO: National Examination Council

NEEDS: National Economic Empowerment and Development Strategies.

NERDC: Nigerian Educational Research and Development Council

NLS: National Literacy Strategy

NNHS: National Nutrition and Health Survey

NNS: National Numeracy Strategy

NOA: National Orientation Agency

NPE: National Policy on Education

OECD: Organisation for Economic Cooperation and Development

PGCE: Post Graduate Certificate of Education

PSNT: The Professional Standard for Nigerian Teachers

SDG: Sustainable Development Goals

SSA: Sub-Sahara Africa

SSSCE: Senior Secondary School Certificate of Education

STAN: Science Teachers' Association of Nigeria

STM: Short-Term Memory

TALIS: The teaching and learning survey

TLMs: Teaching and Learning Materials

TP: Teaching Practice

TRCN: Teachers Registration Council of Nigeria

TTDI: Teacher training and development intervention

UBE: Universal Basic Education

UNESCO: United Nations Educational, Scientific and Cultural Organisations

UPE: Universal Primary Education

ZPD: Zone of proximal development

Chapter One: Introduction to the Study

1.0 Introduction

This chapter provides the background within which the study is framed by discussing the nature of the issues and giving an overview of previous research on interaction patterns in section 1.1. The section also briefly outlines the African and Nigerian contexts of the study and introduces teacher education and classroom interaction in the context of the national policy on education, and further provides the nature of teaching and learning of basic science in Nigeria. Section 1.1 also describes the researcher's interest in the topic. Section 1.2 explains the research's purpose, scope, and significance. The research questions are stated in 1.3, while Section 1.4 highlights the structure of the whole thesis, and the chapter ends with the summary in Section 1.5.

1.1 Background to the study

This section begins with a brief description of the topic explored in this study, then introduces the nature of the issues and situates the study within previous work on classroom interaction patterns in Nigeria.

In the early 1990s, studies showed that the quality of teacher-student interaction is the pivot to educational attainment, among other variables such as high pupil engagement levels, teachers' effective use of time, lesson clarity, and varieties of instructional materials (Brophy, 2001; Mercer, 2000). The present study explores teachers' classroom interaction patterns during basic science lessons at the junior secondary school (JSS) level in Ekiti State, Nigeria. The teachers involved are basic science teachers, and the examined class is the junior secondary school 1 (JSS1), the science foundation class and the students are between 12 and 13 years old. Although there is no strict age regulation for enrolment in Nigeria, many pupils start school early, and as a result, some pupils are as young as 10 or 11 years old in junior secondary school 1, which is the first year of secondary school education in the country. The JSS period is crucial because of the importance of the early years in the educational foundation of individuals and time to unlock children's minds to inventive exploration, build their learning processes and strengthen healthy interaction in a supportive environment.

Lehan (2021) views interaction as a process in which two or more people or things engage in reciprocal action or actions and specifically describes classroom interaction as the occurrence of such engagements in classroom settings. Inamullah, Hussain, and Din (2011) stated that the interaction pattern between teachers and students is essential for communication in the teaching and learning process. Vygotsky (1978), from a social and cultural perspective, supported this notion by arguing that much of a child's learning is through collaborative and cooperative verbal instructions during skilful adult mentoring. The child clarifies the activities for understanding and internalising the information to handle future tasks and attain high cognitive development. Vygotsky identified language as an important tool for social interaction and information transmission from adults to children for cognitive development.

Classroom interaction patterns refer to forms of interaction in classrooms, which could be between the teacher and the entire class, with or without materials, or between the teacher and one student or groups of students. Students also initiate classroom interaction with teachers by asking questions, for example. Students may also work individually or talk in pairs or small groups. When interaction involves an entire class, it does so with the teacher monitoring and facilitating the process. In the latter case, the teacher's responses can either clarify issues by asking clarifying questions, build on previous responses, and give effective feedback to help the students develop high cognitive skills and improve their learning. The types of interaction patterns examined in the current study are (i) how teachers and students at the JSS1 level talk in basic science lessons, (ii) the teachers' direct and indirect talk, (iii) teachers and students' non-talk cues, (iv) the teacher's types of questions – whether pseudo, close-ended or open-ended questions, (v) and the wait time or period of silence after asking questions.

1.1.1 What has previously been done.

However, most of the evidence on the importance of classroom interaction patterns for learning has come from Europe and the United States of America (Ackers and Hardman, 2001; Hardman, Abd-Kadri and Smith, 2008; Prophet, 1994; Juma and Ngome, 1998), which suggests that similar investigations into teacher-student classroom interaction patterns would be of necessity for educational development in developing countries. Indeed, some previous researchers, for example, Ackers and Hardman (2001), Kalu and Alli (2004), Hardman et al.

(2008), and Tabulawa (2013) decried the general scarcity of field data from Nigeria and Sub-Saharan Africa on how teachers teach and argued that such studies could aid policy formulation decisions and close the gaps between classrooms realities, rhetoric, and real educational achievements amidst specific hard situations and unique educational challenges.

In Nigeria, this line of inquiry is not a popular research area. Hence data are scarce on how teachers actually teach. Moreover, few previous studies on classroom interaction in Nigeria have focused on the outcome of classroom events, not their processes. However, Kyriacou (1997) stated that effective teaching and learning processes that aid the success of pupils' achievement of the learning that the teacher intends consist of the outcome variable and the context, process, and product variables. Nevertheless, the few available classroom interaction studies from Nigeria have reported the existence of some relationship between classroom interaction patterns and students' achievement (Udeani, 1992; Okafor, 1993; Ogunkola, 1999; Emah, 1998; Domike, 2002; Kalu and Ali, 2004; Nnorom and Erhabor, 2009; Fakeye and Amao, 2013). For instance, Fakeye and Amao (2013) and Kalu and Ali (2004) found a positive relationship between classroom interaction behaviour and students' levels of achievement, with Fakeye et al. (2013) reporting that classroom participation had the greatest independent contribution (22%) to the variance in achievement scores. Udeani (1992) similarly reported that classroom interaction accounted for about 74% and 71% of the variation in students' cognitive achievement and process skill acquisition, respectively.

Nevertheless, it is important to note that although the local studies mentioned above indicate that students' academic scores in Nigeria depend on teachers' classroom behaviour, they were mostly experimental studies conducted for biology as a subject and done in laboratories, but not in typical classroom settings, thus failing to look at actual classroom behaviours and classroom discourse patterns. In Hardman et al.'s (2008) baseline study, which was carried out in actual classroom settings in primary schools in Nigeria, the authors found a preponderance of teachers' explanation, recitation, and memorisation, with minimal attention to students' understanding. Hardman et al.'s (2008) considered broader consequences for enhancing classroom practices at basic school levels through efficient school-based programmes.

Scheerens (2000), Reynolds and Teddlie (2002), Roffey (2012) and Taiwo and James (2015) identified positive relationships between variables of school effectiveness such as

teachers' effectiveness, positive leadership, monitoring pupils' progress, joint planning, reward and incentives, and pupil and parental involvement and the educational attainment of students. Teachers' effectiveness, positive leadership, monitoring of pupils' progress, joint planning, reward and incentives, pupil and parental involvement and were attributed to the quality of teacher-student interaction, for instance, high levels of pupil engagement, effective use of teacher's time, lesson clarity, and varieties of instructional materials, which they found pivotal to educational attainment (Cinches, Russell, Chavez, and Ortiz, 2017).

1.1.2 The context of the study

This subsection outlines an overview of social interaction in Nigeria and Africa amidst complex socio-economic and political contexts. It briefly overviews the complex multilingual settings, serving as the study's general context.

1.1.2.1 African context of the study

Most colonised developing countries start by implementing the educational policies and strategies handed over by their colonial masters. These strategies and policies usually require gradual changes to suit the colonised countries' local culture, values, and practices to meet their specific needs. Guthrie (2011) states that the colonial masters' educational strategies and reforms generally fail in the developing world because they are irreconcilable with the culture in the developing world. In Alexander (2001)'s opinion, what the teacher thinks, does, and says in the classroom is influenced by the teacher's ideas, attitudes, beliefs (social, cultural, and political), knowledge and understanding of the curriculum and the learning process.

Guthrie (2011), Hardman et al. (2008), and Fuller and Clarke (1994) agreed with Alexander that context is essential when it comes to classroom behaviour in teaching and learning. Mortimer and Scott (2003), Tabulawa (2009;2013), Guthrie (2011), and Westbrook et al. (2013) argued that despite the promotion of teaching strategies from developed countries, there is evidence for the effectiveness and appropriation of the traditional, teacher-centred, whole-class, or didactic approaches to teaching and learning in some educational and cultural contexts and in societies that value respect for authority. Thus, given the prevalence and embeddedness of the traditional teacher-centred approach in schools in Africa generally,

and in Nigeria in particular due to its compatibility with African culture, the relevant question is, how can we improve the quality of the traditional teacher-centred approach? Thus, while the present study aims not to condemn or prescribe any educational culture or method, its goal is to explore how to improve the quality of present classroom interaction patterns to derive as much benefit as possible from existing pedagogical contexts in Nigeria.

The current work aims not to condemn or prescribe any culture or method but to explore the scope for improving the quality of classroom interaction patterns. The findings of the current work can provide insight into classroom practices to explore the scope to support teachers to modify their pedagogy practices considering the teacher's appropriate choice of pedagogy style and previous knowledge. So, teachers can invariably facilitate children's achievement of particular learning goals and still maintain the role of authority in control of the class. Based on the findings, the study will provide insights into classroom practices in basic science classrooms.

1.1.2.2 The Nigerian context of the study.

Education in Nigeria began as informal, traditional education, where skills were transferred to children through mentoring, folktales, advice, and shadowing of skills of parents and ancestors (Umar, 2019). Obedience to elders, parents, adults, rules, and laws was inviolable, and disobedience was punishable. Later on, Jawoniyi (2009) pointed out that religious and Western education was taught by rote learning using songs and hymns to achieve memorisation in the Nigerian educational system. Rote learning and songs later eroded folktales that encouraged the active engagement of children and team building in the old Yoruba settings and laid the foundation for the teacher-centred or authoritative style of teaching to date (Adewole and Oyesola (2017).

In this researcher's opinion, rote learning easily became widely accepted and rooted in African classrooms because it is not contradictory to the culture, values, and respect of elders and those in authority. This view is in tandem with Guthrie (2011), who argued that the authoritative teaching style also found its roots in the Nigeria and Sub-Saharan African (SSA) cultures, which value and respect elders and those in authority and have customary ways of doing things. Aládésanmí and Ògúnjinnmí (2019) also pointed out that traditional and customary practices of respect for authority are highly valued and practised in Yoruba

culture. Osokoya (2013) found that the traditional lecture method is associated with teacher-dominated talk and discourages students' classroom engagement. Although, Osokoya (2013) found that the traditional lecture method is usually associated with teacher-dominated talk and discourages students' classroom engagement.

Ekiti State is one of the Yoruba-speaking states in Nigeria; its people are historically known for their local cultural values and beliefs, discipline, moral upbringing, and respect for elders, according to Aládésanmí and Ògúnjìnmí (2019) and Ayeni (2012). Guthrie (2011) remarked that just like in African culture, which values and respects elders and those in authority, so, out of respect for elders, in adult-child interaction, a child keeps quiet when an adult is talking and speaks when told to speak. Okunola (2003), Osokoya (2013) and Law, (1999) opined that such conversational patterns could lead to adults dominating conversations. In the past, punishment, such as caning, was a generally acceptable method of disciplining children (Babatunde, 1992). Busari, Owojuyigbe, Okunola and Meko (2017) confirmed that caning has recently remained an acceptable method of disciplining children in Ekiti society.

Bernard (2019) pointed out that the Yoruba had many different rich, highly culturally valued non-verbal ways of conveying messages before colonialism and the technology that came with it. The rich cultural heritage is preserved in various non-verbal methods such as dressings, tribal marks, hairdos, caps and symbolic means, body movement and contact, and facial expressions. Bernard continues that parents, adults and, elderly siblings, community leaders traditionally teach and communicate with children and younger members of the community with these various non-verbal methods to avoid confusion and misinterpretations. Each cue is decoded differently depending on the conversation's tone and context; each child is expected to be vast and respond promptly.

For instance, nose squeezing means dissatisfaction, finger-snapping means revenge or need for attention, and when a mother rolls her eyes at a child, the message is for the child to leave the room or for a child to stop whatever the child is doing. As a result, the Yoruba tribe can communicate between themselves without other tribes decoding the message. Nonetheless, these non-verbal cues are now infrequently used by the younger ones because of the advent of modern communication technology. Like how rote learning has replaced old traditional lullabies, folktales, local games, and storytelling that encouraged children's active

participation in learning, modern communication methods are replacing non-verbal communication and gradually becoming the norm.

However, Osokoya (2013), Osuolale (2014) and Omiko (2016) asserted that modern communication and technological materials, and other learning resources, basic amenities, especially electricity to power the few if available are unfortunately inadequate or unavailable in so many classrooms, in Nigeria. Studies on communication reveal that nonverbal cues are used to convey and receive feelings and intentions much more frequently than vocal ones, so there is a need to encourage the effective use of these in classrooms (Fayemi, 2009). However, Guthrie (2011) showed that students in Asian classrooms taught by a sophisticated traditional formalistic approach performed much better than Western international students in Mathematics, science, and language. Guthrie also argued that Western universities use traditional formalistic approaches to teach formal research skills. Sophisticated traditional formalistic strategies among Chinese teachers achieve student engagement. So, in a sophisticated, formalistic approach, students can be actively engaged in a dominant teacher's classroom.

In other words, a dominant teacher is different strategically from an authoritarian teacher. Guthrie (2011) defines authoritarian teaching as a teacher who is formal, domineering, and rigid with norms and corporal punishment, enforcing students' obedience. In the authoritarian teaching environment, teachers define roles, and students are passive and have little interaction with defined content for rote learning. On the other hand, the traditional formalistic teacher has well-established routines and strict hierarchical approaches, and organised syllabus processing with emphasis on memorisation and strong negative sanctions that focus on learning and encourage some level of overt student interaction. Guthrie (2011) differentiated rote learning from memorisation in that rote learning focuses on surface remembering facts while memorisation is not passive but focuses on superior cognitive strategies to achieve an active, deep understanding of meanings.

Guthrie further explained that the systematic use of rote learning strategies is common where most educators are incompetent due to a lack of access to education and training and rigidly adhere to the curriculum. Guthrie's argument supports the findings of Omiko (2016), Osokoya (2013) and Osuolale (2014) that classroom interaction practices in Nigeria involve teachers' use of authoritarian teaching strategies with a preponderance of rote

learning. Based on these explanations, Guthrie suggests the need to improve and encourage greater use of memorisation approaches that focus on superior cognitive strategies to achieve an active, deep understanding of meanings through active students' engagement.

1.1.2.3 Context of National Policy on Education in Nigeria

The Federal Government of Nigeria (FGN), in the latest National Policy on Education (NPE) (2013), states that education shall be free, compulsory, and qualitative for the first ten years of education, one-year nursery, and six years in primary and three-year junior secondary school. The NPE (2013) prescribed qualitative education to develop critical thinking, cognitive development, and problem-solving abilities to create self-reliant individuals. According to Olatunji (2018), the introduction of free education and education for all (EFA) has led to a classroom population explosion and has been very problematic in Nigeria; despite the NPE (2013) having specified a teacher-student ratio of 1:35, the classrooms are overcrowded with more than 50 students in a class in secondary schools, making effective interaction difficult. The need for more teachers to tackle the problem of high enrolment led to the employment of unqualified teachers. Ejere (2011) remarked that the universal basic education (UBE) reported a requirement for 966, 308 teachers but had 267, 550 currently in service, out of which only about half, 368, 613 of the teachers under the UBE programme, are professionally qualified, short of 597, 695 of the requirements.

In Nigeria, though there are various reviews of educational policies, curriculum reforms, and quality assurance strategies guiding the recruitment of teachers, the implementation of these policies and reforms has not been successful. There are gaps in the objectives of reforms in education and development in teachers' classroom practices and improvements in students' learning outcomes (Ogunyinka, Okeke and Adedoyin, 2015; Oyebade, 2012); Osokoya, 2010). Osokoya (2010), Danmole (2011), Ogunyinka et al. (2015) and Ogunmakin (2022) explained that the teaching profession became unpopular in Nigeria due to its poor social status, poor funding, delay or denial of salaries, poorly equipped educational system and hostile work environment which has led to a brain drain and the employment of inexperienced and unqualified teachers. These challenges have also resulted in low enrolment in teacher education programmes, making it difficult to maintain the prescribed NPE minimum standard for admission into teacher training programmes.

The International Labour Organisation (ILO) /UNESCO (2019) recommends that the standard for the selection of candidates for preparation for teaching professionals should include (apart from intellectual qualities) morals, physical and personal qualities and the possession of professionally relevant knowledge and skills. In contrast to possessing personal qualities, the Nigerian education sectors conduct admission processes based on minimum academic requirements by certification and not practical skills and experience (Ogunyinka, Okeke and Adedoyin, 2015). The teacher education curriculum explained that since teachers' classroom experience when they were students have much impact on their classroom practices when they become teachers, the recent teacher education curriculum reform demonstrated a move from teacher-centred to learner-centred pedagogy through activity-based teaching, tagged in the curriculum as 'teach as taught'.

Despite the curriculum specifying otherwise, Ogunyinka et al. (2015), Oyebade (2012), and Osokoya (2010;2013) found that the mode of teaching in colleges of education in Nigeria has remained mainly the old traditional lecture method. They found this conservative method unable to stimulate students' participation, promote high cognitive learning and produce the desired changes and results prescribed in the curriculum for the National Commission for Colleges of Education (NCCE), so teaching methods used in teacher education must change if the ways teachers teach must change. Osokoya (2010) raised concern that overcrowding in classrooms with many desks and chairs does not foster effective teaching and learning in Nigerian classrooms. There are just not enough spaces for effective classroom interaction, which may be one of the reasons teacher results to the lecture method of teaching. The NPE (2004; p. 10) restates the policy on language that every child shall be instructed at the primary school education level in the language of the immediate environment. Nigeria, a multilingual and multi-ethnic country encompassing about 500 indigenous languages, highlighted only three in the 2004 NPE: Hausa, Igbo and Yoruba and are to be studied and used as a medium of instruction. As a result, teachers resort to the use of English language as a medium of instruction where the language in the child's immediate environment differs from these three recommended ones, thus, rendering the implementation of the national instructional language policy difficult.

As Ibrahim and Gwandu (2016) put it, this has become a major contemporary concern because of the highly multilingual nature of the country, with people within a 20km radius

not understanding each other's language. This might be why teachers and administrators of education resort to speaking English. Moreover, there is no law enforcing the use of multilingual teaching in primary schools. Ibrahim and Gwandu (2016) further explained that because the child already knows a language before starting school, children have acquired and processed their mother tongue, which now negatively interacts with learning in a second language which is more complex, time-consuming, and demanding, especially as the problem of linguistic interference is more severe with the indigenous Nigerian language.

1.1.3 Teaching and learning basic science in Nigeria.

Opara and Etukudo (2014) define basic science as an approach to teaching science in which its concepts and principles are presented to express the fundamental unity of scientific thoughts and avoid premature or undue stress on the distinctions between the scientific fields. Nnorom and Erhabor (2009) explained that science and technology had been significantly proven to be useful in people's daily lives to sustain the world and its environment. Most developing nations now make serious efforts to improve the study of science and other allied subjects in their schools to meet these roles.

Basic science is significant in laying a solid scientific and reflective thinking foundation. A good foundation in basic science is important to choosing science subjects at the senior secondary school level and primarily in pursuing courses like information and communication technology, nursing, medicine, pharmacy, space science, applied mathematics, and all engineering fields. Basic science brings together traditional science subjects without distinctions so that students can have a robust understanding of all, irrespective of gender, nationality, religion, and ethnic group, since science is universal. However, in spite of the relevance of basic science in science education, the teaching and learning of basic science face many challenges.

For example, Osokoya (2013), Osuolale (2014) and Ihebeveme (2009) found that the teaching and learning of science in secondary schools in Nigeria is too weak, and science lessons are characterised majorly by teachers' talk and memorisation or rote learning. Omiko (2016), Osokoya (2013) and Osuolale (2014) also found that teachers' talk dominates basic science lessons through the traditional lecture and rote learning method, where students have little or no engagement with the teacher or with their peers in science lessons. The three

studies, Omiko (2016), Osokoya (2013), and Osuolale (2014), decry the inability of basic science teachers to stimulate students' classroom interest. Osokoya (2013) specifically showed that about 45% of basic science lesson time was spent on teachers' verbal and nonverbal talk and noted that rewards and praises took place mainly through students' regular clapping of hands. Mbajiorgu (2003) affirmed that pupils at the primary school level like science as they are at the level where their mind is curious and inquisitive. Hence, it is essential for teachers to be able to take advantage of such curiosity at the junior secondary level by sparking the interest of their pupils early.

The National Teachers' Institute stated that the general objective of Basic Science and Technology (BST) is to enable students to observe and explore using their senses and hands. The BST is an essential aspect of the 9-year free Universal Basic Education that was meant to enable every child to have a chance to acquire high cognitive development (UBE). So, there is a need for in-depth teaching and learning. While proffering solutions to the challenges teachers face in achieving this goal, Ihebeve (2009) stated that the need for a more student-oriented climate means teachers are to make the interest of the students germane. Students need to use their hands and senses as specified by the BST curriculum to develop the basic concepts, skills, and attitudes towards stimulating their interest in creativity and technological applications. Hence, this supports the current study's aim to enhance student active classroom engagement through a change to classroom practices.

Omiko (2016) and Osokoya (2013), however, decried the deplorable condition of schools in Nigeria with dilapidated buildings and the lack of teaching material in rural areas or limited in urban areas for students and teachers to interact that will enable students to use their hands and facilitate the learning process. Similarly, Akhihero (2011), Haruna and Liman (2015), Ekong (2003), and Umana (2018) remarked that there is a lack of essential materials in most communities, especially rural areas in Nigeria, that could provide learners with the required amount and quality of previous knowledge about innovations, equipment, and materials. These materials could aid students' familiarity with simple tools, which could facilitate their interest in the use of essential science equipment and make them quickly connect previous knowledge to new ones.

Furthermore, Ackers and Hardman (2001), Hardman et al. (2008) and Osokoya (2013) identified the use of English language in teaching and learning in Nigeria and other

African countries as contributing to high rote learning and teacher recitation. Dembele, 2003) argued that recent studies have suggested and pointed to the advantage of the use of the mother tongue in teaching in addition to former colonial languages. Moreover, some science words have native names, so students can easily connect new knowledge to prior experiences and culture.

Nigeria National Policy on Education (2004) stated that basic science aims to enable students to acquire skills to observe, report, organise, generalise, predict, design experiments, and explain phenomena and continue the inquiry process if data do not conform to prediction. Osuolale (2014) revealed that most junior and primary science teachers in Nigeria have no knowledge of these objectives and do not possess the skills to implement them and concluded that if teachers lack knowledge about the objectives of basic science, they may not see reasons why they should engage the students in quality talk and activities in basic science classrooms.

Hence, the current study aims to explore how to enhance students' active classroom engagement in spite of the existing challenging conditions by identifying the types of interaction that take place in basic science classrooms; who is interacting and with whom, what is being said, and how does interaction occur, why does it happen, and whether changes could be made to the quality of engagement, so as to ignite students' interest in creative thinking.

1.1.4 The need for teacher education and teachers' continuing professional development in Nigeria.

Given that education is the fundamental mean for strengthening the quality of a country's population, and childhood education is the foundation of a qualitative human labour force, education is, therefore, the cure for extreme poverty, for as Samuel (2013) put it, the level of education in a country is directly related to its progress (Samuel, 2013). United Nations Educational, Scientific and Cultural Organisations (UNESCO; 2019) explained that education is an unavoidable instrument for a nation's sustainable growth, development, and conveyance for raising the younger generation. It is a vehicle for imparting learners' knowledge, skills, attitude, and values (Schmidt, 2018).

The teacher as an educator performs the role of a model, designer, tutor, discipline, guide, maker, and implementer of the formal process in schools; hence, the importance of teacher education. For effective performance of these roles, the teachers must possess quality education. Teacher education refers to teachers' professional training, knowledge, attitude, and expertise towards effective and efficient delivery of teaching outcomes. Samsujjaman (2017) refers to teacher education as the policies, procedures, and provisions designed to equip teachers with the knowledge, attitude, behaviours, and skills needed to perform their tasks effectively in schools, classrooms, and the larger society. These are sets of skills acquired through competency-based training to enable efficiency and qualitative service delivery in classrooms (Hoyles, 1995). Indeed, the specific sets of skills that are germane to survive in this competitive world are acquired through education.

Asaya (2011) explained that staff development programmes as “all activities engaged in by professional personnel during their service and designed to contribute to improvements on the job”. Training and professional development of teachers make marked changes in many countries. The quality of training that teachers receive is paramount and may affect the quality of services or support they provide the learners. Nigeria has undergone significant reforms in its process of standardisation, and the reforms resulted in the establishment of many secondary schools, institutions, and universities, which necessitate the need for teachers' professional education. (Ogunyinka, Okeke; Adedoyin, 2015). UNESCO (2007), in an international report, indicated that there are inadequate programmes in place for professional development in Nigeria. This observed limitation challenges the ability of teachers to cope with new knowledge, new skills, and changes in the education system that requires a new attitude and new orientation of learners. Therefore, teachers cannot reinforce and build on the knowledge acquired from teacher training colleges and colleges of education. This invariably makes them unable to apply new teaching innovations.

While various research remains ongoing into improving the quality of teaching in Nigeria, Asaya (2011), Hardman et al. (2008), Hardman et al. (2011), and Garuba (2007) recommended that continuous professional development remains a good area for investigation. Asaya (2011), for instance, argued in support of the above that the absence of self-evaluation and professional development courses might make many teachers stagnate after a few years into employment. Ogunyinka et al. (2015) found poor quality of in-service

training, inadequate academic assessment, and lack of personal and emotional characteristics, poor policy implementation due to changing socio-economic and political situation in the nation as challenges to quality delivery of teacher education in Nigeria. Osokoya (2010) also found poor incentives to attract, hold and retain good teachers in Nigeria as a challenge; teachers' wages are meagre and barely sustain them to be able to enrol in in-service training. The absence of reward/recognition may particularly discourage teachers from attending continuous professional development programmes even if made available for free in Nigeria, where there are incidents of non-timely wage payments with attendant economic instability.

Guthrie (2011) agrees with the above research that the systematic use of authoritarian rote learning strategies that have been evident in Nigerian classrooms is common where most educators are incompetent due to a lack of access to education and training, rigidly adhering to the curriculum. Hence, the clamours for the need for a traditional, sophisticated approach that Guthrie referred to as superior cognitive strategies to enable students' active classroom participation and the development of cognitive domain in learning. This further highlights the research gaps that this present study seeks to address. The current study aims to determine if an intervention, a form of CPD support for in-service teachers, will change teachers' classroom practices.

Day (1999) claims that teachers are the school's greatest assets and will only be able to fulfil the set educational objectives if both schools and teachers are well prepared for the profession. However, Ogunyinka et al. (2015) found out that teachers in Nigeria are insufficiently familiar with even the use of information communication technology and the internet, which have not only transformed the world into a global village, but the knowledge and use of which are a necessity for teachers, to facilitate communication among professional networks and other teachers, and guarantee the educational system. Thus career-long learning could enable teachers to maintain and improve their contribution to the educational system and society at large as they perform the crucial role of preparing younger generations for both human and economically sustainable national development, regardless of whether or not government designs excellent educational policies, provides adequate funding, and builds standard classrooms. So, without high-quality teachers, efforts aimed at achieving national goals could be in vain. This calls for all hands to be on deck to maintain and enhance teachers' skills, knowledge, and competencies.

1.1.5 The researchers' interest in the topic

The author of the present study is a science educator, researcher and student who has had experiences related to the topic of study as a learner and teacher educator, having personally observed classroom interactions of in-service teachers and trainee teachers and students. These personal experiences have informed the researcher's conclusion that teachers in Nigerian schools carry out almost all classroom activities and do a lot of the talking, whereas students' opinions are hardly explored or considered to be highly valued; teachers ask most of the questions, and the types of questions asked are usually closed-ended. Also, learning seems to be mostly by rote. The researcher considers teaching practice during teacher training ineffective due to the teacher training policy. For instance, the researcher considers a six-month teaching practice as not only too short but that malpractices and lapses surround the implementation of the teacher training process. In a descriptive survey, Iyunade (2017) revealed that responses from 82.3% of participating teachers indicated that they want help in classroom decision-making in the form of CPD activities to impact their practices and to implement educational reforms positively.

The researcher also reflected on how growing up in a home in which children were encouraged to be the first to speak on any issues. Furthermore, with parents that not only spent all of their career lives in teacher training colleges and contributing value to the production and development of teachers in the early 1970s in Nigeria, but it was at a time when teaching was viewed as a noble profession that was responsible for building and framing of individual personality and quality of life. The researcher also had the good fortune of having been taught in secondary school by admirable teachers who valued creative, exploratory learning, with the various availability and accessible TLMs to facilitate our learning. These materials supported our wonderful, natural, inquisitive, and investigative nature as children. The researcher became concerned as an educator and as a researcher about why? how much? and what types of interaction occur during the teaching and learning of basic science in junior secondary school classrooms in Nigeria, especially when the language of instruction is not the student's first language.

As a science educator and teaching practice supervisor, the researcher's interest in the topic arose during some supervisory visitations to teacher training classrooms in Nigeria,

where the researcher observed the under-listed patterns of interactions that characterise teacher training classrooms in Nigeria:

- The tertiary or adult classrooms were characterised by students using their phones while sprawling on tables.
- Teachers were over-dependent on materials and lectures by reading out notebooks to students.
- Evaluation of lessons is usually based on assignments that students usually solve by copying word-to-word answers from the internet.
- Noisemaking was rampant, students aimlessly wandered around the classrooms, and most of the teachers were not bothered whether students listened or understood whatever was being said or lectured by teachers. Thus, at the tertiary level, the teacher seems to have little or no control over the class and shows little concern.

In the researcher's opinion, these practices seem not to have a root at the tertiary institutions but look like practices mastered over time. This seems like an acceptable method, probably because the perception of good practice is based on each individual's experience in schools and colleges. These experiences about the present classroom practices are similar, making it difficult to be viewed as a challenge to quality students' learning. The teachers also seem not to know how best to support students' learning.

The researcher also believes that the present monologue lecture technique, with its rudimentary rote learning method, lacks engagement and may not foster the development of intellectual and thinking skills among students because it does not offer adequate time for students to participate and engage in meaningful classroom activities. In this instance, teachers seemingly dominate the classrooms and often oscillate between an instructor role and a decision-maker role, which is, to a large extent, similar to what the researcher observed in the tertiary institutions earlier:

Furthermore, the researcher, during her supervision visits to secondary school basic science lesson classrooms in her official role as a teacher educator for more than 20 years, also found that the present monologue lecture technique, with its rudimentary rote learning method, lacked engagement and may not foster the development of intellectual and thinking skills among students, because it does not offer adequate time to participate and engage in

meaningful classroom activities. In this instance, teachers seemingly dominate the classrooms and often oscillate between the roles of an instructor and a decision-maker, which largely resemble her earlier observations in the tertiary institutions. For example, her observations include the following:

- Teachers' inadequate knowledge of the subject matter.
- High prevalence of rote-learning and teacher-led recitation
- Pupils' classroom engagement was minimal, mostly inactive, with the teachers doing most of the talking, reading from their lesson notes, or spontaneously using some pre-designed recitation techniques.
- Pupils' responses to teachers' questions lack amendments, and teachers do not encourage pupils to discuss with one another or engage students in meaningful talk.
- The teachers have a tradition or culture of not allowing students to talk while teachers talk. Most teachers' questions were recalled and cognitively related and lacked highly ordered thinking.
- The teachers' prevalent form of questioning is "do you understand," which seems to have become a routine in evaluating students' understanding of topics and ways of soliciting students' talk in classrooms.
- Pupils dozing off, noisemaking, and distractions were significant, with little or no teacher intervention.
- Teachers rarely used gestures.
- Classwork was written on the chalkboard for pupils to complete, which took a lot of the lesson time.
- Teachers employed recitation with a stressed sentence (s) to elicit chorus or individual responses from students, to which the pupils already know whether to give chorus answers or individual answers.
- Another common way that teachers engage students is to command the pupils to give a chorus clap to accept or encourage students' responses.
- At the secondary level, the teachers seem like serious bosses who are mandated to deliver some information to students, orders, commands and punish erring students at will.

Another influence of the choice of the topic on the researcher was the experience with a related topic during her master's degree studies, which employed a multiple-choice questionnaire, and examined students' opinions about their teachers in science classrooms. However, because the former study only covered students' perspectives, it did not portray the actual behaviour of the science teachers in the classroom, thus subject to bias. Nor did the study examine teachers' and students' behaviour from a holistic perspective. However, the study suggested that participants were, on average, satisfied with their classroom experiences. The study explained that the findings might not be unconnected with students' lack of awareness of the quality of knowledge that their teachers should offer them. Another possibility is that participants generally tried to cover the weaknesses in their experiences for fear that their teachers might access the document. Therefore, the study recommended that further studies should investigate classroom interaction patterns between teachers and students. A recommendation for further study that came out of the master's study was the need to observe and investigate classroom interaction patterns.

The researcher's classroom passerby perception of classroom practice in England as a parent who has insight into her child's classroom experience has added to her interest in pursuing the topic. In England's classroom practice, a teacher poses a problem, gives guidelines, and asks students to dialogue in pairs and present their responses. The teachers and other students build upon each group's responses. To the researcher of the current study, the discourse process seems to promote shared knowledge and engagement against the rudimentary teacher-centred and pre-packaged practice. Collaborative group learning with multiple voices is a rare practice in Nigerian classrooms.

In summary, the preceding factors are sources of the researcher's motivation to explore how interaction occurs between teachers and students in basic science lesson classrooms at the foundation junior secondary school level.

1.2 Purpose, Scope, and Significance of the Study

This section explains the broad aims and objectives, the significance and the coverage area and the parameters (scope) of the study in Ekiti State, Nigeria.

1.2.1 The purpose of the study

Classroom interaction patterns in Nigeria have been subjected to some concerns. This study aims to ask teachers about their beliefs, values and classroom practices, and this type of study is not common practice in Nigeria. The study aims to find out from five basic science teachers their opinions about issues affecting their classroom interaction patterns in Ekiti State. This study also explores students' experiences in basic science lessons in junior secondary schools in Ekiti State, Nigeria.

With observation, this study explores the baseline data of teachers' and students' classroom interaction patterns in basic science lessons in Ekiti State and finds out if the provision of intervention will improve the teachers' classroom interaction pattern practices. The study raises awareness about the teachers' amount and types of talk in basic science classrooms and provides a basis for reflection and opportunity for improvement in practice. The current study does not only intend to encourage teachers to reduce the amount of their talk. It also intends to encourage teachers to be aware of the quality of their talk and decide whether it serves educational goals and the essential context of teaching. Another objective of the current study is to promote pupil-pupil classroom collaboration, increase pupils' talk, enhance their verbal competency and self-esteem, and promote critical thinking, thereby improving students' learning outcomes.

1.2.2 Scope of the Research

This section explains the areas and parameters of coverage of the current study.

The study is limited to Ekiti State in Nigeria, including urban and rural geographical areas, to facilitate the collection of rich data from an in-depth observational field of the classroom practices of a set of case study teachers before and after a highly personalised intervention. The areas selected were accessible to the researcher. The study is limited to junior secondary school foundation classes (JSS1). Five junior secondary schools and five teachers were involved in the study. In all five classes comprising about two hundred and fifty students, 45 students were selected for the study. The subject was limited to basic science, so subject-subject-related variability in the data was not an important factor; the

researcher's principal interest is in the quality and quantity of interaction in basic science classrooms.

1.2.3 Significance of the Research

This section describes the study's importance and its benefits.

It is predicted that the research findings of the present study will provide the teacher participants with their objective classroom behaviours, thereby modifying their teaching behaviours by replaying and reflecting on the outcomes of learning. Participating in the current study may improve teachers' confidence and quality of questioning and create reflective teachers who are objective about their classroom practices. The study can serve as career motivation for the teachers through gaining valuable information realised through anecdotal experiences. For other teachers, the findings of this research intend to serve to provide new awareness about teachers' classroom practices and facilitate the replica or extended case projects model of interaction.

It is assumed that the findings and conclusions of this research will assist in improving students' verbal competency, make them more responsive to teaching, and change students' attitudes toward teaching and learning. It is predicted that the findings will enhance classroom interaction among students and promote higher-order thinking. This study may also help students develop multiple solutions for specific problems and gain knowledge that there may be several rational choices available. Furthermore, for the researcher of the present study, it is expected that the findings and conclusions of this research will permit the researcher to develop and improve in self-reflective practice and anticipated effectiveness in the teaching and learning process and encourage the researcher to plan an extension and a similar study. The current study will also enable the researcher to gain experience about other teachers' personal experiences. For other researchers, policymakers, and practitioners, it is intended that the findings and conclusions of this research will provide objective and new information about classroom practices in the Nigerian context and serve as research projections for others to be committed to changing classroom practices.

1.3 Research questions

For the purpose of the current study, this section addresses the overarching main research based on suggestions from previous studies on the different types of classroom interactions:

RQ1: What are the different teachers' interaction patterns presently used in teaching basic science in junior secondary schools in Nigeria?

RQ2: What are the effects of awareness intervention on teachers' interaction patterns in basic science classrooms?

RQ3: What are the issues that teachers say affect classroom interaction patterns in basic science lessons in Ekiti State, Nigeria?

The study carefully focuses and observes the various patterns of teachers' classroom behaviours, in addition to this, the roles that students' responses and initiation play by investigating the following sub-research questions for RQ1 and RQ2:

Sub-RQ1a: What are verbal interaction patterns used by teachers in basic science lessons?

Sub-RQ1b: What are direct and indirect verbal interaction patterns used by teachers in basic science lessons?

Sub-RQ2: What are verbal interaction patterns used by students in basic science lessons?

Sub-RQ3: What non-verbal interaction patterns do teachers use in basic science lessons?

Sub-RQ4: What are non-verbal interaction patterns used by students in basic science lessons?

Sub-RQ5: What are the teachers' different types and time spent on questions in basic science lessons?

Sub-RQ6: What are teachers' silence (wait time) times used in basic science lessons?

1.4 Structure of the Thesis

This section provides the outline of this research work.

Chapter 1, which is the current chapter, provides the background to the study, the nature of the issues, justification for the study, aims and purposes, research questions, the significance of the study, the scope of the study, and the structure of the research. Chapter 2 provides an insight into the Nigerian context of classroom interaction and continuing professional development; reviews the history of education, Nigeria's educational policies and its challenges and issues about problematising teacher education in Nigeria. Chapter 3 involves developing a theoretical framework for the study and a review of key concepts on how children learn and language development in children. Chapter 4 is a review of the literature on interaction patterns and strategies to improve students' classroom engagement. Chapter Five explains pre-service and in-service teachers' professional development and prevailing issues.

Chapter 6, which is the research design and methodology, explores the basis for the approaches used for the data collection and analysis of this work. It also delineates the sampling structure, describes the research instruments, and examines critical issues bordering on methodology and how they were addressed. This chapter also discusses the piloting of the study and examines methods of collecting and analysing the data, and the ethical issues of the research are detailed. Chapter 7 presents the baseline findings from the analysis of the pre-intervention and the findings from the post-intervention analysis. Chapter 8 analysed the teachers' interviews about issues affecting their classroom interaction patterns. Chapter 9 is the discussion of findings from quantitative and qualitative analyses. Chapter 10 gives the conclusion and explains the limitations and implications of the study.

1.5 Summary of the Chapter

The introductory chapter begins with the nature of the issue and previous research on interaction patterns within which this study is framed. The chapter outlines an overview of the African and Nigerian contexts of the study and explains teacher education and classroom interaction in the context of the National policy on education and further provides the nature of teaching and learning of basic science in Nigeria and provides the rationale for teacher education and teachers' continuing professional development in Nigeria. The chapter further described the motivation behind the researcher's interest in the topic and explained the research's problem, questions, purpose, scope, significance, and details of the research structure.

Chapter Two: Nigerian Context of the Study

2.0 Introduction

This chapter is a discussion of the Nigerian context of classroom interaction and continuing professional development and offers a review of the history of education and Nigeria's educational policies and challenges. It also discusses the secondary school education system and its curriculum, the administration and finance of education, policies, and practice of initial and continuous teacher education, and how teacher education is problematised in Nigeria.

2.1 Early Educational System in Nigeria

In considering the present teaching pattern in Nigeria, certain aspects of the history of education are important: before the amalgamation of the three colonies, the North, the West, and the South, with their different traditional and religious leaders; post amalgamation to independence; post-independence.

2.1.1 The Traditional African Education

The education journey in Nigeria began with traditional education with each colony's deeply rooted culture and lifestyle. This kind of Indigenous education fulfilled the purpose of protecting and gaining mastery over the environment, putting food on the table, and feeding the local tribes (Fafunwa, 2018). The skills learnt included farming, trading, fishing, crafting and blacksmithing in farming tools, hunting tools, and war weapons according to the season, climate, and geographical location of the tribe (Fafunwa, 2018). Children were also taught the history of their family and the whole community, families identified certain skills of interest, and the specialised skills were mostly passed on to children by their fathers and grandfathers, and sometimes children were sent to other tribes to learn the skill in another locality or tribe (Fafunwa, 2018).

Fafunwa (2018) explained that skills were learnt through mentoring, advice, shadowing (close observation), listening to elders and masters, and engaging their children in the same activity, and the men were trained as breadwinners in skills involving physical strength and stamina, like hunting, fishing, and farming, while women were trained to

manage homes in cooking, pottery, and weaving. The goal and method of approach of education differ from place to place, people to people and nation to nation. Fafunwa (2018) pointed out that to the ancient Africans and Nigerians, the goal of education was survival and the development of their environment, emphasising social responsibilities and job orientation and an elite was considered a warrior, nobleman, hunter, or man with a combination of these characteristics, and mastering skills inherent in one's family was seen as a virtue. Certain basic principles about the responsibilities of males were passed to the boys by their fathers, and the girls were trained how to greet, cook, and sweep and as caregivers by their mother; other trainers included older siblings, aunts, uncles, and grandparents who, through songs, lullabies, folktales and games and storytelling of legends instil morals and traditions into the children (Umar, 2019).

Fafunwa (2004) further explained that general rules were taught to everyone by the kings and community leaders, dos and don'ts and taboos were passed on to younger generations by elderly ones, and obedience to rules, local laws, taboos, and advice laid down by adults and heads were sacred. Arguments or disobedience to elders, families, or local heads were likened to disobeying the gods, and the very rare offenders were punished publicly in Market squares. Fafunwa (2018) states that this education system was away from the classroom, and children were taught about culture, social activities, etiquettes, societal values, norms, spiritual and moral values by participation, demonstrations, recitation, initiations, and imitation of adults in preparation for adulthood and introduction into the society. The major moral and spiritual values inculcated in children were respect and obedience to local rules, respect for elders, and home training, including methods of greetings and how to sit (Fafunwa, 2018). Children were also taught methods of having conversations with adults, what to say and what not to say, how to respond, and how to behave when talking to adults.

2.1.2 Islamic Education, the onset of rote learning in Nigeria

Islam was brought to Nigeria around 1080-1097 by the Kanem ruler and spread throughout Nigeria in the Uthman Dan Fodyio Jihad in 1804 (Fafunwa, 2018). The Islamic faith spread widely among the Hausas and other tribes like Yorubas and a few Igbos with uniform religion and Quranic educational policy. This brought major changes to life and the educational system in Nigeria. Local priests taught the chapters and verses of the Quran to

people in the Mosque, and Arabic language and its alphabets were also taught as a new language. Islamic education is accepted among Muslims in Nigeria. It is a form of formal education for transmitting Islamic norms, values, culture, and tradition by learning through recitation and memorisation of the Quran and Islamic practices. The teacher, called *Mualim*, dictates the verses of the Quran in a piecemeal fashion to the learners (Fafunwa, 2018).

Islamic Education involved the coming together of Muslims to establish Mosques and Islamic centres. The formal classrooms for learning could be a veranda, inside a Mosque, in a parlour, in front of a house, and under a tree shed where the learners memorise in chant-like songs from word to word, verse to verse and verses to chapter(s) of the Quran (Abdulrahman, 2018). This is either done in a chorus group or one-to-one recitation. The teacher reads out, and learners repeat it several times until well mastered. According to Fafunwa (2004), the method of rote learning met the goal of Islamic Education for memorising the holy book, while Arabic language, transliteration and translation provide understanding, obedience to basic tenets of the religion and applicability to daily life. However, the rote learning method later crept slowly and deeply into most forms of formal education and marked the beginning of rote learning as a widespread pedagogy in Nigeria (Fafunwa, 2018). Rote learning is tagged ‘La cram, La pour, La forgette,’ which means ‘cram and write and forget’ among Nigerian students today.

Ugwu (2018) asserts that rote learning has been used in almost every level of education and has become the main method of instruction in Nigeria. Ugwu explained that rote learning serves the purpose for which it was introduced in Nigeria, for accurate recall of discreet information from the Quran and the Bible and useful in primary schools to learn the foundation of basic knowledge. In addition, in lower science classes, rote learning is important for memorising basic facts, laws, and principles. Nevertheless, Ugwu (2018) argued that rote learning had been excessively used in schools and that when vital information is turned into songs, the idea or purpose of the information is forgotten. Ugwu (2018) further states that in addition, most information is excessively repeated, which wastes time, and rote learning rarely supports sharing ideas, creativity, comparison, clarification, analysis of different ideas, and the use of open-ended questions to guide the development of critical thinking. Earlier in corroboration, Mayer (2002) stated that considering that rote

learning does not allow the clarification of ideas, it may lead to misconceptions of ideas or concepts.

2.1.3 The coming of the missionaries and their role

The first English Christian missionaries arrived in Lagos-Badagry, Nigeria, in 1842 for evangelism, business, and commerce (Fafunwa, 2004), and the idea of evangelising Nigeria through Education stemmed from the Church Missionary Society in London and Freetown. However, the Methodists first sent missionaries and established the first school in Badagry in 1843 with fifty pupils so that people could be able to learn to read the Bible in English and local languages; gardening, farming, training of local schoolmasters, clergypersons and catechists were their other objectives (Fafunwa, 2004). By 1845, the CMS had established two schools in Badagry before proceeding to Abeokuta, and the early mission schools bore similarities to the Islamic schools (Okoro, 2018). According to Fafunwa (2004), the teaching method was rote learning or memorisation, and the Bible was also the textbook for teaching, as the Quran in Islamic Education.

Fafunwa (2004) and Umar (2019) opined that these early missionary schools lacked standards and did not have curricula; they valued music using hymn books, which served as songs of praise sung before any activity. The content of the education taught was referred to as a monument and consisted of folklore and recounting experiences, and the missionaries also engaged in meetings, feasts, services, and lots of music. Christianity became immensely powerful because of the availability of funds from the British colonies, and the establishment of churches became competitive among different missionary denominations (Umar, 2019). Unfortunately, the early colonial masters, continuing in the like of indigenous education and Islamic education, did not tolerate questioning or analysis. It was “do as I say” (Enu and Eba, 2014). The system of learning focuses on rote learning by repetition and singing until memorisation is achieved.

Furthermore, the rote learning or memorisation method, which does not support critical thinking, creativity, analysis, and questioning, has gradually crept into almost all educational and training facets. Ugwu (2018) argued that in kindergarten and primary schools, every piece of information is turned into songs by the teachers who recite and repeat words over and over again. Ugwu explains with concern that sometimes pupils often forget

the genuine idea of the information, for instance, parts of the body, the national anthem and pledge, mathematical tables, mathematical signs, and states and capitals. Ugwu (2018) asserts that for most children, it was the song that appealed and not the ideas; even in homes, when children are sent messages, the messages are equally turned into ordinary songs, not only because of memorisation but also for enjoyment - but once the process is interrupted for example to greet someone passing by, the whole message wipes off. Ugwu added that as children grow up, they normally lose interest and forget the substance of the songs as they grow up. Sadly, this rote learning singing method laid our educational teaching background and prevails until today.

2.1.4 Universal Primary Education (UPE) in the Western Region

According to Jabaar (2014), in 1955, education was declared an emergency by Chief Obafemi Awolowo, who oversaw the Western region, which comprises the Yorubas, and believed that education was an agent of change, hence the launch of the Universal Primary Education (UPE) in the west on the 17th of January 1955. Ayodele and Ajayi (2002) noted that this marked the beginning of an educational revolution in Western Nigeria and Nigeria as a whole. Enrolment in primary schools in the region increased from 457,000 in 1954 to 811,000 in 1955, and the number of primary school teachers increased from 17,000 in 1954 to 27,000 in 1955 (Ayodele and Ajayi, 2002).

Amopho (2020) stated that the education budget of the western region of Nigeria increased from 2.2 million pounds in 1954 to 5.4 million pounds in 1955. About 90% of the education budget in the year was spent on primary education. By 1958, the enrolment of pupils in primary schools in the region was more than one million. The free universal primary education (UPE) in the Western region invariably led to falling primary school standards as enrolment increased. There was a great expansion in education, and demand for more facilities increased, which resulted in the predominance of too-large classes, use of untrained teachers, unsatisfactory syllabus, inadequate supervision of schools, lack of teaching and learning materials and necessary facilities, and lack of cooperation by parents (Amopho, 2020). Some old pupils were used as teachers to train the younger ones because of a lack of trained teachers to cater for the massive enrolment, and the newly introduced English medium and methods of communication were too strange, new, and foreign for the Nigerian child, so the curriculum was clumsy to implement (Fafunwa, 2018; Umar, 2019).

A nine-member Ashby commission was set up in April 1959 to investigate Nigeria's need in the field of post-school certificates and higher education over the next 20 years (1960 – 1980), released its retitled "Investment in education" was submitted in September 1960 (Fafunwa, 2004). The recommendations were as follows:

1. There was no good relationship between primary and secondary levels of education and between secondary and post-secondary education.
2. Three-quarters of the teachers in the country were uncertified.
3. Ninety per cent of the teachers in primary schools were untrained for the job.
4. There were insufficient schools to cope with the number of children seeking admission into primary and secondary schools each year.
5. The commission was critical of the white-collar job nature of the educational system, for emphasising literary education to the neglect of technical, commercial, and agricultural education.

The commission also noted the educational gap between the North and South of the country, based on which it made valuable suggestions for correcting the imbalance. The educational systems in the regions had similarities and differences; they all consisted of primary, post-primary, and further education. Secondary education bore similar components, during the duration of primary varied from region to region. However, Nigeria's amalgamation, regionalisation, and federalisation and the various changes made to different ordinances and policies affected the education system and slowed the country's education development (Fafowora, 2013).

Nigeria, after gaining independence in 1960, with 36 federating states, more than 250 ethnic groups, 500 different distinct mother tongue languages and distinct varieties of cultures until now still operates a single centralised educational system and still retains the inherited educational policy from the British colonial government (Eneh and Owo, 2009). A major curriculum conference was held to reform Nigerian education programmes in 1969, which led to the first post-independent and independent national policy to address the unique local needs of the federating states. Apart from the fact that the 1977 educational policy had only undergone many revisions to date, the problem remains not only making an utterly new reform in policy but also addressing poor implementation, lack of sound monitoring and

evaluation, lack of effective funding, and the need for sound and genuine review of public projects and strategies (Eneh and Owo, 2009).

In conclusion, the above background to the history serves to understand the early efforts made toward the educational system in Nigeria and the challenges faced. The section has highlighted how the traditional method of learning, such as folktales that encouraged the active engagement of pupils and team building, later transformed into the rote learning method both in religion and early Western education. It also explains how free UPE education resulted in a population explosion in classrooms and the use of untrained teachers, hindering effective classroom interaction.

2.2 Policies on Education in Nigeria and Challenges of Implementation

The 1977 policy on education had been edited and updated several times to meet different purposes. There has not been a completely new formulated policy since 1977: in 1981, it was reviewed so that the Federal government could shed the responsibility of free education and transfer it to states. The 1977 policy was reviewed in 1998, 2004, and 2007 to reflect Nigeria's dynamic cultural transmission and changes.

The 1998 NPE version was edited three times, with the 3rd edition containing the changes which raised the minimum standard for entry into the teaching profession to the National Certificate of Education from teacher grade II certificate to improve the quality of teachers. NPE (1998) specified compulsory but unenforced universal basic education for all children for nine years; six in primary and three in junior secondary school. Since the policy was not enforced, according to Imam (2012), Quranic education continued to thrive in the northern states of Nigeria. The fifth edition of the 2007 NPE was revised to include some government reform agenda outlined in the National Economic Empowerment and Development Strategy, to meet the millennium development goals, achieve EFA, and respond effectively to the UBE.

The 6th edition of the 2007 NPE, revised in 2013, revisited and repositioned some educational goals related to this work that include: continuing education shall be a part of every educational level; every child shall be taught in his or her mother tongue language or the language of the immediate environment for the first four years of basic education;

promotion of all children's physical, emotional, and psychological development; and the creation of a free and democratic society. The NPE stipulates that at each level of lower education, each child should learn one of the major languages in Nigeria (Igbo, Yoruba, and Hausa). The NPE (2013) stated that the government must ensure that educational activities are centred on the learners' personal growth and actualisation and that instruction is supported by information and technology and activity based. The realities of these goals' implementation and achievement are explored in a subsequent section of this chapter.

The FGN in 2013 NPE states that education shall be free, compulsory, and qualitative for the first ten years of education, one-year nursery, six years in primary, and three-year junior secondary school. The NPE prescribed qualitative education to develop critical thinking, cognitive development, and problem-solving abilities to create self-reliant individuals. Although compulsory and free in contrast to the 1998 and 2007 policies, according to Ogbidi, Oribhabor, and Okhiria (2018), this policy contains empty words as it is not enforced. The NPE states that the teacher-student ratio shall be 1:35 for effective teaching and learning at the junior secondary school level, and the basic science curriculum shall have elements of basic science, basic technology, information technology, and physical and health education.

The gap between policy formulation and policy implementation has geared inquiries into factors responsible for Nigeria's poor implementation of educational policies. Adesina (2012), Ogbidi et al. (2018), and Ololube (2013) have traced the implementation problems of educational policies to the planning stage. Ololube (2013) and Ogbidi et al. (2018) remarked that after examining such aspects as the planning environment, social environment, political environment, and financial and statistical challenges, good planning would ensure the effective implementation of educational policies. Ololube (2013) commented that with the above observation, proper planning would aid analysis, formulation, implementation, and control of all actions that evolve to achieve the desired objectives and educational goals.

The planning would address societal needs: environmental, political, sociocultural, economic, military, cultural, technological, and scientific realities of the society. According to Adeyemi and Adeyemi (2012), Okoroma (2006), and Ogbidi et al. (2018), the planning stage in Nigeria is inhibited by factors such as inadequate statistics due to failure to acquire up-to-date and sufficient data, underestimation of the cost of implementation and

overestimation of available resources, ineffective communication process, incompetent staff, lack of political support, time constraints, and inadequate financial resources. They further identify a clash of inclination tendency as some individuals charged with the responsibility for performing some duties may not carry them out. Ogbidi et al. (2018) and Okoroma (2006) acknowledged some critical challenges faced by the UBE programme (free education for all in the first nine years) as inadequate fund allocation, inadequate teaching and learning facilities, poor motivation of teachers, unqualified teachers, inaccurate statistics for numbers of children in school. Barely a year after the programme's launch, the government had spent almost twice the money budgeted.

Apart from the general hindering factors of implementing policy in all facets of education in developing countries, Nigeria has peculiar problems causing the lack of implementation or ineffective implementation of education policies. These are corruption, implementation of the language policy, lack of political stability leading to lack of political will and failure to carry out duties. These are discussed below.

2.2.1 Corruption

Hardman et al. (2008) and Okoroma (2006) commented that despite Nigeria being resourceful and the giant of Africa in terms of being a major producer of gas and oils, the National Bureau for Statistics (2012) reports that 112.6million Nigerians live below the poverty line of \$1.00 per day. The report explained that about 60.5% of Nigerians are living below the humanly acceptable level of food intake. Ucha (2010) explained that corruption in Nigeria has become endemic and systemic. Transparency International (2021) released the corruption perception index, ranked Nigeria the 2nd most corrupt country in West Africa, with a score of 24 out of 100 and a ranking of 154 out of 180 countries, with a score drop from 26 in 2019 and 25 in 2020 and a scale of 0-highly corrupt and 100 -very clean.

Poverty in Nigeria has been strongly and directly linked to corruption in Nigeria. Ucha (2010), Eleagu (2018), World Bank (2014), and Okoroma (2006) explained that leaders abuse entrusted power for personal gains, which negatively affects all developmental initiatives to address poverty. Ucha indicates that corruption has invaded all aspects of Nigerian society, and despite the enormous oil and gas reserves, people wallow in poverty. Okoroma asserts that government funds are misappropriated and that the people at the level

of government and politicians and their families swim in wealth. Okoroma (2006) also noted that the money that the government votes to run schools does not get to the schools, and what does get there is usually wasted by those in charge of administering the schools. The studies above concluded that corruption has virtually become a way of life in Nigeria.

Ilechukwu (2014) described the many ways corruption manifests itself in Nigeria, like bribery, extortion, and the illegal exploitation of public property for private gain, and this is supported by Iheanacho (2015), who stated that government officials and politicians collude with private organisations to divert billions of naira meant for programmes. Iheanacho (2015) lamented various ways that corruption affects the implementation of educational policies in Nigeria as over-invoicing, payment to ghost workers and pensioners, payment for items not delivered or services not given, and underpayments of exports and imports, purchase of goods at inflated prices, fraud, and embezzlement, theft of cash and assets. Iheanacho further noted that Agencies like EFCC that are meant to curb these activities have become powerless because of the high level of corruption in the country.

2.2.2 The implementation of the language policy

English has been accepted as the official medium of communication in Nigeria since the colonial era. In 1927, the British Advisory Committee on native education in Tropical Africa recommended the use of native language as a medium of instruction in lower primary education. The NPE 2004 page 10 clearly restates that every child shall be instructed at the primary school education level in the language of the immediate environment. Nigeria, a multi-lingual and multi-ethnic country, comprises about 500 indigenous languages, highlighted only three of these languages in the 2004 NPE, Hausa, Igbo, and Yoruba, are to be studied and used as a medium of instruction, where the language of the child's immediate environment differs from these three.

Ibrahim and Gwandu (2016) noted that this had become a major contemporary concern because of the high multi-lingual nature of the country, with people within a 20km radius not understanding each other's language. This might be why teachers and administrators of education resort to speaking English. Moreover, there is no law enforcing the use of multi-lingual language. Egwutuoha (2016) asserts that this results in the "warm embrace" of the foreign English language, which has become a competition, a fashion, and or

a norm among schools, and the standard of a school is judged by the level of English the pupils comprehend or speak even at nursery level; the native language has been tagged as vernacular and gradually fading off in schools.

Scholars are divided on which language should be used as a tool for teaching and learning. Although NPE recommends the use of English, some notable people continue to promote vernacular languages in education, especially at higher levels, such as secondary schools and universities (Egwutuoha, 2016). Egwutuoha (2016) further illuminates that due to arguments in academic circles surrounding the language of teaching, proponents of this position argue that the child is more likely to benefit from school if taught in the native language. Ibrahim and Gwandu (2016) posit that the NPE on language has proven challenging to put into practice by those who have direct contact with pupils (teachers), so efficient communication and effective teaching and learning continue to be inhibited because English is learnt or used as a second language in schools. Ibrahim and Gwandu (2016) further explained that because children have acquired and processed their mother tongue language before starting school, this negatively interacts and interferes with second language learning.

2.2.3 Failure to carry out duties.

Nwekeaku and Obiorah (2019) lamented that in Nigeria, there is no strict judgment against public officers who do not efficiently carry out official duties because of personal relationships or connections with high political officers. For instance, Nwekeaku and Obiorah lamented that Nigeria's public service is plagued with lukewarm attitudes to work, inefficiency, poor organisation, incompetence, laziness, truancy, malingering, apathy, indiscipline, insensitivity, rigidity, corruption, and favouritism. To these, the FGN established SERVICOM in 2004 as a reform to promote effective and efficient service delivery of Ministries, Departments, and Agencies (MDAs) (public services). Nwekeaku and Obiorah's (2019) report shows that the duties and responsibilities of SERVICOM units were jeopardised because the units are independent of the MDAs within which they were formed and that as of 2019, 15 years later, there had been no report of any public officer who has been punished for those offences or negligence of compliance with service provisions.

2.2.4 Lack of political stability leading to lack of political will.

Instability in government causes a lack of continuity with constant change in regime and policy in Nigeria, as argued (for example) by Effiong and Asuquo (2011), who noted that successive leaders discard the policies of their predecessors and formulate new ones and that uncertainty discourages the political will to implement policies. Effiong and Asuquo gave an example of the replacement of the UPE by the UBE. In addition, Okoroma (2006) states that in the first forty-five years of Nigeria's independence, Nigeria had twelve leaders, of whom only four were democratically elected, and the rest were military heads of state who had no time to prepare action plans because they became leaders in a hurry.

2.3 The 6-3-3-4 system of education in Nigeria

The 6-3-3-4 system, adapted from American schooling, translates to six years of primary school, three years of junior primary school, three years of senior secondary school, and four years of tertiary school. NPE (1981) notes that the major aim of the 6-3-3-4 system is to promote technological development in Nigeria to meet the dynamic global economy by prioritising building the technical capacity of students from secondary schools. The implementation of this policy commenced in 1982, and according to Oyelere (2015), one of the objectives was to produce among students unable to go to tertiary institutions self-reliant secondary school graduates who can effectively use their hands, hearts, and heads.

2.3.1 The (3-3) aspects of the policy on education.

Oyelere (2015) explained that the 3-3 aspect of the 6-3-3-4 NPE is meant to build various skills and promote jobs that match the various skills acquired at the end of junior secondary school for pupils who do not pass the junior secondary school examination and those who want to get jobs at this level. Oyelere (2015) narrated that to promote technical education in Nigeria, the federal government established science and technical secondary schools and polytechnics, vocational and technical education schools under the Colleges of Education and Universities of Science and Technology. Sadly, this level of the educational system that could have promoted classroom participation, improved engagement, and cognitive development during skill acquisition has failed due to the challenges explained below.

2.3.2 Challenges of implementing 3-3 secondary school aspects of the educational policy.

According to Okoroma (2006) enormous number (2015), the 3-3 failed due to a lack of adequately trained or qualified teachers for the programme, inadequate workshops, inadequate operational machines, inadequate fund allocation or release, lack of guidance and counselling services, laboratories and libraries are either unavailable, not equipped, or not adequately planned to accommodate the large number of students that the free education attracted (teacher-student ratio of about 1-35). Many secondary and technical schools were in villages where there was no electricity, and the few generators supplied were stolen in parts before installation.

Oyelere (2015) asserts that science and technology education is expensive, and the government of Nigeria is not eager to commit a huge amount to it. Okoroma (2006) and Oyelere (2015) explained that after twenty-two years, implementing the 3-3 aspect became controversial, and there were lamentations everywhere about Nigeria's deplorable state of secondary education and without empirical research to compare the old adopted British 6-5-4 and the newly adopted American 6-3-3-4 systems. The 6-3-3-4 was again pronounced unsuitable, and in 2006, the FGN introduced the 9-3-4 UBE to replace the 6-3-3-4 system of education. The nine years (six years in primary school and three years in junior secondary school) entail a nine-year free, continuous, and automatic promotion from one class to the other with no entrance examination to senior secondary school to fulfil the Millennium Development Goals (MDG) of free education for all. Okoroma (2001; 2006) and Oyelere (2015) believe that the 9-3-4 system was more of a disaster than the 6-3-3-4 system and that the policy implementation problems are even more evident in tertiary education.

In the researcher of the current study's opinion, Nigeria's educational system continues to suffer despite our awareness of these challenges. Maybe (and this is one of the contentions of the current thesis) Nigeria needs to look inward at its local challenges and formulate new local policies with local implementation modalities in total consideration of our environment.

2.4 A competency-based curriculum (CBC).

The international bureau of education (IBE-UNESCO) (2017) describes a Competency Based Curriculum (CBC) as one that stresses what learners are required to do, in contrast to a knowledge-based curriculum that concentrates solely on what learners are required to know. In theory, such a curriculum is learner-centred and adaptable to students, teachers, and society's evolving needs. In contrast, Niemelä (2022) explains that a knowledge-based curriculum focuses on content to be learnt and emphasises high academic achievement and traditional teacher-centred pedagogy. A skills-based curriculum encompasses cross-curricular competencies that allow learners to see how skills can be applied in different contexts (Wolcott and Sargent, 2021). A competency-based curriculum is characterised by what learners are expected to be able to do to perform jobs or tasks in different situations after the acquisition of various skills.

2.4.1 The new 9-year basic education curriculum (BEC).

The 9-year basic education curriculum was designed and redesigned between September 2008 and August 2014. It replaces the previous 6-3 part of the 6-3-3-4 system and incorporates the junior secondary curriculum as well as primary education. Following the introduction of universal basic education in 1988, Igbokwe (2015) noted that amidst Nigeria's myriads of problems, the National Economic Empowerment and Development Strategy (NEEDS) identified the urgent need to transform and sustain Nigeria's economy through education that could offer technological development. The two major curriculum reforms in 2008 and 2014 were prompted by factors such as the change in the structure of the education system from 6-3-3-4 to 9-3-4 and the introduction of a 9-year basic education curriculum in 2008. Secondly, to change the curriculum from a knowledge-based curriculum to a competency-based one, the 9-year BEC was redesigned in 2014 to address various current and national challenges and make the curriculum more practicable, meaningful, and student-centred and generate young learners' interest. As well as in accordance with worldwide best practices, for instance, Kenya -7 subject, Tanzania- 8 subject, United States of America -6 subject, Malaysia, and Indonesia -9 subject offerings.

The federal government of Nigeria, via the Nigerian Educational Research and Development Council (NERDC), derived and presented the 9-Year Basic Education

Curriculum (BEC). According to NERDC (2013), the BEC contains the pertinent aspect of the National Economic Empowerment and Development Strategy (NEED). The teaching and learning stressed are on creating competencies such as creative problem solving, entrepreneurship, and job skills to make the curriculum competency-based. Because the 9-Year BEC represents all learning that students must be exposed to, a provisional guide was made for contents, performance objectives, teachers' and students' activities, teaching and learning material, and assessment. The Junior Secondary School (1-3) aspect of the newly derived 9-Year Basic Education Curriculum NERDC 2013 version, which is the concern of the present study, contains ten subjects, with a provision to offer a minimum of 9 subjects and a maximum of 10 subjects. Basic science and technology are thematically presented as basic science, basic technology, physical and health education, and information technology within the JSS 1-3 aspect of the curriculum.

Imam (2012) states that the FGN, through the 2013 NERDC version, explained that the curriculum reform initiative explicitly designed science, technology, mathematics, and vocational education and training to give the contents, learning opportunities, and competencies such as good communication, collaboration, critical thinking, creativity, and digital skills needed to perform jobs and activities for Nigeria's national socio-economic development. Imam further reflects that one of the functions of the 9-year BEC is to ensure, among other things, that learners can develop critical thinking, entrepreneurship, and life skills to perform their jobs or activities in order to thrive.

2.4.2 The competency-based nature of the 2012 revised Basic Science and Technology Curriculum.

Oyelere (2015) explained that the FGN replaced the old 6-5-4 system (which was adjudged to promote only white-collar jobs) with the 6-3-3-4 competency-based science and technology curriculum. Oyelere added that the entire skilled-based nature aims to enable learners to develop specific talents to perform small and micro-enterprises beyond academics aiming at the traditional employment pattern like medicine, engineering, and teaching.

In 2006, to fulfil the Millennium Development Goals (MDG) of free education for all, the FGN introduced 9-3-4 UBE to replace the 6-3-3-4 system. The nine years (six years in primary school and three years in junior secondary school) entail a nine-year free,

continuous, and automatic promotion from one class to another with no entrance examination to senior secondary school. Hence, the 2008 Basic Science and Technology curriculum was explicitly revised in 2012. According to NERDC (2013), the main objectives of the new 2012 BSTC edition are to anticipate learners' development and application of scientific and technological knowledge and skills useful in the present and future world. Other objectives include enabling students to utilise a wide range of available options through science and technology, equipping students for advanced scientific and technology degrees, and shunning drug misuse and other vices while prioritising safety and security. These objectives highlight the competency-based nature of this curriculum. According to the curriculum, the teachers would attain this by promoting inventive teaching, learning strategies and activities prescribed under each topic that enhances students' skillfulness, learning by doing and critical thinking.

TABLE 2.1 THE STRUCTURE OF THE NEW 2012 REVISED BASIC SCIENCE AND TECHNOLOGY CURRICULUM (SOURCED FROM NERDC, 2012)

Theme	JSS
	Sub-theme
Basic Science	<ul style="list-style-type: none"> -Learning about our Environment -You and Energy - Science and Development
Basic Technology	<ul style="list-style-type: none"> -Understanding Basic Technology -Materials and Processing -Drawing Practice -Tools, Machines and Processes -Safety
Physical and Health Education	<ul style="list-style-type: none"> -Basic Human Movement -Sports and Games -Health Education -Moving our Body Parts -Athletics -Contact and Non-Contact Games
Information Technology	<ul style="list-style-type: none"> -Basic Computer Operations and Concepts -Computer Ethics -Computer Application Packages -Basic knowledge of Information Technology

NERDC (2012) listed prominent issues infused into the BSTC, including climate change, HIV/AIDS, food and drugs safety education, environmental education, drug abuse education, disaster risk reduction education, safety, and safety security, consumer education, and entrepreneurship. According to Igbokwe (2015), the contents above, if taught effectively with student-centred approaches, could enhance students' interest in science learning and may help develop talents that could convert knowledge, skills, and attitude acquired into high proficiency in performing whatever job or work they do. This will finally shape the modern growth and development of individuals and Nigeria as a nation.

Igbokwe (2015) opined that the spiral nature of the curriculum, from simple to complex, is to spur students' interest and enhance the development of skills and purposeful learning. Igbokwe (2015) further noted that the curriculum encourages the use of locally acquired resources and familiar, local real-life examples that foster the development of key traits and survival techniques for living effectively in today's global environment. The BSTC curriculum contains many suggestions about classroom practices that could improve the quality of students' classroom participation, keep students engaged, improve learners' interests, and verbal competencies, and promote teamwork, as suggested by the current study. The BSTC also allows teachers the choice to source local materials to relate topics to the immediate environment if there are challenges in the provision of materials or equipment.

Imam (2012) noted that for the effective implementation of the 9-Year BEC, the Federal Government of Nigeria produced some teachers' guides in the ten subjects through the Nigerian Educational Research and Development Council. The teachers' guide in each subject includes seven units on how to: (1). Understand the curriculum. (2). Split the curriculum into syllabi. (3) divide the curriculum into a scheme of work, units of work, and lesson plans. (4). Create a lesson plan that incorporates innovative instructional strategies. (5). Teach difficult-to-understand subjects and concepts to students. (6). Search, obtain, and generate instructional resources and (7). Evaluate students in each subject. Distinctive modern practices highlighted in the teachers' guide produced by NERDC comprise engaging in learner-centred teaching, using information and communication technology, and linking teaching and learning to learners' social or immediate environment.

These ideas of practices that are innovative in the Nigerian context were also supported by Ogunleye and Sowunmi (2020), who point out that distinctive creative

classroom techniques highlighted in the teachers' manuals are intended for learner-learner, teacher-learner, and school-school collaborations and emphasise teaching and learning activities about issues arising from the students' surroundings. Ogunleye and Sowunmi (2020) further explained that the activities in the guides are learner-centred and problem-solving oriented, and they promote student-teacher, student-student, pair, or pairs work with learning materials that foster the development of critical thinking among students. The curriculum and the detailed teachers' guide illustrate that the BSTC is competency-based and should be implemented as such using more pupil-centred pedagogical approaches.

Ogunleye and Sowunmi agreed with the present study that suggests that rote learning is not enough in the teaching and learning of science if the nation is to achieve the goals of the BST curriculum since it is not just for knowledge and skills transmission. The BSTC aims at what learners can do. Incorporating learners' interactive, participatory activities into their classrooms, as suggested by the researcher, is likely to go a long way towards achieving the knowledge, skills, and attitudes needed to attain high proficiencies and effectively perform jobs, thrive, and be proud of own cultural heritage, and eventually, improve Nigeria's technological and economic growth.

According to NERDC, the teacher's guide recommends the organisation of national workshops and seminars to train teachers in the effective use of the guide in order to achieve the change the nation desires. Apart from what to teach and competencies to be developed, various forms of assessment focussing on competencies to be assessed have been introduced in the competency-based science curriculum. Danmole (2011) states that the policy of the UBE indicates a major school-based assessment (continuous assessment, CA) of learning outcomes. Various forms of assessment, such as illuminative, diagnostic, summative, and formative evaluation, are introduced because the competency-based science and technology curriculum focuses on the development of many skills. The policy specifies that CA constitutes 60% of the overall assessment, and the remaining 40% is through a standard examination conducted by the state ministry of education and moderated by an approved body.

2.4.3 Emerging issues on the new BST curriculum and implications for teachers.

In addition to the scores of challenges to the implementation of the NPE earlier discussed in section 2.2, Abakpa (2013), Akpan (2012), and Okpala (2011) lament the lack or inadequate structure, materials, and appropriate activities, lack of specialist teachers, and inadequate mentoring, support, and supervision of teachers to promote effective curriculum implementation in the schools. Specifically, in the new BST curriculum, Ukor and Agbidye (2015) and Danmole (2011) found some contentious issues that include all four core curricular subjects (basic science, basic technology, computer science, science and development, information, and communication technology) being merged as basic science and technology, which these authors regard as unnecessary. They further indicate that in current practice, teachers employed to teach basic science also find themselves teaching other core subjects like computer science, family life, sexually transmitted infections, and drug abuse education which require special relevant competencies. This makes teaching more challenging for the present basic science teachers.

Ukor and Agbidye (2015) and Danmole (2011) further reinforced the concerns of other stakeholders about the capacity of one teacher to teach the different areas in one subject without adequate training and retraining. Four languages are represented as subjects amongst the compulsory ten when the trend in the world is economic competition driven by science and technology. They argued that this negates the achievement of the objectives of entrepreneurship and self-reliance and could compromise the learning experiences as learners will have less time to concentrate on learning science (Ukor and Agbidye, 2015).

One other criticism is that the former basic science curriculum was phased out too soon; the rate of change in the science curriculum has been extremely high since 2008. Atomatofa and Agadaigho (2010), Ukor and Agbidye (2015) and Odili and Ajuar (2011), in their studies, found that very few teachers have knowledge of the new BST curriculum as the new curricula were not available in most schools, so the teachers have not been involved in the implementation. Ukor and Agbidye (2015) further found that by 2015, some teachers were still writing integrated science as the nomenclature for the subject following the 1988 version of the 6-5-4 system and were not aware that the curriculum had been through two successive changes.

Despite the policy that the school-based assessment of BEC is to identify students for further education, training and employment, this change in policy has not yet yielded results (Imasuen and Iyamu, 2021). They claim that the school structure and educational systems are unsympathetic to the learning goals of the new BSTC, so they lack sensitisation programmes or initiatives to create awareness for value change towards these new learning goals; schools tend to stress memorisation of facts rather than creative problem solving; because, parents and students are unaware of the new learning goals, their interests in education remain those related to seeking white-collar jobs.

Imasuen and Iyamu (2021) and Adediwura (2012) found the frequent use of tests as an assessment technique rather than the school-based assessment prescribed by the policy and that checklists, sociometric techniques, anecdotal records, personality, and attitude scales were seldom used in the assessment of students in junior secondary schools despite them being prescribed in the new BEC. They argued that testing only encourages teachers and students to aim at performance goals rather than learning goals. Ukor and Agbidye (2015) and Danmole (2011) also observed that the science teachers who are expected to implement this curriculum are not adequately sensitised and trained (or retrained) on how to implement the new curriculum, especially around new emerging issues. Oluwatayo (2012) found that most basic science teachers are not computer literate in Ekiti State, without which the implementation of the new BSTC may be hampered.

2.5 Secondary school management and administrative challenges in Nigeria.

Olorunsola and Belo (2018) stated that the principal is to ensure that the students and teachers meet the standard set by the goals and mission of the curriculum and education by effectively and diligently performing the responsibility of providing leadership and management role. According to them, these roles are to ensure the instruction that the teacher provides is consistent with the policy and curriculum requirements; promote cooperation between staff; supervise and evaluate teachers' and students' teaching and learning and encourage teachers' professional advancement to improve their classroom practices. Furthermore, the BEC requires significant development, implementation, and maintenance expertise. Hence, the principal's competency is significant in carrying out the roles mentioned above.

However, Uwiyi and Usuji (2014) and Abdulrahman (2012) argued that despite the expertise required by the policy and curriculum in discharging education leadership roles, political factors in the appointment of these leaders by the state government hinder their competencies. They decried mediocrity in the appointment of academic amateurs, which makes the effective management of secondary schools difficult and hinders the achievement of BEC and the goals of education. Achuonye and Nwiyi (2010) submit that the poor state of school facilities, lack of ICT materials, lack of internet services, emails, computers, and digital libraries impede the quality of classroom activities and effective teaching and learning of the merged BSTC. Achuonye and Nwiyi (2010) also found that the crumbling state of most of the schools' buildings is not fit for human habitation, machines, and equipment; the teachers' classroom practice is inhibited by the poor physical environment of the schools, therefore making teaching, and learning difficult. Uwiyi and Osuyi opined that the government did not also take cognisance of the long lingering problem of unstable national electric power supply or total lack of power supply in many rural areas, making it impossible to power the computers that are key to the components of the BSTC.

2.5.1 Financing Education.

Despite the fact that UNESCO recommends that 27% of a nation's budget be allocated to education, the FGN report of FGN annual budget for education funds allocation between 2012-2021 as 2012(8.4%), 2013(8.7%), 2014(10.6%), 2015(10.75%), 2016(7.92%), 2017(7.4%), 2018(7.04%), 2019(7.05%), 2020(6.7%), and 2021 (5.6%). This reveals that education funding had not been up to 15% within ten years; instead of striving to reach the minimum standard set by UNESCO, the funding is decreasing. The fund allocated, if released, according to Adeyemi (2011), is shared between the primary, secondary, and tertiary education sectors, which results in severe underfunding of education in Nigeria, which affects infrastructure. Ehulonu and David-west (2020) assert that a cursory look at Nigeria's primary and secondary school buildings reveals walls, tables, and desks without instructional materials that could promote learner-centred activities and enhance classroom talk and cognitive development.

2.6 Policy and practice of teacher education and continuing professional development programmes in Nigeria.

Section 8 of the NPE 2004 emphasises that the goal of teacher education in Nigeria is to produce efficient teachers and to encourage teachers' commitment to the teaching profession at all levels of the educational system. It stresses training and professional development and buttresses that with in-service teacher training, which is conceived as a part of continuing teacher education to cater for deficiencies which are also envisaged within the scope of the current study is also to explore the possibility of encouraging teachers to see the need to change their classroom interaction patterns through training. The various pre-service and in-service teacher education offered in Nigeria as required by the NPE occurs at post-secondary institutions like Colleges of Education, which could be technical, special, or conventional.

2.6.1 The policy on teaching as a profession in Nigeria and competencies required for pre-service teacher training.

The NPE 2004 approved the possession of a minimum qualification of Nigeria Certificate in Education awarded by the Colleges of Education and the National Teachers' Institute to qualify as a teacher in junior secondary schools. Oyebade (2012) reports that others with higher qualifications can also apply, such as a first degree in education, a first degree in other courses in addition to a postgraduate diploma in education (PGDE), and a master's degree in education with PGDE. The NUT established the Institute of Certified Teachers of Nigeria (ICTON) to provide automatic certification to its members.

UNESCO (2013) states that quality education demands highly qualified and committed educators who use active methods and practices to enable learners to have exceptional knowledge, experience, or skills in the learning process, engage with the content and materials, and control and own their learning in varieties of approaches. With the emergence of the global movement, the UN, Heads of State, and civil society organisations (2015) adopted the SDGs and, to integrate the SDGs into the classrooms, recommended that teachers must possess the ability to identify the new competencies that current learners need to develop to address evolving specific complex challenges that are both global and indigenous. The NPE 2004, section 8, paragraph 72 states that "all teachers in educational institutions shall be required to undergo professional training in the methods and techniques

of teaching”, and all education stakeholders agreed on a need for pedagogies suitable for the 21st century.

Based on this, Namubiru (2021) asserts that teachers and curriculum developers in Africa should target the attainment of skills, attitudes, and values that are beneficial to African society, so teachers in Africa must be trained to acquire the skills to teach learners to acquire integrated and meaningful learning experiences that help them grow academically, personally, and socially. Oyebade (2012), in his submission, explained that teachers need specific technical skills to be able to collaborate with learners one-to-one effectively, coordinate group work, integrate the activities in the curriculum and gain knowledge of the subject matter and practical application of information and concepts. Danmole (2011) suggests that process-based learning techniques such as cooperative learning and concept mapping, which require the use of instructional materials and science apparatus, should be taught to teachers to improve the teachers’ science teaching competencies. The policy, the curriculum, and various kinds of research among those cited above are in support of the aims of the current study that encourage teacher training on the use of learner-centred teaching methods and sourcing locally available materials that can promote learners’ qualitative and active classroom talk to develop high cognitive thinking.

2.6.2 Students’ entry requirements and skills into NCE programmes.

The FGN established the National Commission for Colleges of Education (NCCE) with the mandate to lay down minimum standards for all teacher education, including standards for student entry requirements, accredit courses, and academic certificates and awards. Many researchers have found a positive relationship between student entry qualification and academic performance and the quality of teachers produced. The requirement for admission into the National Certificate in Education programmes at the colleges of education in Nigeria is the Senior Secondary School Certificate (SSSC) or its equivalent with five subjects, including English language.

Ogunmakin (2022) and Osokoya (2010) comment that teaching is a poorly remunerated profession in Nigeria which gives teachers a poor societal impression and sometimes causes psychological problems, and the NCE, which is the main delivery and preparation ground for teachers, is often regarded as the route of last resort of entry to tertiary

institutions. Ogunyinka, Okeke and Adedoyin (2015) submitted that most candidates with “A” or “B” in SSSC would rather apply to the popular professional fields of engineering, law, and medicine, resulting in a fall in enrolment in teacher education programmes and, by extension, making it difficult for the minimum policy standard to be implemented. They further stressed that candidates who apply for teacher education have either been denied admission into their area of choice or are unqualified for the more socially accepted and valued professional courses. The academic requirement for gaining admission into educational courses and placements is not as rigorous and has the lowest entry requirements.

The teacher preparation selection process in Nigeria described above disagrees with the International Labour Organisation (ILO) /UNESCO (2019), which recommends that the standard for selection of candidates for preparation for teaching professionals should include (apart from intellectual qualities) morals, physical and personal qualities and the possession of professionally relevant knowledge and skills. In contrast to possession of personal qualities, the Nigerian education sectors conduct admission processes based essentially on minimum academic requirements by certification and not practical skills and experience, while ILO/UNESCO consider other preconditions for admission requirements such as moral rectitude, good communication, and physical and emotional stability (Ogunyinka, Okeke and Adedoyin, 2015).

Many researchers decried the menace of examination malpractices and found it a chronic corrupt practice in Nigeria’s secondary school education system (Okafor, 2021; Onwe and Opa, 2015; Eneh and Eneh, 2014). Animasahun and Ogunniran (2014) highlight the various acts that constitute examination malpractices and state that examination malpractices in Nigeria have become endemic, a norm and almost everybody is involved in this menace, including school heads and examination officials who collude with parents and students. According to National Orientation Agency (NOA) in Eneh and Eneh (2014), Nigeria ranked number one in the world’s examination malpractices index. Orji, Madu, and Nwachukwu (2021) view Nigerian society today as a society that has lost the correct perception of differences between right and wrong, good, or bad, uprightness and perverseness and do not see anything wrong in using anything or any means to acquire certificates.

Many teachers and principals connive with exam officers to perpetrate examination malpractices to improve the results of their students in external examinations SSSCE and NECO because they believe that the better the students' results, the more parents enrol students in their schools (Orji, Madu and Nwachukwu, 2021; Okafor, 2021; Eneh Onwe and Opa, 2015; Eneh and Eneh, 2014; Raji and Okunola, 2017). The implications for teachers' classroom practice, according to them, is that most secondary school graduates who present certificates for admission for entry into teacher training schools are not able to defend the certificates claimed at teacher training institutes and are unable to grasp simple concepts, making teaching frustrating or difficult for teachers. Over time, teachers may lose their professional zeal, values, and ethics as this becomes the norm among trainee teachers and in-service teachers who have previously engaged in examination malpractice as students (Orji et al., 2021; Okafor, 2021; Eneh et al., 2015; Eneh and Eneh, 2014; Raji and Okunola, 2017).

The researcher of the current study would argue that intending trainees for teacher education who potentially possess all the characteristics above may be difficult to effectively train as they may need value reorientation and lots of counselling on self-worth, self-esteem, and ethics of the teaching profession. Also, it may be difficult for a practicable, effective pedagogy to be implemented if the same teacher who implements the already cumbersome curriculum is expected to be a counsellor and a value changer. If so, the teachers need to continuously update and evolve their teaching skills and knowledge to tackle evolving societal challenges that hinder effective teaching and learning processes.

The shortfall in the implementation of the educational policy and the competence-based science curriculum that has led to the obsession and desperation with certificates for white-collar jobs calls for actions to encourage changes in teachers' classroom practice. Improving teachers' teaching skills, knowledge, and attitude to promote an active learner-centred approach will encourage learners to develop appropriate skills to become self-reliant and drive the economy (Okafor, 2021) rather than turning out secondary school graduates who may gain admission into teacher training colleges and may later become low-quality teachers who cannot spell their names and lack appropriate skills in the choice of learning and teaching materials (Raji and Okunola, 2017).

2.6.3 Quality of teacher training programmes in Nigeria.

The previous section discussed the policy of students' entry requirements, implementation, challenges, and characteristics of students admitted into teacher training sectors in Nigeria and its implications for teachers' classroom practice. Therefore, considering the discussed numerous and devastating state education in Nigeria, it is obvious that any effort, no matter how little, to improve the quality of teachers' classroom pedagogy at the basic education level is more than timely, so the aims of the present study are justified. This section will now discuss the policy of teacher training curriculum and present teachers' pedagogic approaches to teaching and specific factors influencing the implementation of the teaching curriculum.

The NPE, Section 5B, (sub-section 93 (a, b, c, d), 94 and 96) (2013) describes below the goals of teacher education concerning classroom practice:

- produce highly motivated, efficient, and conscientious teachers.
- encourage teachers' innovativeness and explorative nature in classroom practice.
- make teachers adaptable to changing situations.
- integrate ICT training.
- be aware of changes in methodology and curriculum and
- subject teachers to professional innovations.

Osuji (2009) and Odey and Effiong (2012) criticised the teacher education curriculum in Africa generally and in Nigeria specifically, as structured on general studies, students' field of study and teaching practice and principles and practice of education that is cumbersome and overloaded with academic contents. They concluded that students spend only a little time in teaching practice to learn the art and science of teaching; they rather spend a long time in the lecture room learning theories of education. They further suggest an increase of 40% in the classroom experience for trainee teachers to be able to connect the theories of education with classroom practice to make them better teachers.

2.6.4 Quality of teacher trainers in Nigeria.

The quality of incoming trainee teachers, by implication, affects the quality of teacher trainers, as most teacher trainers were once trainee teachers. Numerous studies decried the poor quality of teachers in Nigeria's tertiary institutions and claimed this to be due to the

challenges previously described in this study facing the educational sector (Osokoya, 2012; Danmole, 2011; Ogunyinka et al., 2015; and Ogunmakin, 2022). They opined that these challenges have led to a brain drain and reliance on inexperienced or unqualified teachers or lecturers, which affects the quality of teaching and graduates who eventually become teachers. Onwe and Opa (2015) reported a case of a scandal involving fifteen lecturers of Ebonyi State College of Education with fake international PhD certificates, who, when thoroughly investigated and found guilty, faced no grave consequences other than demotions.

Onwe and Opa (2015) argued that this seems to be an insufficient deterrent for others, and there is no assurance that the demotion will stop them from perpetrating further similar or same acts and allowing them to remain in the educational system reflects the decay in the sector that further demoralise the teaching profession. This vicious cycle is devastatingly impacting Nigeria's educational section and national development. Teachers need to be aware of important policy and curriculum changes and encourage a positive attitude and value reorientation to contribute positively to improving the quality of teacher education in Nigeria. The current study is relevant in that it encourages teachers to keep abreast of information on new or latest education policies and curriculum reforms, especially the recent competency-based basic education curriculum that affects classroom pedagogy. The current study may help bridge the research gap that found that most teachers are unaware of the 2014 new policy and the new BSTC, so they do not deem a change to a more learner-centred approach that allows learners to engage in active classroom participation and high cognitive thinking necessary.

2.6.5 Pre-service teacher training in Nigeria.

The NCCE, which is the apex regulating body for colleges of education in Nigeria, in the 2012 latest edition, recommended a graduation requirement of a minimum of 64 credits in integrated science (double major), education components of a minimum of 30 credits, six credits in teaching practice and general study with a minimum of 18 credits with a total of a minimum of 118 credits and the same minimum of 118 credits for the single major. Also, the recommended mode of teaching-learning of integrated science must be activity-based field trips/excursions, practicum, laboratory work, and practical as deemed appropriate for each course. The recommended teacher-student ratio is 1:35. The mode of assessment for practical

courses is 50% for CA and 50% for examination, and for theory-based courses, 60% for examination and 40% for CA.

According to the National Commission for Colleges of Education, all these requirements were for the effective and efficient preparation of future integrated science teachers who will continue to 'teach as they are taught' using the prescribed activity-based approach to teaching students at the basic education level in the country. A standardised laboratory is described in the curriculum. There are specific course contents describing the role of science teachers and how teachers plan and organise learning activities and workshop practices, laboratory management, and safety.

There are occasions when teachers lecture more than a group of one hundred trainee teachers in a classroom as against the NCCE's prescribed teacher-student ratio of 1:35; the implication for teachers is that effective classroom dialogue or interaction may be hindered with one hundred students simultaneously. Moreover, this same teacher will teach two or more courses, perform administrative duties, and supervise projects and teaching practice. The same lecturers will be owed salaries for months. Large class sizes and work pressure have been found to have negative effects on teachers' classroom effectiveness and students' learning. Ogunmakin (2018:2022) submits that the mode of teaching in colleges of education in Nigeria has remained the old traditional lecture method that is teacher centred, which cannot produce the desired changes and results prescribed in the NCCE curriculum. One of the aims of the current study is to encourage modification of teachers' classroom practices to enable learners to engage in dialogue in their learning. Ogunyinka et al. (2015) also previously called for teachers to develop different arrays of teaching methods or pedagogy and awareness of different learning processes of students.

The classroom experience that student teachers gain during teaching practice is just six weeks as prescribed in the NCCE, and this has been found not to be enough and increase of this period to one year has been recommended by the Teachers Registration Council of Nigeria (TRCN) to allow student-teachers to adequately link the theory they acquire in classrooms and laboratories if any to practice (Hamilton-Ekeke, 2016). The teaching practice exercise that is supposed to bridge the gap between theory and practice has been found to be faced with so many challenges. Hamilton-Ekeke (2016) found that despite the NCCE

recommending three supervision meetings within six weeks, some supervisors manage the scheduled supervision visits to student-teachers once or not at all.

These challenges have led to poor-quality graduate teachers with low-quality professional development who cannot progress in CPD and generate new learning materials, so therefore, they continue to employ obsolete teaching principles and methodologies (Okoro, 2019). These practices, over time, may lead to reinforcement of the practice and students' resignation to fate, frustration, and acceptance of this as a norm, so dialogue or engagement may not occur to students as an essential aspect of learning.

Aina (2014) and Aina and Abdulrahman (2021) found that integrated science teaching in colleges of education in Nigeria is currently theory-based as against the prescribed NCCE practical method, with very few laboratory practicals carried out in classrooms as there are no adequate and or available science-equipped laboratories. The laboratories could have served as a place where students could work in groups, share ideas, and dialogue has been found to be almost non-functional and or non-existence, and science student graduates, therefore, lack employability in other professional areas such as the industries; hence, a majority of NCE science graduates are teachers in Nigeria (Aina and Abdulrahman, 2021).

2.6.6 In-service teachers' continuing professional development.

The NPE (2014), section 5, subsection 77 specifies that newly recruited teachers shall undergo induction training, and in-service teachers' education shall be integrated into teachers continuing professional development. Subsection 100 states that only professionally qualified are allowed to practice, and newly qualified teachers shall undergo an internship of one year. Subsection 101 of the NPE (2014) explained that a national framework for teachers' continuing professional development should be laid out to aim at what teachers should know and do at various stages of their professional development and provide in-service teachers with the constant chance to update their knowledge and skills through long career professional development.

In Nigeria, teachers continuing professional development (CPD) include induction which, according to the policy, is aimed at supporting new teachers through peer networking, education experts' support and other mentoring strategies. Ejima and Okutachi (2012) argued

that in practice, the actual induction prescribed by the NPE does not exist, and mainly taking teachers around the school environment where the new teachers are posted is the common practice of induction. The Professional Standard for Nigerian Teachers (PSNT) (2010) approved other CPDs for teachers, which include capacity and roundtable workshops with 50 minimum credits, Annual Conferences of Registered Teachers (minimum of 30 credits), and approved stakeholder workshops and seminars with 50 minimum accrued credits.

Ejima and Okutachi (2012) and Ajani (2018) argued that the process of selection of teachers for CPD in Nigeria is based on favouritism and partiality, so it is not a fair process, so many teachers do not stand the chance of being selected. In fact, Ejima and Okutachi found that most benefactors are directors and senior officers in government ministries attending CDP for teachers, such as conferences and seminars at the expense of classroom teachers and further found that traders and artisans are among participants selected for teachers continuing professional development in Nigeria. This action denies teachers access to CPD activities and poses a challenge to individual and collective professional development for teachers. The researcher, a teacher with almost more than two decades of experience, has only benefitted a few times in all-inclusive CPD and twice in specific CPD for teachers. In the researcher's opinion, Nigerian leaders need to separate educational policies from politics to produce quality teachers in the country. The present study seeks to explore the perspective of basic science teachers on CPD and the influence of CPD on teachers' classroom practices.

Ajani (2018) found out that CPD activities in Nigeria do not meet the classroom need of the teachers as they do not positively influence their classroom practices; some teachers comment that they are mandated to attend specific CPDs that are unrelated to their subject areas, so most are a waste of their time. In my view, there is a need for the articulation of CPD programmes well designed with individual teachers' learning experiences to be acquired and a comprehensive follow-up or post-evaluation strategy to determine the impact on classroom teaching and learning. Hence, the researcher intends to explore the needs of teachers in classroom interaction, then provide support on CPD activity and find out the extent of the impact of the support.

From the above, the government of Nigeria has a good policy document for the provision of CPD for teachers; however, according to Ejima and Okutachi (2012) and Ajani (2018), the same government lacks commitment to policy implementation and no standard

regulations to ensure and monitor the quality or standard of teachers and the quality of CPD teachers receive in Nigeria. The PSNT (2010) states that any teacher that does not attain some level of credits in teachers CPD or is unqualified for a specific period may have to leave the teaching profession at a point, but again there is no mechanism put in place to ensure strict adherence to this provision, so teachers do not keep up with classroom pedagogy and teaching professional update. Many private and public institutions supervised by different bodies offer CPD services to teachers in Nigeria, leading to inconsistency in curriculum and a lack of stress on the significance of curriculum (Ajani, Maluleke, and Govender, 2018) and (Ejima and Okutachi, 2012).

Iyunade (2017) and Ejima and Okutachi (2012) pointed out that the NTI, FME, and TRCN seem for political and financial gains, established a special teachers' weekend (Friday and Saturdays starting at 16:00) upgrading programme for secondary school certificates and the old grade 2 certificate holders (uncertified primary school teachers) for the award of NCE certificates and PGDE which most research found the period of completion too incredibly short for a sensitive professional upgrade with the aim to increase the number of teachers in the teaching profession but the programme ended in a decrease in the quality of teachers of basic education. Ayodele and Akomolafe (2019) observed that the supervision and coordination of CPD for teachers in Nigeria seem ineffective, making standard regulating and monitoring of CPD activities very difficult; even though the educational policy is in place, they argued the need for an inbuilt evaluation of every CPD program in Nigeria.

There are reports, comments, observations from various stakeholders and research evidence indicating that the quality of teaching in Nigeria has drastically declined because of the poor quality of teachers, and this outcry has been ignored for too long. Because of a lack of commitment to policy implementation and monitoring, many myriads of other issues mitigating teacher education cropped up, debarring individuals and the societal transformation that education offers. Therefore, the researcher aims to explore teachers' classroom interaction patterns and provides intervention in the form of CPD activity, then examine possible modification to teachers' classroom practice.

2.7 How teacher education is problematised in Nigeria.

Some of the issues that come to mind with problematising teacher education in Nigeria are:

- Emphasis has been on the number of teachers in Nigeria, so there has been a decline in the quality of teachers.
- Some teachers are still professionally unqualified.
- The quality of assurance of teacher qualification and training institutions is poor.
- The cumbersome teacher training curriculum stands in the way of effective learning.
- Short period and pervasive negative attitude to teaching practice exercise.
- Non-implementation of policy advocating the “teach as they are taught activity-based science teaching” - teacher training in Nigeria remains the traditionalist and conservative style of teaching.
- Persistent change in political leaders and change in policies and interest in teacher education.
- The system works against access to professional development by teachers, despite evidence of teacher demand for CPD.
- Too much of teachers’ CPD is of poor quality.

The analysing of the points raised above are as below:

2.7.1 Low quality of teachers due to high student enrolment and high demand for teachers.

In the late 19th century, the recognition of Western education as a means of decent livelihood rose, leading to a growth in the school population and student enrolment. Demand for teachers accordingly rose without the commensurate supply of highly trained teachers, which led to lowered recruitment standards, particularly in primary schools (Ogunyinka et al., 2015; Imam, 2012; Adeyemi, 2011). As school enrolment increased, classes became overcrowded with the government’s introduction of universal free and compulsory primary education.

Tandem growth in the country’s unemployment level made teaching one of the easiest routes to a guaranteed job. To meet the demand for the rapid supply of teachers, higher institutions’ entry requirements were lowered to as low as one or two credit points at the general secondary school certificate level against the previous standard of five credit points (Okebukola, 2010). The lowered entry requirements envisaged that their quality would be improved during the teacher training process. However, reports, research evidence, and stakeholders’ observations suggest a gradual decline in the quality of teachers produced in Nigeria.

2.7.2 Many teachers are professionally unqualified.

As stated earlier, Ejere (2011)'s remarks that only about half of the teachers under the UBE programme are professionally qualified, and the number of teachers currently teaching is way too short of the number required. The above challenge became prevalent even though the required standard for teacher recruitment was specified in the NPE (2004) as those with NCE and University graduates of various faculties. The FGN (2010) set up a committee for teacher training reform, and in the end, all the members agreed on the need for teacher education reform. A memo was issued by the minister for education and sent to state governors, local government chairs and education secretaries to stop the employment of unqualified teachers.

However, according to Okebukola (2010) and Aina and Abdulrahman (2021) and many other observations and reports from various concerned stakeholders, the employment of unqualified teachers continued to date due to corruption and political favouritism while thousands of professionally certified teachers roam about unemployed in Nigeria. Furthermore, they added that these unemployed professional certified teachers had no other skills to do other jobs as the teacher training curriculum did not significantly contain contents that could develop the potential for other skills.

2.7.3 The quality of assurance of teacher qualification and training institutions is poor.

The NPE gave various institutions a mandate to offer teachers professional training programmes. The educational institutions (National Institute of Education, Colleges of Education, Faculties of Education, Schools of Education in the Polytechnics, and National Teachers Institutes) that the NPE (2004) mandated to train teachers inaugurated many other teacher training routes and branches. Amongst these are Pre NCE programmes and sandwich programmes, which sprouted up in all nooks and corners of the nation affiliated with the training institutions offering distance learning and weekend programmes. Quality assurance and control then became a challenge. According to Okeke (2019) and Israel (2018), quality assurance and control strategies were put in place, and departments for quality assurance control were introduced in teacher training schools; however, due to the proliferation of many private and public training institutions, the departments did not function in practice, so this measure did not fully yield the desired results. The control of the teacher training institutions thus became an issue (Okwuba and Umezinwa, 2018).

2.7.4 The cumbersome teacher training curriculum stands in the way of effective learning.

Hamilton-Ekeke (2016) and Ekeng (2016) stated that educational stakeholders criticised the minimum credits required for graduation as cumbersome, with too many contents that keep student-teachers moving from one department to the other for lectures. Therefore, spend the most time in the lecture rooms learning the theories of education with little or no time in the laboratories and teaching practice to enable them to learn the art and science of teaching and learning. They added that some of the course contents in the curriculum are not even offered at the basic education level that NCE graduates are meant to teach. In 2010, the old curriculum was reviewed by the National Commission for Colleges of Education (NCCE). The newly revised curriculum falls into various criticism again as research still showed slight differences between the old and the new. There were new agitations to reduce further the minimum 118 credits and an increase from the six weeks of teaching practice.

2.7.5 Short period and pervasive negative attitude to teaching practice exercise.

The researcher is singling out the issue of teaching practice (TP) because it is an important aspect of teacher education that, according to the NCCE, provides the opportunity to encourage student-teacher development of good teaching proficiency and to address student-teacher grey areas. As described in Section 2.6.3, those six weeks of teaching practice are insufficient. Ikitde and Ado (2015) corroborate the above and found student teachers' highly significant negative attitude toward teaching practice. For one reason or another, few studies established a positive correlation between teaching TP exercise and students' achievement in junior secondary school examinations and trainee teachers' professional development (Okoro, 2019; Omodan and Tsotetsi, 2018; Oyedeji and Adebowale, 2021).

As a teaching practice supervisor for over 20 years, the researcher has different opinions from them in that a period of six weeks of practice is too short for trainee teachers to develop teaching foundation skills or the art and practice of translating theories into practice. From the researcher's anecdotal experience, many supervisors do not conduct three supervision visits to each trainee student within a span of six weeks. This is because of the large number of trainee teachers assigned to each supervisor; the trainee students are scattered in far different schools located in the state; the period allocated for TP supervision is always too short; the allowances released for teacher-educator are too meagre to cater for

travelling expenses. Most supervisors sometimes even require student teachers to bring their lesson notes to the main campus for a 1-1 micro-teaching with the supervisor to meet up with time.

In corroboration of my above personal experience in Nigeria, Hamilton-Ekeke (2016) and Ikitde (2015), and Ololube and Nanighe (2014) asserted that the period of teaching practice exercise is too short and pointed out some negative behaviours of supervisors, such as failure to visit, intimidation and assigning fake scores. The anecdotal experience and subjective opinions above could be hypothesised, challenged, and further tested for validation.

2.7.6 non-implementation of policy advocating the “teach as they are taught activity-based science teaching.”

In the new teacher education curriculum, the NCCE recommended that integrated science teaching and learning must be activity-based field trips/excursions, practicum, laboratory, and practical work appropriate for each course. The recommended teacher-student ratio is 1:35. The mode of assessment for practical courses is 50% for CA and 50% for examination, and for theory-based courses, 60% for examination and 40% for CA. These requirements were for the effective and efficient preparation of future integrated science teachers who will continue to “teach as they are taught,” specifically using the prescribed activity-based approach to teaching students at the basic education level in the country. Moreover, specific course contents describe the role of science teachers and how teachers can plan and organise learning activities and workshop practices, laboratory management, and safety. However, the implementation of this curriculum practice has been a challenge.

The gap between the expected goals of the reformed teacher education curriculum and actual classroom practice was evidenced by Ogunyinka et al. 2015, Oyebade (2012), and Osokoya (2012;2013) found that the mode of teaching in colleges of education in Nigeria has remained the old traditional conservative lecture method, which is teacher centred. This traditional approach has been found not to be able to stimulate students’ participation, promote high cognitive learning and produce the desired changes and results prescribed in the NCCE curriculum, so teaching methods used in teacher education must change if the ways teachers teach must change.

2.7.7 Persistent change in political leaders and change in policies and interest in teacher education.

Aina and Abdulrahman (2020), Olayisade (2018) and Muyiwa (2015), and other stakeholders observed and reported that another major concern in education is that as political leaderships constantly change in Nigeria, so do educational acts, codes, and ordinances, so issues raised and stipulated in the changes or reforms in revised educational policies have often not been subjected to implementation. This has been the case for several policy changes in relation to teacher education, both initial and continuing.

NPE (2014), section 5, subsection 77 specifies that newly recruited teachers shall undergo induction training, and in-service teachers' education shall be integrated into teachers continuing professional development. Subsection 100 states that only professionally qualified teachers are allowed to practice, and newly qualified teachers shall undergo an internship of one year. Subsection 101 of the NPE (2014) explained that a national framework for teachers' continuing professional development should be laid out to aim at what teachers should know and do at various stages of their professional development and provide in-service teachers with a constant chance to update their knowledge and skills through long career professional development.

The Professional Standard for Nigerian Teachers (PSNT) (2010) approved CPD for teachers, which includes capacity building with roundtable workshops, annual conferences of registered teachers and approved stakeholder workshops and seminars. Generally, teachers' continuing professional development (CPD) in Nigeria should include induction to support new teachers through peer networking, education expert support and other mentoring strategies. Ejima and Okutachi (2012) argued that in practice, the actual induction prescribed by the NPE is not obtained; what is obtained is mainly merely taking teachers around the physical school environment where the new teachers are posted.

2.7.8 The system works against access to professional development by teachers, despite evidence of teacher demand for CPD.

Another problem conceived is the process of selection of teachers for CPD in Nigeria. Ejima and Okutachi (2012), Iyunade (2017), and Ajani (2018) criticised the process and stated that

the process is based on favouritism and partiality. Instead of being a fair process, it is compromised by political considerations and chooses most of its beneficiaries as directors and senior officers in state ministries other than education, who attend CDP for teachers (particularly conferences and seminars) at the expense of classroom teachers. Ejima and Okutachi (2012), Iyunade (2017), and Ajani (2018) added that even traders and artisans are among the participants selected for teachers' continuing professional development in Nigeria.

Some outcries and observations identified the need for primary and secondary school teachers to be given a fair chance to attend seminars, conferences, and workshops specific and relevant to their taught subjects to update their skills and improve their individual and collective professional competencies. Among these outcries, Awodjii, Ogbudinkpa and Agharanya (2020) and Iyunade (2017) stressed that it is unfortunate that there are no data to show the rate of uptake and quality of training programmes that individual secondary school teachers attend in Nigeria due to the inconsistency of CPD programmes. Iyunade (2017), as previously described in section 1.2 of the statement of this research problem, indicated that teachers want help in the form of CPD activities in classroom decision-making to impact their practices and to implement educational reforms positively. Therefore, the present study also seeks to explore the perspectives of basic science teachers on their classroom practices and the impact that supports via CPD activity would have on the teachers' classroom practices.

2.7.9 Too many of the few available teachers' CPDs are of poor quality.

Iyunade (2017) and Ejima and Okutachi (2012) pointed out that NTI, FME, and TRCN set out evening and weekend professional upgrade programmes for teachers with lesser qualifications to upgrade to PGDE and NCE. Iyunade (2017) and Ejima and Okutachi (2012) posit that periods for these programmes are far too short for a professional upgrade, so the programmes aimed at increasing the number of qualified teachers resulted in a decrease in the quality of teachers in basic education. This seems absurd, but evidence shows that many professional certified teachers lack the methodological/strategy to implement the competency-based curriculum to promote trainees' understanding and ability to develop relevant skills for effective teaching (Aina and Abdulrahman, 2021; Mezieobi, Nwakwo, Mezieobi, 2017). The increase in certified teachers and decrease in the quality of teachers have been traced to corrupt practices such as an unmerited award of scores, examination

malpractices and commercialisation of teacher education programmes (Nwachukwu, 2021; Mezieobi, Nwakwo, Mezieobi, 2017).

Ayodele and Akomolafe (2019) observed that the supervision and coordination of CPD for teachers in Nigeria are ineffective because the government does not enforce laws that regulate the standard of CPD in Nigeria, so the proliferation and irregularities of poor quality CPD activities spread throughout the country. Ajani (2018) and Ejima and Okutachi (2012) stated that the government of Nigeria has a good policy document for the provision of CPD for teachers; however, there is no commitment to policy implementation and no effective standard regulations to ensure and monitor the quality or standard of teachers, and the quality of CPD teachers receive in Nigeria. The PSNT (2010) states that any teacher who does not attain sufficient credits in teachers' CPD or is unqualified for a specific period may have to leave the teaching profession, but again there is no mechanism put in place to ensure adherence to this provision, so teachers do not keep up with classroom pedagogy and teaching professional updates.

Some of the above concerns drive the current study, and in the researcher's opinion, Nigerian leaders need to separate educational policies from politics to produce quality teachers in the country. The present deterioration in Nigeria's educational and other sectors and the alarming state of unemployment indicate that the above suggestion for change is currently challenging in Nigeria, but little drops make an ocean.

2.8 Summary of the Chapter.

In summary, chapter two reviews the background of the history of education in Nigeria in section one. Section two describes the policies on education in Nigeria and the various challenges mitigating their implementation. Section 3 highlights various efforts made by the Federal Government of Nigeria on education reforms and challenges of implementation and explains the replacement of the 6-3-3-4 system with the 9-3-4 system of education to attain the MDGs free education for all (EFA). Section 4 highlights how the 9-Year BEC was designed and redesigned in a bid to transform and sustain Nigeria's economy and illustrates how the goal of the BEC transforms from knowledge of the content to the development of competencies. The competency-based nature of the new BSTC and the difficulties of implementation were also explained, and teachers' guide with various assessment forms,

focussing on different competencies, was discussed. Emerging issues and implications for science teachers were discussed. Section five discusses secondary school management and administrative challenges in Nigeria. Section six discusses the policy and practice of teacher education and continuing professional development programmes in Nigeria, and the chapter concludes with section seven, which explains how teacher education is problematised in Nigeria.

Chapter Three: Developing a Theoretical Framework for the Study.

3.0 Introduction

This chapter describes related theories to the current study, explains and reviews relevant literature on classroom interaction, classroom interaction competency, and early sociocultural perspectives on interaction and learning and discusses the theoretical practice in Nigeria and Sub-Saharan African classrooms. This chapter also provides insight into teaching approaches in developed countries. The chapter arrives at a conceptual framework for the current study and explains the justification for the choice of the theoretical foundation.

3.1 Related learning theories

This section contains two parts; the first part emphasises the learning theories related to the current study, links them together, and the second part describes the gap within the literature and finally achieves a conceptual framework that closes the gap and connects to the aim of the study.

3.1.1 The Cognitive theory.

Johnson and Crowe (2009) explained that Tolman, the founder of the cognitive theory, described the cognitive theory as a stimulus approach. Cognitive theory concerns things in our brain, such as attention, thinking, learning, perception, and problem-solving. The basis of learning is the generation of knowledge, like an inventory containing information called schemas. There are three essential aspects of Cognitive theory: comprehension, which focuses on the justification for learning a specific subject; memory, which focuses on the ability to relate new knowledge to previous information and experiences; application, which helps learners to apply new information or skills to life situations.

Jean Piaget (1936) is also one of the Cognitive theorists and opposes the idea that learners are passive and learn directly by responding to stimuli. Piaget established four phases of cognitive development to show the potential of the learner to understand abstract complex concepts: the sensorimotor stage (birth to 2 years); the pre-operational stage (2 to 7 years); the concrete operational stage (7 to 11); the formal operational stage (12 and above).

The Cognitive theory explains how the mind works during the learning process rather than observable behaviours in response to stimuli. The Cognitive theory recognises learners' roles in receiving, memorising, retrieving, interpreting, and reacting to the stimuli. Cognitive theorists argue that learners shape a cognitive structure in memory that arranges and maintains information about different experiences that occur in learning. The Cognitivist approach is teacher centred. For maximum efficient learning, information must be presented in an organised manner, which may make changes difficult because of what has been learnt and processed.

3.1.2 The Constructivist.

There are two schools of thought within constructivism: the social constructivism theory and the cognitive constructivist theory. The social constructivism theory, founded by Lev Vygotsky, a Russian psychologist, asserted that learning is a socially interactive discourse process of collaboration essential for cognitive development. According to Merriam and Caffarella (1999), this process of learning is constructed through dialogical meaning-making. Piaget and Bruner contribute to the conceptualisation of the cognitive constructivist learning perspective. Bruner's (1966) theory's educational implication is to create self-reliant learners who acquire knowledge that can promote symbolic thinking and problem-solving skills in children and can then be applied to various situations.

Constructivism theory in education acknowledges that learners' knowledge and understanding are based on interaction with their experiences and ideas before entering school. Constructivist pedagogy recognises the learner's interests and characteristics; the learner is seen as an essential entity in the learning process. The learners build on schemata, which are the prior knowledge structures, to conveniently construct new knowledge from the original experience. This diminishes the power of the teacher and supports students' active participation and meaningful learning. The teacher purposefully empowers and guides the students to annex their classmates' strengths, creating synergy through student-student interaction and high-ordered thinking.

Constructivist opinions illustrate a shift from viewing the learner as responding to external stimuli to actively constructing their own knowledge through social interaction (Bruning, Schraw, Norby and Ronning, 2004). Constructivism suggests that students are not

blank; knowledge and experience are constructed upon previous experiences and previous knowledge (Bransford, Brown, and Cocking, 2000).

3.1.3 Sociocultural theory.

The socio-constructivism theory focuses on the collaborative learning process of peer-to-peer interaction, mediated, and structured by the teacher who guides through the use of effective questioning, clarification of concepts and information and makes use of the previous knowledge and experiences of the learners. On the other hand, sociocultural theory focuses on interactions between people and the culture where their learning is situated or where they live to learn. These two theories base their principles on an individual aspect and a social aspect and see the learner as active and not passive or shaped by reinforcement and stimuli or just a receiver of knowledge. They both acknowledge the role of socio-interaction in learning. They differ in that sociocultural theory is concerned with learning through apprenticeship and learning through the help or support of an expert. The sociocultural theory suggests that the individual is shaped by society and history, while constructivist theory suggests that students learn independently by exploring (Rogoff, 1990) and discovering the world as they learn, and the teacher acts as a facilitator. Simultaneously, sociocultural theory sees teaching as a helping hand for performance and learning as an apprenticeship (Rogoff, 1990). The constructivist theory emphasises a change in perspectives, while sociocultural theory stresses the development of skills (Rogoff, 1990).

This study is about social interaction, and it, therefore, needs to introduce some essential principles of the social-cultural theory. In modern-day research, individual views of teaching and learning are insufficient to explain the complex teaching and learning process (Leach and Scott, 2003). The researcher based the current study on the concepts of Vygotsky (1896-1934). Adopting this will allow the researcher to consider pupils as active participants in constructing learning processes and investigate interaction patterns between teachers and students involved. According to Levy and Stockwell (2006), theories provide a position to view a problem, analyse, interpret, and build a framework. This will allow the researcher to see learning as co-construction through interaction with others and in a social-cultural context.

Vygotsky's ideas have greatly influenced the field of the second language, psychology, and education (Gutierrez, 2003; Lantolf, 2000; Swain, 2000). The remarkable gains in reforms in educational research and evaluation of science teaching have been based on Vygotsky's (1978) simple ideas about learning through communication and interaction. Vygotsky believed that though biological factors are a prerequisite for a child's developmental process to emerge, sociocultural factors are essential for elementary development. Vygotsky states that the child is dependent on the adult, who is usually the parent, who initiates what and what not to do and how to do it by instruction. The parent represents the culture and passes the culture to the child. The instruction is passed to the child through language. The sociocultural approach has steered researchers towards examining the nature of interaction taking place in the classrooms. The sociocultural theory provides a framework of approach for investigating the link between language and learning, and it is now a trendy approach in the field of education (Alexander, 2006; Littleton and Howe, 2009; Mercer, 2000; Mortimer and Scott, 2003) and science (Lemke, 1990; Mortimer and Scott, 2003).

Vygotsky (1962) compares three forms of language: social speech, used by a child to talk to others from age two; private speech directed to self and serves as an intellectual function from age three; and diminished private speech, which becomes inaudible and develops to self-regulating inner speech from the age of seven. Vygotsky's position is that thought and language are initially separated from the beginning of life and combined at age three. Thought and speech become connected; thought becomes verbally represented by speech. Children start internal monologues, which become inner speech.

Vygotsky (1978) stated that: "Every function in the child's cultural development appears twice: on the social interaction between people (inter-psychological) and on an individual level, secondly, inside the child (intra-psychological). For Vygotsky (1978), learning and developmental processes take place independently but influence each other. In his findings, learning by participation precedes development as learning leads to development. Vygotsky identified three important elements for a child's effective learning and development: mediation (language/dialogue tools of the culture), the zone of proximal development, and scaffolding. The zone of proximal development is explained by Vygotsky (1978) as "the difference between the actual developmental level of a child (what they can do

themselves independently) and what a child can achieve with the support of a skilled adult in collaboration with more capable peers as determined through problem-solving.”

Vygotsky emphasises that interaction between people, environment and peers helps students’ learning in the zone of proximal development, internalised through the learning process. This claim shows that learning takes place in interaction and not through interaction. The third of Vygotsky’s elements, scaffolding, is defined as “the role of the teachers and others in supporting the learners by developing and providing support structures to get to the next level.” It is the assistance provided by a more knowledgeable adult. The child’s cognitive development depends on the level of support or assistance provided. If the assistance is high, the learner’s skill improves as the learner completes and masters the task, and then the adult can progressively withdraw the scaffolding. If the task is replaced by another or more complex task, then the child’s cognitive development increases, and the zone is adjusted to a new zone. The goal of the third level of cognitive development scaffolding is for the learner to be able to solve problems and become independent.

Piaget’s theory differs from Vygotsky’s theory in that Piaget’s theory is a cognitive constructivist while Vygotsky is a social constructivist; Piaget’s theory is concerned with children rather than all learners, and it lays strong emphasis on stages of development while Vygotsky has no general stages of development, it places little emphasis on sociocultural context. Vygotsky believed that a person does not only possess a set of abilities but a set of abilities with potential that can be realised with an adult’s proper support or help. Piaget lays minimal emphasis on language’s role; in his view, language provides labels for children’s experiences, while language plays a powerful role in moulding thoughts. The implications of both theories for teaching are that Vygotsky’s theory creates opportunities for children to learn with the support of tutors and more skilled peers. Piaget’s theory encourages children to explore and discover new knowledge and supports individualised activities. Bruner, like Piaget, said children have the innate capacity and cognitive ability to develop through active interaction, but unlike Piaget, Bruner argued that social factor, especially language, is important for cognitive development.

3.2 Classroom interaction.

Classroom interaction involves more than the teacher's and students' capability to speak; it involves a range of meaning-making processes. Hall (2003) described classroom interaction as a medium or means through which learning is attained, and Walsh (2013) describes classroom interactional competency as a level of proficiency in the process of communication between groups. Walsh (2013) explained that the organisation of interaction depends on the participants in the communication process. In the classroom, it is the teachers and the students so that it can be organised according to the teaching objectives and students' needs. The participants are teacher-learner or learners and learner-learner or learners. Walsh (2013) suggested that helping teachers to comprehend the importance of classroom interaction to learning better enhances engagement, participation, and involvement in classroom social activities.

The help rendered to teachers must enable them to see the need to attain classroom interaction competency that ensures that the classroom discourse is context specific; that is, the language must meet the learning goals. The classroom interaction competency must be characterised by the ability of the teachers to create an enabling environment with space and time that enable students to produce more responses and elaborate on the responses. The teacher extends the students' responses, links them to specific references, and shapes the responses to promote students' engagement. These activities will maximise learning and learning opportunities (Moorhouse, Li and Walsh, 2021).

Flanders (1970) categorised major tools/mediators used for patterns of interaction into two; verbal and non-verbal. There are others, such as (silence/wait-time, confusion, and noise). Verbal or talk as a tool is defined as words that individuals use in communication. In contrast, non-verbal is defined as communication produced other than words, such as gestures, smiles, facial expressions, posture, and eye contact (Gamble and Gamble, 2014). On the other hand, Shapiro (2004) divided non-verbal interaction into two; body language and paralanguage: Body language consists of eye contact, gesture, and posture, while paralanguage includes any communication without words like tone, rate, and pitch of voice.

Verbal message or communication is not just the transmission of messages; it includes sharing meanings, particularly the exchange of ideas, thoughts, and messages. Gulati, Mayo

and Nohria (2015) claimed that verbal messages include writing, listening, reading, and speaking. Listening and reading are how physical behaviours (speaking and writing) are understood. Akhtim (2018) affirmed that the teacher's effective communication would help in learning and daily interaction. Akhtim (2018) also believes that there is a relationship between culture and communication; culture can be a challenge and cause misunderstanding during an interaction process, so the teacher must be adequately skilled in communication. This ultimately affects the competency of the students. The problem in communication is usually a problem in a language that includes problems in finding the right words, the right voice patterns, and the right tones.

Many scholars hold the view that non-verbal messages have the same or more significance than verbal messages. According to Akhtim (2018), non-verbal communication is important, as 50% of body language is used in communication. Singh (2018) infers that our body has its own language that influences the words we speak when we interact, the way we sit, the way we talk, and the way we walk speak volumes. They expressed that it is indisputable that verbal messages are important but argued that nonverbal messages are equally and sometimes more important than verbal messages. Mehrabian (1972 cited by Ekasaputra (2019) stated that in exchanging our feelings and attitudes, research shows that only a small percentage of all our messages come from words, as 55% of our message comes from body language, which can convey happiness, shock, disbelief, doubt or disgust, and fear), 38% of our message comes from tone of voice, our words convey only 7%.

Zeki (2009) also stated that many communication experts believe that most interpersonal communication is non-verbal and found that non-verbal tools are important for motivation and concentration for students' learning. Ledbury and Darn (2004) stated that eye contact and facial expression are two powerful tools to convey messages in the classroom, but notwithstanding, the teacher's eyes are mostly fixed on the book or roaming around the classroom and its environment. Kochosca and Gramatkovski (2016) explain that the primary use of eye contact in the classroom is for teachers to talk to an individual student and show students that the teacher is taking notice and for the teacher to indicate to a student that the teacher wants to talk. According to them, the teacher's eye contact is important when the teacher wants a student to do something, to check for a student's attention or to encourage a

student to elicit a response, bring out more ideas, or encourage contributions from a whole class.

Pollitt (2006) believes that a teacher's inability to have eye contact with their students is a sign of insecurity and a lack of confidence in oneself, and they may likely have issues with classroom discipline. Teachers need to create a well-coordinated body language, maintain eye contact and good command of the language, and have a clear voice to create a convincing and not confusing impact on students. In the long run, create a credible, confident, trustworthy, and convincing impression on the students. Ledbury et al. (2004) suggested that teachers should watch and listen to learners for signs of being bored or lost, as puzzled expressions can imply a lack of understanding so that teachers would know what to revise or repeat. Ledbury et al. (2004) also reported that eye contact could save time and effort by delivering some messages using facial expressions, eye contact, intonation, and voices. Students need to be taught how to make eye contact as making eye contact signifies a stronger personality, a confident student, and a foundation for trust between groups of students.

Ali and Muhammad (2011) stated that some research findings suggested that two-thirds of our communication is non-verbal. Some research found that 7 per cent of a message is sent through words and the remaining 93 per cent through facial expression and intonation and further suggested that teachers would know more about their students by watching their actions than listening to what students say. Randall, Gillis, and Nilsen (2017) argued that verbal and non-verbal messages could be consistent or inconsistent, and when not consistent or conflicting, can create mistrust as people tend to believe nonverbal cues more than verbal ones. This statement means that if people say they are happy and bear angry expressions, others tend to believe the expression on their faces more than what they say. Action speaks louder than words. It is not what we say but how we say it that is most important. Ledbury et al. (2004) submitted that even though speech is a part of communication, teachers often underestimate, forget or are unaware of the importance of non-verbal cues in their own and students' performance.

Cagri (2020) explained that classroom interaction is a practice that strengthens the development of speaking and listening, which are the two important language skills and acknowledged the importance of non-verbal cues in classrooms. This shows that Ledbury et

al. (2004) and Darn and Eryilmaz's (2005) submissions are similar, which suggests that it is only reasonable to raise learners' awareness about our non-verbal communication in order to improve their skills of language, increase confidence and fluency and avoid inter-cultural misunderstandings since ten per cent of communication takes place verbally, and gesture, posture, facial expression forms most part of our culture and language. Much work is being done on the verbal aspect of communication in the classroom; therefore, Darn and Eryilmaz (2005) raised concerns that little attention has been paid in education to non-verbal communication as a complement to verbal communication, and most nonverbal attention has been focused on social skills development, lie-detector test, and presentation skills.

Similarly, Flanders (1970), who developed the category system adopted in this study, did not consider non-verbal classroom behaviour with the assumption that a person's verbal behaviours are consistent with non-verbal behaviours. Adesanya (2020) provided an insightful reminder of the old traditional practices of non-verbal cues in Nigeria, especially in the Yoruba context, that laid much emphasis on the crucial role that body language and eye contact play in relaying information, emotions, thoughts and ideas in interpersonal relationship, and their role in the stress of verbal communication. Aboh (2015) and Adesanya (2020) concluded that in recent times, despite the importance of nonverbal cues, their use has been neglected and has gradually faded away in Nigeria.

3.3 The sociocultural perspective on interaction and learning.

Vygotsky's work has sparked a research prototype within education that encourages natural observation and reflection to understand classroom behaviours (Lyle, 2008).

Vygotsky aroused a lot of research into language and its impact on learning. The world can only make meaning if we understand our lives through our cultural system of interpretation, mediated by talk through language. Vygotsky expatiates the basic essence of social interaction in a child's cognitive development.

With the challenge of multilingual and multi-ethnic groups of over 500 indigenous languages, Nigeria adopted English as a medium of instruction in the NPE. This becomes strange and different from the language of children's environments as they enter primary schools. English language is widely famous and warmly embraced in Nigerian society and throughout every level of its education, despite the sociocultural belief that language, through

interaction with their social environment, helps the child to acquire knowledge by developing understanding, constructing shared meanings, developing knowledge and meanings, and adapting old ones. NPE specifies the use of indigenous languages at primary schools with no law for enforcement, and proponents (Fafunwa (2018) and Egwutuoha (2016) of this position in Nigeria argue that the child is more likely to benefit from school if taught in the native language. Egwutuoha (2016) stated that the level of English the pupils comprehend or speak judges the standard of a school, so teachers and students scramble to find the right words, tone, and voice pattern to use to bridge the gap between cultural differences in speech and languages.

From the sociocultural perspective, human development is partly guided by mentors who are more skilled in our lives, such as our teachers and parents. In addition, children develop values, beliefs, and cultures by interacting or participating in cultural events with peers and social groups. The learning acquired during interaction can then be internalised and integrated at the individual stage. The context of learning and teaching in Africa, especially Nigeria, is determined by a culture that holds high value and respect for authority. Fafunwa (2018) submits that in Nigeria, adults teach children major cultural values, norms, social activities, societal values, respect and obedience to local rules, respect for elders, and home training. These also include methods of greetings and how to sit, how to have conversations with adults, what to say and what not to say, how to respond, and how to behave when talking to adults through methods such as recitation, memorisation, imitation and participation and there are consequences for arguments, disobedience, and disrespect for elders and family heads.

These culture, values and practices might be conjectured to promote a routinised teacher-dominated classroom and hinder meaningful participation, limit students' classroom talk, and hinders the achievement of the zone of proximal development with the assistance of a skilled teacher or more skilled peers. According to Vygotsky, each culture provides specific tools (such as rote learning or memorisation, other strategies for thinking, learning and problem solving that children internalise from a more skilled adult) for intellectual adaptation that allows children to use their potential in an adaptive way to their environment. Vygotsky explains that culture forms and shapes humans' life and mind, not biology. Teacher trainers and policymakers can help teachers in Nigeria to develop specific context-based strategies or

context-based intellectual adaptations that enable the achievement of learning expectations and goals.

Vygotsky's work influences and encourages an increased body of research investigating talk as the key to learning, especially children's talk in collaboration with adults or peers and promotes more participatory activities to foster cognitive development, like meaningful conversations, helpful criticism, and teamwork with others. In Nigeria and Sub-Saharan Africa (SSA), there are challenges, such as limited teaching and learning materials (that could have fostered meaningful interaction), as well as overcrowded classrooms (that limit space for interaction). Implementing the participatory and collaborative classrooms described by the sociocultural theory of learning requires helping teachers identify and adopt a practical adaptive teaching approach. According to Oskoya (2013) and Westbrook et al. (2013), this approach should involve the use of simple and locally improvised materials that can be used across different topics. Considering the issue of time and work pressure in lessons in Nigeria, the practice of the sociocultural approach to learning requires helping the teachers design strategies to improve language use. This would create an enabling environment for space and time that can accommodate more students' responses, elaborate, link students' responses to references and finally shape them together to maximise learning and learning opportunities (Ukor and Agbidye, 2015).

Like Vygotsky, Bakhtin (1895-1975) viewed language as social practice and conceded that all thought and language are dialogic. During the process of dialogic interchange, the concept of meaning-making grants learners the opportunity to play an active role in the development of a personalised constructed understanding of the curriculum. In Bakhtin's views, any single natural language can be broken down into social dialects, characteristics of group behaviours, generic languages, age groups and generations, professional jargon, language of authorities, language, different circles, and passing fashions. These are essential requirements for a genre. Another in support of the sociocultural theory is Bruner, who agreed with Vygotsky that human development occurs between a mediator adult and a child. Children depend on adults for scaffolding in the form of support, but as they learn new skills and knowledge, they become independent, and the support wanes.

3.4 Uniqueness of interaction in science classrooms.

What is there to understand about explaining science differently? Science explanation is crucial to every science teacher's job as there is a lot to explain in science Mortimer and Scott (2003) and Bartholomew, Osborne and Ratcliffe (2004). What keeps the moon orbiting the earth? What is responsible for metal to sink while metal ships float? If teachers do not explain adequately, the students become uneasy. Science teachers need to explain theories, concepts, and abstracts, like how we see and why we have two ears. Scientists can share models, analogies, and ideas, but explaining is not treated as something to be learnt or taught, and there is no common language for talking about explaining science except common-sense terms, for example, clear or confusing, or simple or complicated (Wellington and Osborne, 2001).

Teaching science entails the teacher introducing the students to the social language of science. When students learn science, they construct meanings and develop understandings in a social context (Brown, Reveles and Kelly (2005). In view of the nature of science, where scientific phenomena are presented in context and scientific methods and concepts are used in a functional way, in science classrooms, practical work and communications are key elements through which pupils can get a feel for the phenomena that science seeks to understand (Löfgren et al., 2013). Duschl and Osborne (2002), Bennett, Hogarth, Lubben, Campbell, and Robinson (2010) and Lemke (1990) submitted that learning science directly from practical work is difficult, and more studies encourage 'talking science' and the significance of language in science education. Science education can be viewed as a specific culture or a group of sub-cultures groomed over a long time (Lemke, 1990; Bruner, 1996). Learning science means learning a scientific, conceptualised language with learners and teachers communicating various terms and concepts different from everyday normal language.

Science controls the classroom's thinking, talking, and acting (reading, writing, reasoning, and practical activities (Lemke, 1990). In the science classroom, everyday culture overlaps with scientific knowledge cultures, and pupils learn to discuss, listen to one another, respond to others' ideas, and give constructively criticise others' ideas (Mercer and Dawes, 2008; Barnes, 2008). A successful science classroom depends on the teacher, who has to collaborate jointly rather than work on individual tasks (Mercer and Littleton, 2007). The

teacher must relate scientific ideas to students on a social plane to help students make sense of and internalise the ideas and support students while applying the knowledge (Chin, 2006).

Mortimer and Scott (2003) suggested that the teacher employ the role of language in distinguishing between authoritative and dialogic approaches in science classrooms. The sociocultural principle can either use a dialogic approach or tend towards an authoritative approach in lending voice to the scientific point of view. The sociocultural and dialectic approach is similar, where learners collaborate to achieve the knowledge learnt, while in Bakhtin (1986), which is the dialogic view, the participants made available their different perspectives on an issue or topic without fear of being right or wrong Wegerif (2008). Dialectic learning, on the other hand, focuses on the achievement of joint aims and objectives collaboratively; this type of teaching does not encourage the emergence of pupils' original separate, digressive, and different ideas or opinions despite being collaborative, interactive, and reciprocal compared to the characteristics that exist within Mortimer and Scott (2003) framework of dialogic teaching. In dialogic teaching, apart from learners' build on their ideas (Mercer, 2000), teachers also build on learners' ideas (Alexander 2006; 2008; Mercer, 2008).

Therefore, consideration should be allowed for linking collaborative, reciprocating, and interactive elements in cumulation; for instance, in inquiry-based, these elements relate to linking students' everyday experiences to scientific explanations, thereby promoting the development and connections of more learning routes of learning in and out of the classroom (in all settings) over time (Littleton and Kerawalla 2012). The exploratory has cumulative characteristics in that it involves, among others, how connections are made between ideas and settings within a certain period of time. The concept of accountable talk (Michael, O'Connor, and Resnick, 2008) is characterised by responding to peers' opinions and building or developing the responses, which can be related to cumulative talk.

Wells and Arauz (2006) demonstrate that integrating dialogic with inquiry influences teachers' communication, although the study still recorded a dominant classroom teacher. Löfgren et al. (2013), a study of the role of exploratory in inquiry-based learning and communicative approach, found that teachers use authoritative or non-interactive approaches during scientific descriptions and explanations open up to interactive or exploratory talk. This agrees with Scott (2008)'s opinion that presenting scientific ideas in an authoritative style will require time to explore the same ideas. Löfgren et al. (2013) concluded that there is no

bad or good way since exploratory talk will allow the students to state their ideas through teachers' effective questions and wait time (Mortimer and Scott, 2004; Mercer, Dawes, Wegerif, Sam, 2003).

3.5 Insights into teaching approaches in developed countries.

Teachers generally can view, analyse, and synthesise the insightful theoretical and empirical evidence of approaches in developed countries and make decisions to modify their thinking about the nature of their pupils' learning in relation to their environment. Teachers in Nigeria can also consider the elements against other studies with different emphases. Teachers should understand specific issues in culture, values, attitude, society, socioeconomic, low resource availability, and learning situations before adopting an approach to teaching for effective implementation and sustainability of such approaches.

3.5.1 Monologic talk.

Sinclair and Coulthard's (1975) built their study on that of Halliday (1975). They established a three-part sequential IRE (initiate-respond-evaluate) exchange which they described as the basis for classroom interaction where the teacher elicits information from an individual student by asking a known answer question to ascertain if each knows something about the topic (initiation) and the student provides a response. The teacher evaluates the student's response as 'right,' 'good,' and 'not right.' Barnes (1992) found that the IRE pattern is authoritative for the complex exchange of information in the classroom between the teacher and the students. The teacher is the sole participant who decides who, when, and how much students can say.

Along the same line, Nystrand, Gamoran, Kachur and Pendergast (1997), in a more comprehensive study of 112 eighth and ninth-grade language arts and English classrooms, showed that there was a negative correlation between the use of IRE pattern of interaction and students learning, adopting a similar position. Nystrand et al. (1997) established limited recall ability and less understanding of the content's topic among students exposed to exclusive use of IRE patterns of interaction. Also, they found extensive use of the IRE interaction pattern among low-income class students, and Lin (1999a, 1999b, 2000) reported similar findings. Other writers have argued the disproportionate learning opportunities for

students to acquire and advance in high-ordered reasoning to develop complex skills and knowledge (Lin, 2000).

In a follow-up study, Wells (1999) investigated more relationships between the three-part sequences of classroom interaction and learning by observing some science classrooms of expert teachers. Wells (1999), however, found that teachers often follow up on students' responses by asking students to elaborate and clarify rather than close them up with a narrow evaluation of the student's responses. His classroom observations divulged extended students' participation in the discussion, and students showed keenness as their contributions were treated as cherished. Wells found that the pattern of the (E) restricts and puts constraints on the students' learning opportunities.

Wells proposed an extension of the third part with a follow-up of students' responses with an (F) and concluded that the teacher's type of follow-up would determine the extent and pattern of the student's contribution. Myhill and Fisher (2005) also found out that the IRE in the classroom emphasised recall of facts and did not foster higher-order reasoning; the opportunity for children to ask questions, participate, and explore ideas was limited, resulting in minimal constructive meaning-making. Similarly, Nassaji and Wells (2000) found that the teacher's kind of contribution in the third part of the sequence determines the shape, form, and direction of the talk that follows.

A monologic teacher, therefore, is the authority over the goals of talk in the classroom, is most interested in transmitting knowledge to students, and the IRE wastes much of the talk's discursive patterns, cognitive and educational potentials (Alexander, 2001; 2008; Hardman, Smith, and Wall, 2003; Mortimer and Scott, 2003; Smith, Hardman, Wall and Mroz, 2004). Alexander (2018) and Lyle (2008) argued that despite the above, the IRE exchange structure with the characteristic of close-ended questions, restricted responses consisting of recall answers, and minimal feedback remain the pedagogical methods in many schools.

3.5.2 Exploratory talk.

Douglas Barnes (2008) describes exploratory talk as an opportunity for learners to sort out their ideas and thoughts, see how they sound, receive feedback, and sort out their different

ideas into different arrangements. Neil Mercer (2000), inspired by the work of Douglas Barnes, who outlined the views of constructivists on the nature of learning, reveals that acquiring new knowledge requires reflecting and reshaping prior knowledge and mirroring this in the light of a new way of seeing things or method of doing things. The pupils' challenges in reshaping old ones provide dynamics for the accommodation, changing previous ways of understanding for new ones (Barnes, 2008). Mercer and Littleton (2007) indicate that collaboration and high-quality discourse positively correlate with educational outcomes if mediated by exploratory talk. 'Good teaching can make a world of difference to children's future' (Mercer and Littleton, 2007).

When children are encouraged to work together, think together, and subject learning together, their general reasoning skill is stimulated (Mercer, Dawes, Wegerif, and Sams, 2004; Hardman et al., 2011; Mercer, Wegerif, and Dawes, 2004; Rojas-Drummond et al. (2013). Dawes, Mercer and Wegerif's (2004) intervention research ('Thinking Together') in primary schools, focusing on pupils aged 6-13 and 8-11, has been found to promote deep thinking and reasoning skills and increase learning outcomes. However, there are concerns about computer screen-sharing tasks; the nature of the resource where students have to cluster around may restrict the need for children's talk and reduce explicit sharing and collaboration of knowledge (Wegerif and Mercer, 1997). Secondly, when working in primary schools, exploratory and scientific explanations are challenging, so teachers need to be trained because using inquiry-based material does not automatically provide the skills (Löfgren, Schoultz, Hultman and Björklund, 2013).

3.5.3 Interactive whole-class teaching.

In the UK, the US, and Australia, the government has recently been specific about classroom practice and the continual establishment of the national curriculum. Approaches have been geared towards strategies that promote active teaching and learning with accountability systems that measure students learning instead of student achievement. According to Smith, Hardman, Wall, and Mroz (2004), the UK government in 1992 discussed curriculum and classroom practice with little guidance on how to use it and endorsed whole-class teaching. In 1997, to address the problem of literacy and numeracy in education in primary schools, national literacy and numeracy strategies were constituted (NLS and NNS) and launched in 1998 and 1999 by the Department for Education and Employment (DfEE) (1998).

However, Smith et al. (2004) used computerised systematic classroom observation and transcripts of discourse analysis and questionnaires and found that features of the old traditional patterns still materialised in the whole class teaching. Also, they found the teachers' questions to be low-ordered, designed to direct students' responses towards the required responses. The features of the findings were that the teacher dominated the class 74% of the time, which were explanation, direction, and 24% of students' response was individual answering questions and choral responses. These findings support the studies of Mroz, Smith and Hardman (2000), English, Hargreaves and Hislam (2002) and Hargreaves et al., (2003), who found the dominance of recitation where pupils have little opportunity to ask questions or provide various ideas to promote deep thinking.

Lyle (2008) argued that although the literacy and numeracy approaches entail the use of small group and individual work with an emphasis on direct instruction and well-paced interactive oral work, the interactive style imposes discursive patterns and functions differently from the original dialogue. It differs little from the old traditional didactic teacher-student interaction style (Alexander et al., 1996; Pollard et al., 1994). In contrast, Brown, Askew, Baker, Denvir, and Millet (1998) argue the claims that whole-class teaching is associated with high attainment in Mathematics and report the evidence that whole-class teaching is associated with poor results. They argued that teacher-student interaction quality is more significant than classroom organisation. This suggests that whole class interaction may increase the negative effects of lower quality interaction, though making use of high-quality teaching.

Interactive whole-class teaching was replaced with an interactive whiteboard using teacher- pupils interaction in the UK to study the impact of an interactive whiteboard on student-teacher interaction. The studies found that the IRF (initiation-response-feedback) feature is strong and could not be replaced by technology (Higgins et al., 2005). Rather than supporting a shift from teacher's control learning to pupil's independent learning, the length of the pupil's responses was reduced (Smith, Hardman, and Higgins, 2006). Several studies on classroom observations in various areas have concluded that a lot of talk takes place in the classroom. However, there is an absence of talk interchange with no power shift, and the studies call for a more dialogic classroom that stemmed from the challenges of the practice of IRE, IRF, interactive whole-class teaching, and interactive whiteboard teaching. The teacher

dominates the class with monologic authoritative talk, a pattern related to a premeditated script.

Concerning the students, the challenges range from the following: a reduced amount of learners' talk, leaving them passive; little promotion of students' talk; little opportunity for learners' contribution of ideas or opinions; learners as recipients and respondents of information; children are prevented from having a voice; children are prevented from being aware and able to discover their capacity, means and ends.

3.5.4 Dialogic talk

A growing body of evidence suggests that classroom talk has richer and more attention worldwide. Most psychological and neuroscientific research revealed close relationships between language and thought and the potential of spoken language to promote and increase cognitive development in children (Beck, Kumschick, Eid, and Klann-Delius, 2012; Ferrari, 2011; Bruner, 1996; Goswami, 2015).

Alexander (2008) described talk as the most potent mediating classroom tool used by children to make sense of what their peers and teachers mean. Talk facilitates the social and cognitive environment between adults and children, teachers, pupils, the young, and others. Talk bridges what a child already knows and understands and what they still need to learn. Alexander was influenced by the works of Vygotsky (1962,1978), Bruner (1996), and Bakhtin (1981,1986). The sociocultural theory approach offers solutions to the challenges between the pedagogic approach and students' learning. This explains how sociocultural factors can make each individual's learning process vary. Interactive teaching (dialogical inquiry) is a socially mediated tool for learning guided by societal rules, norms, values and beliefs, and individual perspectives (Alexander, 2001; Wells, 1999; Rogoff, 1990).

Alexander (2001), in a study of five transnational and cross-cultural classroom research, showed how the classroom's culture, values, and interaction are shaped by communal, collective, and individual emphasis in the process of social and cultural relationships in human development. Further, Well (1999) explained that classroom discourse is a collaborative behaviour of two or more participants in the process of jointly contributing to meaning-making through shared language with others; as you jointly make meanings with

others, one also makes meanings with oneself and extends one's understanding. For the benefit of students' understanding, the teacher-student interaction is a tool to be collaboratively developed by the teacher and student.

Socio-constructivist (Vygotsky, 1978) encourages the use of open-ended questions, which invite students to use talk to explore understandings to speculate, hypothesise, reason, and evaluate, consider a range of possible answers. This helps to construct and reconstruct knowledge and understanding. So, studies of the two-way relationship between teacher and pupil advocate for collaborative learning (Wegerif and Mercer, 1997), joint construction of knowledge (Mercer, 1995; Wells, 1999), guided participation or apprenticeship (Rogoff, 1990), and negotiation of meaning (Lave and Wenger, 1991).

For Alexander (2006), dialogic teaching challenges the theory of knowledge of the dominant teacher by rejecting the idea of accepting someone else's idea without question; he explained that dialogic teaching is when teachers and students work together to build on their own and others' ideas to develop coherent thinking. Alexander explains that dialogic teaching explores the learner's thought process by addressing all learner's contributions or answers to questions at every stage as it occurs instead of at the end and taking into consideration the student's engagement, confidence, responsibility, and independence. Alexander rejected the view that the only way to boost the quality of talk and power is through small group discussion and whole-class teaching and advocated for the need for every teacher to develop a vast repertoire of talk-based pedagogical skills and strategies. This is to refine the talk repertoire and capacity of their students and put into consideration the uniqueness of personalities and circumstances of each classroom.

Alexander outlines the process of dialogic interaction as when students ask questions, state their points of view, and make comments. The teacher uses these accounts of pupils' ideas to develop the lesson's theme and uses talk to provide a cumulative continuing frame for students to participate in the new knowledge they are creating. Nystrand et al. (1997) described dialogic teaching, which features both teachers' and students' use of authentic questions where answers are not specified but incorporated into the dialogue so that the responses adjust the topic of the discussion. Alexander advocates for strengthening teachers questioning skills, which promote complex learning when employed to prompt, probe, and stimulate thinking through skilful scaffolding. In the researcher of the present study's view,

dialogical teaching acknowledges the importance of learners' knowledge as a resource for learning. It promotes pupils' collaboration and participatory spirit and strengthens pupils' ownership and sense of belonging as in 'our classroom,' 'our lesson,' and not the present common slogan of 'teacher A's class or teacher A's lesson in Nigeria. Dialogic teaching decentralises power with a shift from the teacher and spreads it equally among the pupils.

Lyle (2008), in support of dialogic teaching, stated that dialogic teaching and learning with characteristics and principles that challenge the power relationship in the classroom are potentially threatening to teachers and a source of liberation to their students. Teachers who enjoy both positional and cultural authority over students based on traditional values might find it difficult to embrace changes (Ho, 2001). This could probably be one of the reasons why teachers find it difficult to change their practices.

Alexander (2018) developed a dialogic teaching framework in which four significant components are justification, principle, repertoires, and indicators, and I will make their explanation into succinct themes as follows: The first four, just like education, are democratic, take up an ethical and pragmatic position, and the last three from published evidence. Alexander (2017a) found that the first three principles are associated with agitation or the 'act of talk.' Cumulation, on the other hand, tests the teacher's mastery of the knowledge of the area of content, the teacher's exploration, interpretation of meanings that the teacher gives to the talk, the teacher's perception of the students understanding within the bounds of the content area, and skills of interaction in taking the understanding forward.

The third principle, supportiveness, covers the exclusion of criticism in Mercer and Littleton (2007), which explains cumulative as when teachers and students positively build on their ideas without criticism. Alexander (2017a) argues that this kind of cumulation may direct the discussion towards untimely general agreement or general agreement that lacks evidence. The cumulation is closely related to the accountable talk in Resnick, Michaels, and O'Connor (2010) and exploratory talk in Mercer and Littleton (2007), where speakers make clear the evidence behind their explanation and oppose or dare each other in the absence of evidence to support their claim or explanation. In building a repertoire of learning, the five principles are not limited to only one organisation pattern. The dialogic framework consists of six repertoires: interactive settings, everyday talk, learning talk, teaching talk, questioning talk, and extending.

Alexander (2017a) supported by Barnes and Todds (1995) with small group discussions and contrasting Mercer's preoccupation. The small group discussion is just one of the five interactive settings in Alexander's dialogic framework for teaching. Alexander expanded the three interactive settings for teaching, whole class, group, and individual into five: whole-class teaching (teacher-student); group work (teacher-student, teacher-led); group work (student-student, student-led); one-to-one (teacher-student), one-to-one (student-student pairs). To sustain and engender everyday interaction, the second repertoire of the framework has six general types of talk: transactional, expository, interrogatory, exploratory, expressive, and evaluative. This repertoire identifies the schools' role to adequately equip the pupils with the skills and capacity to manage social meetings, speak and discuss ideas freely, express and articulate their feelings, form opinions and judgments, and make decisions.

Alexander (2018) notes that teachers should be conscious of the possibility of slipping into the traditional mode of teaching, so they should avoid the exploratory and expressive type of talk while maintaining and restricting the scope of pupils' everyday talk. Secondly, teachers should develop the skills of mastery and modelling in order to teach effectively. Everyday learning is expanded into eleven categories of student talk; narrate, explain, speculate, imagine, explore, analyse, evaluate, question, justify, discuss, and argue. The last four (question, justify, discuss, argue) facilitates the dialogic teaching principles of collective, reciprocal and supportiveness and are in line with the standard rules for discussion suggested by Mercer and Littleton (2007) and Michael and O'Connor (2015).

For such talk to happen, students need to develop their capacity to listen, think about what they heard, give others time to think and respect alternative viewpoints. The dialogic teaching framework also includes teaching talk, which contains rote, recitation, instruction, exposition, discussion, and dialogue. Dialogue is the only form of teaching talk that is interaction specific and extends the series of students' learning talks. Contrastingly, the close-ended question at the start of recitation allows students to tell and narrate or explain to a limited extent; it demonstrates the IRF exchange sequence. Recall questions cannot allow students to speculate, imagine, explore, analyse, provide an argument, or initiate questions independently.

According to Alexander (2017a), the fifth repertoire of the dialogic framework is questioning, which includes: the character or intention of the question, which can be

authentic; response cue; participation cue; wait-time; feedback; purpose; and structure. Nystrand et al. (1997) defined authentic questions as questions without prespecified answers; they are questions asked to elicit information, not to see what students know or do not know. Teachers ask authentic questions to know students' thoughts and opinions. Test questions are questions of recitation that indicate the students thinking and not just remembering. The teacher poses some questions to elicit and handle students' responses. Extending, which is the sixth repertoire of the dialogic teaching framework, is incorporated by Alexander (2018) from Michael and O'Connor (2015). It proposes nine moves to assist students to share, expand by having time to think, say more and repeat and clarify their thinking, listen carefully to one another, deepen their reasoning by asking for evidence of reasoning, counter-examples and think with others by agreeing, disagreeing, and stating reasons add on and explain what someone else's mean.

Chin (2007) posits that the types of questions teachers ask influence students' cognitive processes during instruction. Research indicates that verbal questioning is a teaching strategy that teachers use to involve students in classroom discussions to promote classroom interaction (Adedoyin, 2015; Brown, 2006). Studies on teachers' questions revealed that close-ended or display questions are used more in classrooms than open-ended questions (Nunan, 1991; Ho, 2001; Walsh, 2006; Yu, 2010; Adedoyin, 2015). The extensive use of closed-ended questions has been criticised by Nystrand (1997), Alexander (2008), and Hardman et al. (2008), who argued that the use of close-ended questions only encourages short and restricted responses which do not reflect deep and genuine interaction and have been shown to impede students' engagement and learning. On the other hand, open-ended questions encourage deep thinking, enhance increased complex answers, and promote more interaction and meaningful negotiation (Behnam and Pouriran, 2009; Maftoon and Rezaie, 2013).

Open-ended questions are important tools in getting children engaged in challenging cognitive conversations and promoting higher-order thinking and are also found to offer language skills development in children. They help develop children's vocabulary and cognitive skills. Also, apart from improvements, open-ended question is consistent with the sociocultural view of knowledge construction that focuses on working together when learners construct their own web of knowledge by connecting new information with previous or past

knowledge (Barnes, 1992 and Lyle, 2008). Alexander's (2008) and Vygotskian's views are essential in how dialogic talk can help children develop both thinking and communication skills, suggesting that using dialectic language to communicate helps children to think. What children gain from communicating between minds (intermental experiences) through interaction with others helps shape the way each individual child thinks (intramental experience).

Students need to ask questions to activate their previous knowledge, connect to the present task, focus on learning efforts, elaborate on their knowledge, and create new knowledge. During the process of forming questions, students focus their attention on the content and ideas and check for understanding of what they know and do not know (Chin and Osborne, 2008); demonstrate the role of students' questions in self and pair assessment (Black, Harrison, Lee, and Marshall, 2002); improve product thinking (Gallas, 1995), promoting creativity and high-ordered thinking. A student's ability to compose a good question is a sign of deep understanding (Corley and Rauscher, 2013). However, these questions also assist the teacher in prompting, engaging students in deep, reflective thinking, getting, and increasing their engagement. Hence, teachers need to foster an intellectual, socially academic class environment to foster students' thoughtful questions.

Teachers should create a warm atmosphere that encourages students to voice their questions even if students feel the questions are foolish or stupid. Alexander (2018) suggests that more efforts should be geared towards fostering dialogic teaching by designing teachers' professional development programmes that incorporate all elements of dialogic teaching and supports the reflection of evidence of good teaching practices.

3.6 Towards developing a theoretical framework for the study.

This study examines the teacher-student interaction and considers the concept of Vygotsky (1978), which states that every function in a child's cultural development appears twice: between people on a social level (inter-psychological) and on an individual's level (inside the child) intra-psychological. The second aspect of Vygotsky's theory is the idea that the prospect for a child's cognitive development depends on the zone of proximal development (ZPD). In other words, individuals can shape these views and opinions on a personal level during integration and internalisation (a child's level of development attained when engaged

in social behaviour). Hence, the learning process is interconnected and not separated into external and internal processes. The full development of the ZPD depends on the quality of a child's social interaction and the various ranges of knowledge and skills that can be developed with an adult's support and peer collaboration. It is complex and beyond what can be achieved alone.

Affine (2012) suggested that a teacher should provide just the right amount of help to support the child to think and succeed in solving the problem, recognises the point when the child begins to learn independently and withdraws the help in time so as not to do all the thinking. The teacher would be able to effectively scaffold the student's problem by motivating them to employ alternative methods within the ZPD. Examples of such methods are constant and effective feedback, providing oral clues to activate student's previous knowledge or breaking the task into simpler ones to minimise confusion, provision of more detailed information or clarification, modelling by demonstrating visual aids such as showing pictures, videos flashcards and questioning (van de Pol, Volman and Beishuizen (2010).

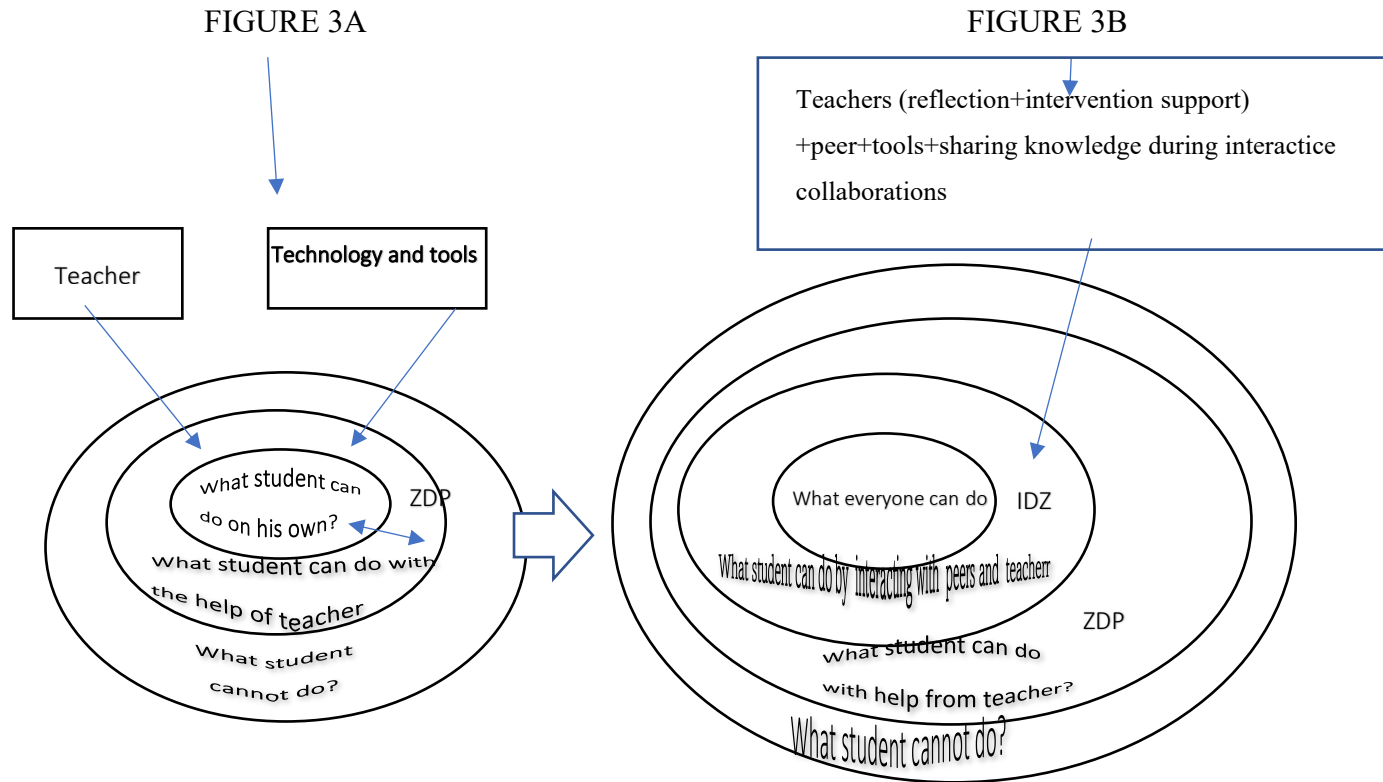
In the present study, the researcher provides the teachers with intervention about classroom interaction patterns so that teachers can provide quality scaffolding (quality patterns of interaction focussing on both instructional and emotional support) to the student in the classrooms. Furthermore, the present study encourages the extension of the scaffold and ZPD (as seen below in Figure 3.1A) to a more collaborative group work, where students learn from one another and share knowledge through interaction, which promotes teamwork, the Intermental Development Zone (IDZ) as shown in Figure 3.1B below. The IDZ is a zone that focuses on the nature of classroom interaction, where the concept of scaffolding is actually realised.

The most important mediator in the present study is classroom behaviours, talk and non-talk, the teacher's types and use of questions and feedback to improve the quality of talk and enhances an environment where the learners are given the opportunity to talk about their views and opinions to develop critical thinking and confidence in them. It is the knowledge and skill a child acquires with adequate help and guidance or tutoring from a teacher and more knowledgeable peers through various classroom activities. These classroom activities are verbal and non-verbal, and all other activities are embedded within the classroom that the child gains.

The figure below illustrates how the teacher steers the learning process through scaffolding within the zone of proximal development, assisting in the development of the individual student's potential. The zone of proximal development is extended by collaborative, reflective, and shared efforts between colleagues and mentors, creating a change in the teacher's quality of interaction to improve and increase student-to-student classroom interaction in the IDZ. The intervention and reflection of practice enabled the teachers to acquire new patterns of interaction different from the previous ones, which in turn brings about students' interacting and socialising with peers, thereby enhancing the sharing of ideas as they all actively, jointly, and meaningfully participate.

FIGURE 3.1A SHOWS WHERE AN INDIVIDUAL, THROUGH THE SUPPORT OF THE TEACHER OR A MORE LEARNT PERSON AND NON-PEER COLLABORATIVE SUPPORT, ATTAINS ZPD.

FIGURE 3.1B SHOWS THE EXTENSION TO THE IDP ZONE OF INTERACTIVE COLLABORATION THROUGH IMPROVED TEACHER'S PRACTICE (REFLECTION AND INTERVENTION) AND THEN TRIALS WITH STUDENTS' CLASSROOM INTERACTION PATTERNS.



3.6.1 Justification for the theoretical foundation of this research

The current study is situated in the sociocultural viewpoint to address the gap found in the literature on classroom interaction patterns in Nigeria. Literature evidence shows that the present pattern of classroom interaction in Nigeria is teacher-centred monologic and authoritative teaching and learning, where students are passive receivers of information (Domike and Odey, 2011; Hardman Abd-Kadri, and Smith, 2008; Nnorom and Erhabor, 2009; Osokoya, 2013). The sociocultural stance adopted for this study is underpinned by the principle that considers the pupil as an active participant, actively engaging in the teaching and learning process and allows learning to be seen as a collaborative activity through interaction with others in a sociocultural perspective.

The current study stems from the aspect of sociocultural that provides the link between language and learning; it shows the importance of language in the immediate environment in which the learner lives and aims at addressing the gap in the language used in learning in Nigeria as discovered in literature (Hardman Abd-Kadri, and Smith, 2008). For these reasons, the sociocultural approach has become a benchmark for investigating the nature of interaction in the classrooms instead of focusing only on learning outcomes. Lemke (2001) stated that offering theoretical leverage (importance) to the role of social interaction in science classrooms is necessary when investigating research in science education.

Many researchers found reasons to investigate various methods that increase students' participation, like explorative, dialogic teaching in the classroom and justified collaborative, interactive learning; for instance, Alexander (2018) listed seven justifications for developing a dialogic teaching framework explaining that the first four justifications are ethical. They take up the pragmatic approach, which argues the need for children to be able to communicate, build relationships, participate in their culture with a value-shared identity, and become committed, active citizens. Hence teachers must consider "why talk", the kinds of their talk, and the quality of their classroom activities. Positive development in students' thinking and learning gains has been linked to the quality of classroom interactions (students and teachers talk and non-talk, questions, responses, and wait time (Alexander, 2005; Chin and Osborne, 2008, Mercer, 2000; Mercer and Dawes, 2008; Mercer, Dewes and Staarman, 2009). The quality and how individual child adopts the cultural tools to enhance their own learning are

described in the associated concept of appropriation (Rogoff, 1995, Wertsch, (1998) as cited in Tomadaki and Scott, 2006).

Andrews, Leonard, Colgrove, and Kalinowski (2011) found no association between students' learning gains and using active learning strategies in biology. They concluded that the active learning designed by college teachers might superficially look like active learning but lacks the constructivist elements essential for learning, or there is a misconception in the student's previous knowledge or inaccurate previous scientific knowledge as submitted by (Anderson, Fisher, and Norman, 2002; Gregory, 2009). They proposed that teachers be trained to specifically design and implement active learning to elicit and address students' prior knowledge. Secondly, they proposed the integration of dialogic and exploratory talk to help in the enhancement of students' critical thinking.

In another study, Linton, Pangle, Wyatt, Powell, and Sherwood (2014) investigated key features of effective learning by comparing the outcomes of three different methods of implementing active learning in biology. Students completed activities in three areas, writing, discussion, and discussion with writing. The findings showed that student scores were higher on exam essay questions when the activity was implemented with a writing component compared with peer discussion only. Another important area is their suggestion that the instructors may need training and practice to become effective in active learning. Based on these, the current study encourages the extension of the scaffold and ZPD to more collaborative group work, where students learn from one another and share knowledge through interaction, which promotes teamwork, the Intermental Development Zone (IDZ). The IDZ is a zone that focuses on the nature of classroom interaction, where the concept of scaffolding is realised.

3.7 Summary of the Chapter

Summarily, this chapter examines some literature on general theories of learning that is related to this study. The chapter discusses interaction and sociocultural perspectives and the uniqueness of interaction in science classrooms and provides insightful reviews of the literature on practices in developed countries. The gap between related theories was identified, and this helps to adopt a theoretical framework for the current study. The adopted framework was extended to include Intermental Development Zone to improve classroom collaboration, dialogue, and cooperation. The justification for the theoretical foundation is also discussed.

Chapter Four: Literature Review Towards Improving the Quality of Classroom Interaction Patterns and Increasing the Length of Students' Talk in Nigeria.

4.0 Introduction

This chapter describes empirical evidence of the appropriateness of theoretical learning ideas in Nigeria and within different contexts, vis-a-vis teacher-centred and student-centred approaches to teaching and learning. This chapter also provides an insightful review of literature in the UK, USA and Australia and gives evidence for the effectiveness of the dialogic teaching approach.

4.1 Empirical evidence of the appropriateness of theoretical teaching and learning ideas in Nigeria and Sub Sahara Africa, vis-a-vis teacher-centred and student-centred approaches to teaching and learning.

Research has shown that there is scarce empirical evidence on how and what teachers actually teach and the impact on students' learning in Sub-Sahara Africa as a whole, especially Nigeria, despite the broad objective for science education that suggests a deliberate attempt to bring about critical thinking abilities out of learners right from primary schools (Ackers et al., 2001; Hardman et al., 2008; Juma and Ngome, 1998; Kalu and Alli, 2004; Prophet, 1994). They suggest the need to analyse process factors and outcomes since effective teaching is significant to improving the quality of students' learning. More research in this field will provide enough baseline field data on which policies are formed and decisions are based on genuine educational development.

4.1.1 Empirical evidence of teaching styles and practices of teachers in Nigeria and some parts of Sub-Sahara Africa:

Abuh (2021), in a descriptive survey design using 344 students and 10 physics teachers, found that the teachers' teaching style was lecture recitation method which resulted in the poor quality of classroom interactions between the teachers and the students and found that the teachers lack good quality of good teachers. In addition, the types of questions teachers asked elicited choral responses from the students. However, Abuh's findings were based on the extent or amount of the classroom interaction patterns and did not explore the classroom discourse

patterns to describe the types and kinds of classroom behaviours. Abd-Kadir and Hardman (2007) examine the whole class discourse of 20 lessons in Nigeria and Kenya primary schools based on the IRF exchange, focussing on initiation and feedback part exchange in a bid for teachers to employ questions and follow-up to enhance students learning, promote thinking, justify, and clarify student's opinions and encourage connections to previous knowledge. They found a dominance of closed-ended questions with the recall of information, and few follow-ups consist of short evaluations inhibiting students deep thinking and limiting their participation.

They went further to suggest teachers' professional development programmes for teachers. Hardman et al. (2008) investigated classroom interaction and discourse practices of 42 recorded lessons and 59 teacher-questionnaire in primary schools in 10 states in Nigeria and sought attitude, role, and teachers' teaching experience. The study found a prevalence and dominance of teacher recitation, explanation, and rote-learning similar to the IRF sequence of exchange in Sinclair and Coulthard (1992) and code-switching with teacher-dominated and teacher-initiated students' choral responses. The suggestion for improving the quality of classroom interaction in Nigeria is through the consideration of in-service school-based training that can facilitate strategies for a change in classroom pedagogy rather than the current monotonous practice to enable students' meaningful learning.

Osokoya (2013) also investigates teaching methodology in basic science and technology in 60 primary 3, 4 and 5 teachers in six states of the Southwest, Nigeria and found monologue sequences with teachers intermittently code-switching to Yoruba to teach science and in a 20 minutes lesson, an average of 8 minutes (38.8%) was spent teachers prompting, 45% on teacher activity while 16.7% on whole-class discussions. Osokoya suggests the need for more in-service training to equip teachers better, and Zekariya (2012) corroborates that few opportunities are available for basic science teachers' in-service training. Kalu-Uche, Alamina and Ovute (2015) explored teachers' classroom pedagogy in the teaching of science in River State secondary schools by employing an observational study and found a teacher-dominant and teacher-centred lecture method of transmitting information in the teaching of physics.

In African Kenyan primary schools, Pontefract and Hardman (2005) also found highly ritualised, rote, and repetitive sets of teacher-dominated patterns in three subjects, Mathematics, Science, and English. Also, Ackers and Hardman (2001) conducted a national

baseline study on classroom interaction in Science, Mathematics, and English and found a teacher dominated with little consideration for students to explore their ideas or involve in their thinking. In Botswana, Mpho (2018) explored 14 teachers' approaches in instructional delivery in 6 primary schools using classroom observation and interviews and found an account of institutionalised routine teacher-dominated and led recitation and code-switching that have minimal learning gains. This does not allow learners to construct their own understanding of concepts through reflective and critical thinking of past experiences and actions.

Also, in Uganda, Muganga and Ssenkusu (2019) found the predominance of teacher-centred teaching in using FGD with 54 students in a mixed method study and concluded that in many regions of the Sub Sahara Africa, rote-learning and memorisation method still dominates their classrooms. Jan Abd-Kadir and Hardman (2007), Hardman et al. (2008) and Osokoya (2013) above showed that nearly all teacher's questions employed in the assessment of the test performances or test scores are closed-ended recall of information, which do not enable critical thinking that promotes students' higher learning outcomes. The above studies suggested specific, culturally based activities and continuing professional development for in-service teachers.

The exploratory research above was designed to improve the quality of teaching and predict greater students' learning gains or leveraging improvements in educational outcomes. They explored what happened in the classroom, based their conclusion on what they observed, and indicated that meaningful teaching has implications for learning, retaining, understanding, and application. They aimed at providing baseline information about classroom behaviours as the basis for policy decisions on teachers' professional development. However, the above research did not directly look into the relationship between what happened in the classroom and student learning outcomes.

Education aims to improve students' learning gains or outcomes. Effective teaching and learning processes that aid the success of pupils' achievement of the learning that the teacher intends consist of outcome or product variables and process variables. The above studies did not evaluate the overall benefit of students' achievement. Exploratory research aimed at improving classroom interaction should also consider their impact on students' learning outcomes. Process and outcome research which is the relationship between classroom processes (teaching) and outcomes (what students learn and how they behave), should be

considered. Gettinger and Kohler (2006) corroborated that research linking process and outcome research has been the source of important instructional advancements for both improving classroom behaviour and promoting student achievement.

Among the studies above, Abd-Kadir and Hardman (2007), Hardman et al. (2008), Pontefract and Hardman (2005) and Ackers and Hardman (2001) included the transcripts of discourse patterns to describe the type and kind of interaction that took place. The other studies did not show evidence of their classrooms' discourse patterns. The studies above found that teachers employed the traditional lecture method of teaching, which according to the findings, did not facilitate critical thinking. Critical thinking occurs through exploration, observation, report, organising, generalisation, prediction and designing phenomena, and continues the inquiry process when new data do not conform to predictions (Chin and Osborne, 2008). These studies demonstrated the need for more exploratory research on teachers and their classroom pedagogy in Nigeria and the scope for specific teachers' professional development.

The teacher-centred or authoritarian approach to teaching is based on the principles of Skinner's behavioural theory, supported by Serin (2018), that behaviour changes based on external stimuli and learners are passive and respond to external stimuli. In teacher-centred learning, the teacher is the centre of the learning, the main source of information, and transmits knowledge to learners with the main foreground on classroom order and control (Mpho, 2018). The content and learning tasks are designed and structured by the teacher. The teacher presents the instruction through lecture methods with the chalkboard and textbooks or lesson notes as the interactive materials, and these practices result in students' loss of interest. Guthrie (2011) agrees that an authoritarian teacher is dominant and defines the norms and classroom behaviour with the main duty to enhance orderliness and promotes students' obedience, while students' responses are manifested in their reactions to the teachers' guild. These classroom qualities are consistent with the culture and customs of the community in which they were born.

Isa, Mammam, Badar and Bala (2020) alluded that the teacher-centred method is theoretically principled, encourages memorisation and presentation of facts, and impedes meaningful students' engagement by practising and learning real-life problems based on experience and does not support the reflection and high cognitive development in learners. Emaliana (2017) argued that although teacher centred has many advantages in that it is shorter to cover the curriculum content through notetaking, memorisation, and chalkboards, it makes

teachers less nervous, it is easy to use in large class sizes, and teachers can set criteria on the English used in communication.

Mpho (2018) associated teacher-centred learning with an authoritarian approach since it hinders students' active learning and encourages leadership to gain control over schooling to produce obedient passive adults. With the widespread discovery learning strategy, many scholars in the developed world are adopting the student-centred approach, but most of Sub-Saharan Africa continues to implement the teacher-centred approach (Isa et al., 2020). Giroux (2010) stated that the concept of student-centred pedagogy is to allow a system of instruction that encourages interaction between students and teachers and places educational activities in the context of learners' actual experiences. Muganga and Ssenkusu (2019) in their own opinion explained that student-centred teaching provokes students to construct their own knowledge mainly and actively through actual experiences that enable them to acquire problem-solving skills, innovation, creativity, collaboration, and critical thinking skills necessary for future or modern-day use.

Conversely, in teacher-centred teaching, the teachers aim to cover the curriculum through the memorisation of contents. The course content depends on the learning process, and teachers teach students the skills to discover their own knowledge or make sense of what they are learning by relating them to previous experiences and by discussing and learning from peers. The teacher considers the students as an individual and a group. The process of constructing own knowledge increases the quest for more knowledge, widens understanding and enhances powers of recall and promotes high cognitive achievement (Serin, 2019). The student-centred approach to learning is viewed as a constructivist approach of a community where the teacher and student construct knowledge through shared activity (Brophy, 1987, cited by Bature, 2020).

The next set of studies below presented evidence of the positive impacts of different patterns of interaction on teaching and learning in Nigeria; although they concentrate on using laboratory settings with very few natural classroom environments, many consider either teacher or student activities and curriculum separately. Many of the studies associated achievements gain to the teacher's characteristics such as experience, content knowledge and qualification or the curriculum but not the student behaviour, and some are design-based analysed instead of exploratory discourse analyses, despite the complex nature of the classroom. As earlier noted,

studies on classroom interaction patterns are sparse in Nigeria and SSA, so few of the studies available are old literature sources that also justify the present study, and more of this has been discussed in chapter one.

Nnorom and Erhabor (2019) investigate the effect of interaction patterns on secondary school students' cognitive achievement in Biology in Edo, Nigeria, with a sample of 270 SS1 Biology students. The results revealed a lower performance of students taught with traditional lecture strategy than students taught with classroom interaction. Also, Kalu and Ali (2004) identified patterns of classroom interaction patterns, teachers' and students' variables, and students' post-instructional attitudes and academic achievements, with 516 and 15 students and teachers, in physics, using a questionnaire, attitudinal scale, science interaction category and physics achievement test and found students need to achieve, teachers' attitude towards teaching result to students' high academic achievements.

Udeani (1992) made a landmark in bridging the gap in students' learning outcomes even though the students' variables considered were only sex and socioeconomic status. Udeani (1992) examined students learning outcomes as related to teacher characteristics (experience, content, knowledge, and qualification) and students (cognitive achievement, attitude, and acquisition of process skills and classroom interaction patterns. Udeani found that experience is the highest contributor, content is second, knowledge is third, and qualification is the least. Teacher personality traits contributed highly to explaining achievement and acquisition of process skills. Teacher and students' classroom interaction patterns accounted for 74% variant in cognitive achievement, 71% acquisition of process, and 30% variant in attitude to science. The students' sex and socioeconomic status did not correlate with learning outcomes.

Fakeye and Amao (2013) submitted that classroom participation independently contributed to a 22% variance in achievement scores. Similar to Udeani, Kalu, and Alli (2004) in a study to determine the patterns of interdependency among classroom interaction patterns, teachers and student variables and students' learning outcomes in Physics consisting of students' attitude and achievement in low and high academic task with a sample of 516 SS1. Physics students and 15 teachers in Cross Rivers State. The results show that 89% of the variance in students' learning outcomes can be accounted for by classroom interaction patterns and teachers' and students' characteristics. The results also show that cognitive gains do not

correlate well with students' affective gains. Moreover, teachers' and students' variables associated with achievements in lower-order cognitive outcomes are not necessarily associated with achievement in higher-order cognitive outcomes.

The above studies showed that classroom interaction patterns positively impact students' academic performance when modified with existing culturally acceptable practices in Nigerian classrooms. These showed that when students were allowed to actively engage by interacting with peers and teachers, asking questions, and engaging in classroom discussions improved students' learning outcomes. The problems with these studies are that there was no evidence of the classroom discourse., Interaction patterns were correlated against scores of students, and they concentrated on using laboratory settings with very few natural classroom environments. Many consider either teacher or student activities and curriculum separately. Many of the studies associated achievements gained with teachers' characteristics.

The modification of the existing teacher-centred approach by introducing classroom interaction patterns and some elements of the student-centred approach in the empirical evidence above fulfil some principles of sociocultural theory, where students construct their own knowledge through support and interaction with a more skilled teacher or adult or peers for cognitive development. Children develop values, culture, and beliefs by interacting with social groups in society and are able to develop skills and knowledge through the help of more skilled adults and gradually progress to attain individual competency.

Both constructivism and sociocultural theory approaches are associated with student centred approach that promotes students' active role in their learning and believes that learning is socially and individually constructed, "learning by doing", integrating new information with prior school entry experiences. In the classroom environment of both theories, children are able to think and solve real-life problems actively and critically. In the sociocultural and constructivist approach, the teacher serves as a guide or facilitator so the students can make new interpretations of the learning materials, and collaboration and peer-to-peer interaction could produce a wealth of information as against the teacher-centred approach, where the teacher serves the role of an instructor. Knowledge and learning are improved when a teacher is placed on a peer level, which benefits the student and the classroom as a whole through peer-to-peer interaction and collaborative thinking.

In a student-centred approach, underpinned by the constructivist theory, students choose what they will learn, how they will learn, and how to access their learning. The sociocultural and socio-constructivist lay importance on the context of the learning in that the specific society to which the learning is situated is important. In this situated learning, the learning and activities must be relevant, useful, and applicable within the same or similar culture. Serin (2019), however, argued that the student-centred strategy might be disadvantageous in that it may make the classroom noisy and disorganised and can lead to the teacher's loss of class management and an attempt by the teacher to put the class into order may waste precious lesson time, and argued that teachers should be enthusiastic and be aware that it is their duty to inspire students and create an engaging and active learning environment in the classroom and promote the growth of students' morals and healthy and sound mind.

Serin (2019) alluded that pupils cannot develop their knowledge and abilities without a facilitator. Without a facilitator, pupils are unable to develop their knowledge and abilities to achieve high learning outcomes provided at the zone of proximal development (Vygotsky, 1978). Is the student centred, where students solely choose what they will learn, how they will learn it and how to access their learning practicable in Africa? What discourse and pedagogy practices best support learning in classrooms in Sub Sahara Africa?

Guthrie (2011), in support of a formalistic approach to teaching, extensively described the elements and principles at play in formalistic and progressive educational systems, their differences and their effectiveness in developed and developing countries. Guthrie referred to most recent educational reforms in Western countries (for instance, student-centred, active learning, discover, participatory and constructivist) as a progressive Western culturally centred classroom and referred to the formalistic classroom as one designed around the teacher as an expert skilled in the transmission of culturally valued knowledge. Some of the characteristics of the formalistic classroom are that it is teacher-dominant and controlled, strict, routine, and hierarchical. The content is organised and with importance on memorisation with teachers' use of closed-ended questions. Students are passive but limited with some interactions through questions and answers, pair group work and students' sanctions focused on learning.

Since the society's culture and curriculum reflects what the people in the society believe and do, a curriculum represents the educational need of a particular society, so it is important to consider "what? to whom? when? and how? for whom?" of the curriculum of a

society based on its culture (Nakpodia, 2010; Namubiru, 2021). Guthrie (2011) provided evidence for the success of formalistic education in developing countries and justification for a symbolic cultural continuity and argued that it is culturally prevalent and characteristic in Africa and symptomatic and embedded in African culture, and it is likely to remain in classroom practices.

Tabulawa (2006) and Westbrook et al. (2013) argued that the authoritarian or traditional teaching method is compatible and appropriate with the African culture and should not be condemned. Tabulawa (2006) views language and authoritative principles as cultural antiques that have evolved from society over time and influence how teachers and students behave in the classroom and play their respective roles. Teacher educators in Africa transmit their instructional approaches to student teachers, who then impart the same knowledge, skills, and values to their own pupils in elementary, secondary, or postsecondary education. In fact, according to Otaala, Maani, and Bakaira (2013), the majority of teachers and instructors attribute their pedagogical practices to their education and the significance of standardised national tests, which has led to the persistence of teacher-centred techniques. Tabulawa (2009), in a bid for reform of education in Botswana, suggested the need to design intervention or reform to change not only teacher-dominated practices but also students' classroom practices as they are co-construction of knowledge in classrooms.

Muganga and Ssenkusu (2019) opined that most Sub Sahara African countries inherited their educational systems from the missionaries and colonial authorities and followed the theories and practices that aim to create and maintain a class of subservient government employees based on the European civilisational model. The missionaries and colonial authorities alienated the African children from their cultural roots and indoctrinated them with European languages, culture, and religion (NCHE Report, 2018). Although Guthrie (2011), Busari et al. (2017), and Osokoya (2013) argued that the old long traditional form of informal education practised in African societies prior to colonisation still exists today (see chapter 2, section 2.1 of this thesis).

4.1.2 Evidence that the traditional style is compatible and appropriate in African classrooms.

Guthrie (2011) remarked that formalistic teachers' practice does not have to be the teacher-dominated lecture method, can be in a hierarchy, and may not necessarily be authoritative.

Guthrie argued that traditional, authoritarian, or formalistic instruction could be modified and organised to improve teachers' pedagogical skills. Guthrie critiques studies whose findings of classrooms' behaviours were not based on whether student-centred or teacher centred or the kinds and types of classroom behaviours but where findings of teachers' classroom behaviours were based on teacher's lecture time in percentages or the amount or extent of the lesson time based the findings were not presented in these studies.

Guthrie compared the findings of Hardman et al. (2008) in Nigeria that teachers dominated the teaching by initiation and re-initiation of students' responses, and overuse of tag questions and choral students' responses dominated the classrooms with no variations found in teaching approach with the findings of (Fuller and Sydney, 1991) in Botswana with the use of a structured observational method in 154 junior secondary schools and 127 primary teachers. The teachers in Botswana employed mainly the formalistic approach with varied classroom behavioural practices such as written exercises, chalk and talk, and textbooks depending on class size and subject they taught. Guthrie argued that, In Botswana, there were variations in the characteristics of the classrooms, and students' behaviours were a mixture of active and passive, and the teachers made efforts to initiate pupils' responses through close ended-questions and recitation.

Barrette (2007), in an exploratory study of 28 lessons in Tanzania consisting of 32 teachers in 18 schools, the teachers' classroom behaviour was weighed against their perspectives of good classroom practices. The teachers' classroom behaviours varied depending on the knowledge of the subject matter, in-service training, conviction, school culture and pedagogical skills. Barrette concluded that the traditional form of teaching could vary in Africa depending on shared cultural mutual understanding with the implication for training for the betterment of teachers' classroom behaviour within the shades of the existing practices.

Tabulawa (2004) observed 70 classroom lessons and teacher interviews and found that teachers and students have shared expectations of the values of classroom pedagogy. In addition, teachers played a dominant role, basically in the transmission of knowledge, in the process, reinforcing students' right answers and oblivious of the wrong ones but found that there was no power tussle. The teachers did not coerce students, and the students actively co-construct knowledge and expectations. Students understand and jointly protect the teacher's

societal value within the society's context and opined that students' passive or silence means students are exercising their power. The students did not compel the teacher-dominant classroom behaviour, but it is a jointly mediated meaning-making process of using power against each other in a manner that is compatible with the culture of the classroom setting.

The researcher's understanding of Tabulawa's views about students' 'silence' in classrooms as a way of exercising their own power is that since silence is a non-verbal form of interaction, then, it can be interpreted in different contexts based on the culture, the pattern of the discourse and the setting, for instance, in classrooms where interaction is a two-way process of complex exchange where the types and kinds and quantity of messages shared matters will be interpreted differently from a classroom that lays emphasis on one-way authoritative quantitative interaction. How do teachers know what students know, and how do teachers understand how students know what they know if students' power remains in their silence and the teacher talks almost through the lesson? How would language skills be developed? In some cultural settings, silence may even be interpreted as ignoring the other participant, confusion, disrespect, boredom, wisdom, or being forced to accept a silent position. Conversely, it is regarded as an act of respect in the Yoruba culture in Nigeria if the other person is older and leading the conversation. In some cultures, an individual's silence can mean tranquillity and a period of reflection; to some, silence is therapeutic. Nevertheless, Tabulawa acknowledges the importance of students in classrooms by suggesting to researchers and policymakers that designing programmes for training students should be considered alongside designing programmes for teachers' professional development and for the success of such programmes to be achieved.

In Alexander's (2008) and Vygotskian's views, dialogue with children helps them to develop both skills of thinking and communication, which suggest that using dialectic language to communicate helps children to think, that is, what they gain from (intermental experience) communicating between minds through interaction with others helps shape (their intramental experience) the way each individual think. The teachers control the class and solely bear the role of encouraging students to ask questions lies with the teacher. Chin and Osborne (2008) show that teaching good questioning skills to children can improve performance, and research also suggests that students rarely ask spontaneous questions. When students ask questions, it means they are thinking of some ideas about issues presented and trying to connect them to

previous knowledge. The values of students' questions have been emphasised by studies (Chin and Osborne, 2008; Mercer, Dawes and Staarman, 2009).

When students do not ask questions, it may be because teachers do not encourage students to ask questions or do not elicit students' critical thinking, or students do not have enough confidence to ask questions or do not want to call attention to themselves. Students ask questions to activate their previous knowledge, connect to the present task, focus on learning efforts, elaborate on their knowledge, and create new knowledge. During the process of forming questions, students focus their attention on the content and ideas and check for understanding of what they know and do not know (Chin and Osborne, 2008). Students' questions improve product thinking and promote creativity and high-ordered thinking. A student's ability to compose a good question is a sign of deep understanding (Corley and Rauscher, 2013). However, these questions also assist the teacher in prompting, engaging students in deep, reflective thinking, getting, and increasing their engagement.

Chan and Rao (2010) argued against the common belief that the Chinese educational system is passive rote learning within the Confucian heritage in the light of their culture, and this influences the Chinese educational method. Chan and Rao proved that students who learnt through overt passive rote learning performed better than students in Western countries in Mathematics, science, and language. This showed that superficial passive learning with strategies that allow students to understand deep meanings promotes high cognitive development. This study also showed that a formalistic strategy could enhance students' participation.

Lomoteyi and Gyima-Aboagye (2021) investigated the use of IRF exchange in Ghana basic schools, employed a qualitative method, 100 minutes interviews, and analysed and transcribed 11 hours and 40 minutes of recorded lessons. The teacher divided the students into different groups. This finding suggests that teachers predominated the usage of the exchange pattern, allowing the students to exclusively supply responses, as there were more initiation and feedback acts than response acts. Findings also revealed that teachers play a significant part in implementing the IRF to create the most engaged ESL class possible, the teachers and students were involved in the initiation, and effective prompts of students were used by the teachers in a timeframe as suggested by (Li, 2018). Lomoteyi and Gyima-Aboagye (2021) combined the old IRF method with students' grouping, which may have contributed to the lesson's success.

The researcher of the current study's understanding of the above arguments about the compatibility of the traditional method in Africa is that emphasising and understanding the promotion of practices that are sustainable in developing countries need the consideration of existing large classes, lack of resource materials, unqualified teachers, multilingual societies, poverty, culture, values, and other educational problems discussed in Chapter 2 of this study. For instance, in South Africa, teachers fear a loss of class control if they change their style of teachers (Fenning and Rose, 2007). In addition, the researcher understands that the studies that were considered effective and appropriate provided interventions in African classrooms in recognition of the complexity of the contexts and others described in Chapter 2. For example, group work could be challenging with a large class and may result in students working individually, so teachers have to understand the learning process to make it successful.

Compared to the findings on the use of group work in low-resource settings, Mercer and Drummond (2003) stated that using group work in a rich-resource environment could be challenging. Dembele (2005), therefore, suggests a child-friendly approach with a mixture of teacher-centred and student-centred learning. In the researcher's opinion, employing Alexander's (2001) dialogic framework to build on the discussion might be helpful. Howe and Mercer (2007a) critique that the small interaction that takes place in group work is not enough to contribute to meaningful learning because the teacher's concern will centre on class control (Baines, Blatchford and Chown, 2007). Alexander (2018), therefore, proposed training teachers on the effective use of collaborative group work to solve this challenge.

The researcher noted that the competency-based BST curriculum in Nigeria aims to anticipate learners' development and application of scientific and technological knowledge and skills useful in the present and future world. Other objectives include enabling students to utilise a wide range of options made available through science and technology and equipping students with advanced scientific and technology degrees. According to the curriculum, the teachers would attain this by promoting inventive teaching, learning strategies and activities prescribed under each topic that enhances students' skillfulness, learning by doing and critical thinking. NPE (2013) stated that the BST curriculum contains many suggestions about classroom practices that could improve the quality of students' classroom participation, keep students engaged, improve learners' interests and verbal competencies and promote teamwork, as suggested by the current study. Contrary to Tabulawa's arguments in support of the

traditional teaching approach, these objectives will be difficult to achieve solely by the traditional teaching approach in Nigerian classrooms.

The BSTC also allows teachers to source local materials to relate topics to the immediate environment if there are challenges in the provision of materials or equipment. The Federal Government of Nigeria produced some teachers' guides in the ten subjects. Distinctive modern practices highlighted in the teachers' guide produced by NERDC comprise engaging in learner-centred teaching, using information and communication technology, and linking teaching and learning to learners' social or immediate environment. The researcher explained the elements of the competency-based BST curriculum in Chapter 2 and the teachers' guide with teachers' activities and different choices of strategies for implementation. However, many studies found that consistently, most learners perform poorly academically, which is directly related to the use of inadequate teaching strategies by teachers to impart knowledge effectively to students (Adunola, 2011).

In Nigeria, studies have shown that teachers' teaching style is routine, with excessive teacher talk, lecture methods, memorisation, recitation, and asking mainly close-ended and very few opened-ended questions. Furthermore, studies also agreed that open-ended questions help students initiate talk, expand their responses, and promote students' questions, participation and sharing of ideas to develop critical thinking, deep understanding, and applications of their learnings. The researcher thinks that helping teachers to modify their practices to incorporate students' activities through participating and engaging in discussion will assist teachers in understanding what students are thinking and how they know what they know.

4.1.3 Evidence for the effectiveness and otherwise of teaching styles in different contexts (SSA and Asia).

Westbrook et al. (2013) provide an in-depth literature review on the evidence of the effectiveness of teachers' teaching strategies with effective use of demonstration, flexible use of whole class, group work and pair work, frequent use of learning materials beyond textbooks, open and close-ended questions to promote the extension of responses and students' questions and use of indigenous languages. Westbrook et al. (2013) identified three strategies that teachers need to develop by bearing a positive attitude toward training and students; teachers'

provision of feedback and rendering consistent attention to individual and all students; establishment of a safe space for students and teachers' reflection on students' upbringing in teaching discourse.

A total of 54 empirical studies were reviewed in-depth, 29 from Sub-Sahara Africa (It is important to note that only 1 study was from Nigeria), 15 from India, and the rest from other Asian countries) with detailed descriptions of pedagogy practices. Most of the studies reported that the teachers were qualified, 5 reported unqualified, and 8 were a mixture of both, but there was no specifying the types of qualifications, whether highly or poorly educated. They were scored high and moderate in quality based on the two features. The studies were classified into three; intervention studies based on intervention provided to address pedagogy based on context or funded educational reforms to enhance schooling or baseline exploratory research based on existing conditions. Their evidence was scored primarily on high and moderate-quality research from various situations.

Westbrook et al. (2013)'s review indicated an overall moderate; some indicated a vigorous uniformity in how the teachers carried out three pedagogy strategies; feedback and paying sustained attention to all students; creating enabling environment; teachers drawing on students' backgrounds. The methods used for the strategies were demonstration, flexible use of pair groups, whole class, use of TLMs, open and closed questions, expansion of responses, use of indigenous languages and code-switching, planning, and various sequences in lessons. All these positioned with CPD with curriculum and pedagogy, the positive impact of follow-up class support and peer support, although with a poor comparison of the practice with learning outcomes. The review categorised the studies into a variety of contexts, high and moderate quality in relation to pedagogy practices concerning regions, mostly positive outcomes, mixed outcomes, and negative outcomes, and concerning whether they are intervention, reforms, or existing conditions.

Westbrook's review revealed that studies with mostly positive outcomes are from Ghana, one from Egypt, and two in India (three from intervention and one existing situation), seven mixed outcomes (intervention and reform and ten with negative outcomes mainly from sub-Sahara Africa (existing conditions)). Most of these studies underpinned their studies on discussing the differences between social constructivism and constructivism, and the main pedagogical approach was student-centred. The studies emphasised the significance of students

or pupils engaging and creating in their learning to deepen their thinking and for high cognitive development. The review examined the reports of the findings of these studies that teachers' positive attitudes and beliefs towards (four interventions and one reform) enhanced pedagogy strategy contributed to higher student attainment (positive outcomes). The findings suggested some synergy between culture and pedagogy, with the pedagogy's rationale being obvious as a consequence. This was owing to the consistency of training in the intervention studies, the pedagogy used, and the contexts of the settings.

The review found that Eight of the studies from East Africa and India reported mixed or ineffective pedagogy implemented in challenging situations of poor resources and large classes. The studies further showed that some teachers have constraints on how society shapes the position of the teacher as an authority, which stands in the way of students centred approach. Based on feedback and sustained attention, Westbrook reported that seven studies paid positive attention to students by focusing on individual students' level of knowledge, quieter students, and students from low socioeconomic homes. In three studies, teachers were either unable to recognise students who were failing or did not understand how to deal with pupils who had not understood the lesson work beyond repetition, and large classes hindered teachers from introducing varied activities using group work to encourage sharing ideas.

Westbrook et al. (2013) review reported that six studies in Asia and Africa associated improved teaching strategies with teachers' ability to create a safe, enabling environment. Students were not stressed and described their teachers subjectively as warm, lively, and friendly, encouraging participation despite the large teacher classes. The review further reported that in the six studies, teachers refrained from corporal punishment, and students described themselves as happy and confident despite not being connected to students' learning outcomes, but they could positively enhance their learning.

Based on teachers' classroom teaching, Westbrook's review showed that group work and pair work was evident in student-centred learning and produced mixed outcomes with unclear explicit outcomes. In the review, Westbrook et al. (2013) found that fifteen studies found group work effective in mostly interventions combined with existing conditions of large classes in poor-resourced classroom settings. The report stated that there was evidence that in all existing conditions, group work was not found to be effective, although there were indicators instead of evidence of increased student participation, happiness, and confidence. In

existing conditions, either with the support of teachers or without, students in pair or small group work scored higher than students that were not monitored or supported by teachers. In Ghana and Kenya, teachers' use of paired groups with the whole class or individual work produced high student attainment. The review reported that in activity-based learning, with the provision of TLM, the use of outdoor and out-of-school learning activities, group work and teachers' support to groups and individuals resulted in students being motivated and confident with higher achievement.

The review reported that in Uganda, Africa, among studies conducted mostly in existing conditions, group work allowed modification to the difficult existing situations of large classes and sharing of little available resources, and the teachers changed the seatings and organised students in groups, they ensure that the learning was meaningful and increase in students' engagement. However, the review reported that where teachers used group work for class discussion and presentation but could not re-arrange the seating to prevail over existing conditions did not encourage high-ordered. Another report is that in some Sub Sahara Africa and India, where there was no group work and studies were conducted under the existing situations, with few student-student interactions, learning did not take place, the students maintained their seating positions, and teachers mainly stood in the front and employed closed-ended questions. Westbrook et al. (2013) reported that where the students sitting in the front of the classrooms mostly gained the attention of the teacher and participated more with higher scores than those inactive at other places due to overcrowding, few TLMs and use of second language as the medium of instructions as challenges mitigating against the teachers' practices.

Westbrook et al. (2013)'s review showed that using the indigenous or first language enhances classroom interaction. Students easily understood the interpretations of teachers' explanations and allowed connections between previous and new knowledge, promoting high cognitive thinking. Using the first language encourages understanding of abstract concepts, makes learning meaningful, improves teamwork and understanding in a group or pair work, and encourages using various strategies in interventions and reforms. Conversely, studies with interventions and pedagogy practice with English as the medium of instruction perform less than those that the medium of instruction is their first language. Another report is that in some studies in Africa, the use of English or languages other than the first language in classrooms was more routine, which played a part in didactic style and with poorer outcomes. Some

reported mixed results with the national policy being violated by teachers' use of native dialect, which makes its usage quite more hesitant than required.

Westbrook et al. (2013)'s review also showed that nine studies with interventions reported that the use of TLMs enhances students' learning. Five studies within the existing situation reported the main usage of textbooks in a directive manner or a lack of textbooks. Studies, where various TLMs were used showed indicators of success instead of evidence of success. However, in intervention studies, higher student attainment was reported when teachers used different TLMs other than textbooks. Westbrook et al., (2013) detailed review also showed that some studies use students' learning materials that are appropriate to students' effectiveness by connecting pictures to previous knowledge, while some studies explained that teachers read from textbooks without considering the needs of students or the learning outcomes.

In the review, Westbrook et al. (2013) showed that ten studies reported effective questioning within different contexts. The effectiveness of the use of questioning was, however, classified into less effective and most effective. The most effective were qualitative studies, and it seemed the teachers generated various questions based on students' backgrounds. The questions spanned from closed to open-ended, with the integration of feedback by expansion, giving clues by reframing and probing of questions with Sharma topping the list by allowing students time to talk, listening attentively and did disrupt them. In some, the teachers use questions in various classroom contexts, such as group work and encouraging students' questioning to promote high cognitive skills and spark open-ended conversations, which was influenced by their training.

Westbrook et al. (2013) reported teachers' effective questioning in greater existing challenging traditional whole-class situations in four studies, but there were no discourse patterns to give a deep and elaborate understanding of the effectiveness of classroom questioning in many of them. In contracts, seven studies indicated teachers' ineffective use of a great percentage of questions of closed-ended questions to elicit and check information about facts and recall information and reported 97 per cent of positive and negative outcomes. The ineffective questions and answers patterns that were seen resulted from large classrooms, a lack of resources, obsolete ITE, and minimal CPD. Although the students were involved, their comprehension was not examined by the teachers, and teachers seldom re-formulated and

articulated or probed students' responses, and teachers' recognition of students' responses was whole class clapping and brief praise. These studies concluded that no learning occurred.

From the above, the researcher of the current study elicits that interventions and reforms studies reported high to moderate outcomes. They promote teachers' development of positive attitudes and beliefs towards consistency between the context of the classroom, training, and pedagogy practices; teachers connect learning to students' sociocultural backgrounds with local examples. Training promotes pedagogy and positively impacts teachers' practices and students' learning. Concerning teachers' practices in Sub-Saharan Africa under existing conditions, the researcher understands the following characteristics from the review: teachers were unable to identify struggling students; teachers were not able to connect learning content to students' prior experiences in life; teachers were unable to refrain from corporal punishment; group work not effective in large classes; poor- resourced settings, immovable desks and chairs; use of second language; seating positions where teachers were mostly in front, students sat in rolls and students in front gained most of the teachers' attention; overcrowding classrooms; main use of blackboard, textbooks; teachers mainly read from textbooks or lesson notes; closed-ended questions; teachers questions dominate; ritualise questions and answer strategies; choral responses; clapping; no check for students understanding.

Conclusively, this review indicated the scope for future research that will combine quantitative and qualitative with baseline and post-test to measure students' attainment to measure the impact of the intervention rather than observation- descriptive studies that use standardised or national tests to measure the impact of the intervention. Students' perspectives and experiences and teachers' understanding should be foregrounded in further studies.

4.2 Evidence for the effectiveness of the dialogic teaching approach.

An internal evaluation of the dialogic teaching project piloted in London and North Yorkshire (Alexander, 2003; 2005a; 2005b; 2018), employing different methods, arrived at positive outcomes. Lefstein and Snell (2010; 2011; 2014) investigated three-year changes in classroom talk resulting from the teacher training and development intervention (TTDI) London project through the services of the external forensic, scientific description of individual human societies' perspectives and identified glaring and convincing evidence of a strong-established

signature of pedagogy linked with TTDI confirming the effectiveness of the project, and in line with the findings of (Alexander, 2005b). The findings include a general increase in the number of probes and hypothetical questions, peer-to-peer talk, whole-class discussion, various kinds of talk and an increase in pupils' participation in explanatory and descriptive talk, rationale, and hypothesis types of talk. These changes were apparent in 2008-2009 observations (Lefstein and Snell, 2014).

In a talk-to-learn project, Alexander (2006) shows that dialogic teaching promotes a more encompassing classroom where pupils can speak and contribute confidently without competition. Deakin, Taylor, Ritchie, Samuel, and Durant (2005) report that the EPPI-centre review of evidence on citizenship education found that the quality of dialogue and discourse is central to learning in citizenship education. Dialogue and discourse are connected with learning about shared values, human rights, and issues of justice and equality. Transformative, dialogical, and participatory pedagogies complement and sustain achievements instead of diverting attention from them.

Later, Alexander (2018) built on earlier works, showed evidence through randomised control trial implementing dialogic teaching intervention as interwoven sets of repertoires, piloted in London, and supported by the UK Education Endowment Foundation, found teachers direct positive gains from the programme's talk, students' engagement, and learning. In addition, improved teachers' professional understanding and skills were found, the ratio of closed to open-ended questions was fairly balanced, and the intervention group used dialogue and discussion more than the control group. Mercer and Littleton (2007), Reznitskaya et al., 2009; Reznitskaya et al., 2011; Reznitskaya (2012), and Soter et al. (2008) also showed empirical evidence linking dialogic teaching to positive outcomes, whereas Mercer and Littleton (2007) equally show theoretical evidence of the positive impact of dialogic teaching.

4.3 Summary of the Chapter

This chapter reviewed literature providing evidence on the teaching styles in SSA and Nigeria and the appropriation of theoretical teachings and ideas considering the various challenges influencing teachers' classroom practices, such as culture, large class size, limited resources, and lack of enough or unavailability of teaching and learning materials and discussed the teacher-centred and student-centred. The chapter also reviewed the literature on how these

factors determine teachers' use of student- or teacher-centred approaches in different contexts. The chapter showed that teachers, including the researcher, have choices to make decisions based on what we do, who we are and what our environments offer and critically and reasonably accommodate what our society can accept and sustain from other countries.

This chapter showed that most teaching strategies used by teachers in Nigeria and other Sub Sahara Africa are ineffective, and students are not learning because of the existing conditions with massive challenges detailed in chapters 2 and 4. Equally, the chapter suggested that specific expanded training that targets the context of the setting and proffers solutions to the challenge can improve teachers' teaching strategies. As teachers, the chapter demonstrated that we are ready to change and can modify our existing strategies to accommodate effective ones to enable Nigeria to achieve the NPE and MDG. There is no gaining saying that teachers' practices need changing in Sub Sahara Africa and Nigeria. The curriculum, the NPE and classroom practices are in the opposite direction. Teachers cannot teach, and learners are not learning due to deteriorating and existing conditions. Studies agreed on the need for change in practice in Sub Sahara Africa to encourage improvement by modifying existing practices; no matter how little, it is better than nothing (Guthrie, 2011; Westbrook et al., 2013; Tabulawa, 2009). The chapter also provides evidence for the effectiveness of dialogic teaching approach.

Chapter Five: Teacher Education and Teachers' Professional Development and Prevailing Issues.

5.0 Introduction

This chapter supports and reflects on the details of the pre-service and in-service teacher training and development in Nigeria, which had been discussed in Chapter Two, the challenges of education and how teacher education is problematised in Nigeria and Sub Sahara Africa. This chapter provides an insightful literature review on teachers' pre-service and CPD in different contexts and factors that support and promote effective and positive teachers' practices.

5.1 Achieving a change in teachers' practices in Nigerian classrooms.

Teaching and learning in Nigeria and Sub Sahara Africa have different educational circumstances and myriads of problems ranging from high-level corruption to cultural, socioeconomic, and political instabilities and challenges of education and teacher education. Teachers need local help to create awareness of the need for a change and understanding of our current practices to promote a modification and change that will align with our traditions and culture and fit into the context of our settings.

Alexander (2001; 2018), Hardman et al. (2001), Hardman et al. (2011), Guthrie (2011), Namubiru (2021), and Westbrook et al. (2013) noted that the peculiarities of Africa's cultural background, local background knowledge, demands of different learning needs with scarce resources should be seriously considered before developing policies for teachers' CPD about new educational reforms and before internationally acceptable best practices are integrated into existing curriculum practices.

The researcher of the current study's anecdotal experience to support that teachers often feel coerced, forced, or threatened by reformers, leaders, or new policies or innovations is that, in 2012, the past government of Ekiti State, under the leadership of Fayemi, proposed that all primary and secondary school teachers in the state had to participate in a state-mandated test to assess their level of strength and weaknesses and ICT knowledge. Almost all the teachers and principals in the state refused to participate for fear that the government may use the results to lay them off from their job. The resistance was so intense that it began the governor's major

exit from the state's leadership. This may be related to (Tabulawa (2006), Guthrie (2011), and Hargreaves and Fullan, 2009), which suggests that change is not easy or a war in disguise.

In contrast, Tóth and Csapó (2022) and Terhart (2013) found that teachers' reactions to states' mandated test accountability practices were positive, and the teachers judged them to be useful through previous training offered to a group of teachers, a precondition that geared the acceptance, so training, motivation, conviction, and acceptance are important factors for acceptance of educational reforms. Westbrook et al. (2013), in the rigorous review of studies, remarked that teachers in four studies reported that they developed positive attitudes and beliefs towards the training and practices because there was a coherence between training and pedagogy practices and the classroom contexts, which makes visible the logic behind the pedagogy transparent.

The researcher of the current study strongly agrees that we cannot ignore that the stark realities of everyday classrooms in Nigeria, with massive corruption, very high poverty rate, and myriads of problems detailed in chapter 2 of the current study, are distinct from the realities in other parts of the world, but very similar to other countries in Sub Sahara Africa. The educational circumstances are different. Imagine a classroom with no chalkboard, no benches, or tables where pupils sit on the floor and come to class mostly on an empty stomach. These contextual factors were also asserted by Avalos (2011), who also shows that the way contextual factors interact with learning needs varies depending on a country's tradition, policy, culture, and school conditions.

Westbrook et al. (2013) cited 18 research conducted in sub-Saharan Africa that reported insufficient or chronic shortages of textbooks and other instructional and learning materials and their poor quality, crowded classrooms as the main obstacles to students' learning and opined that teachers required specialised training to fully utilise resources even when there was an abundance of them. Westbrook et al. (2013) reported that in a study in Uganda, when teachers tried to create their own materials, it was just impossible to provide enough when classes had more than 150 students, as the study showed. Interaction and paying attention to numerous students can be very challenging for teachers in these situations.

This section has argued that change might not be easy to effect and sustain and that there are various specific and unique challenges mitigating teacher's interest and ability to

change in Nigeria, but I have also argued that through mentorship, motivation and collaboration, teachers' positive interest in CPD for change in classroom practices can be achieved by modifying and improving their practices.

Avalos (2011) refers to the influence of the culture of mimicking a practice or transmission of teaching patterns that focus on memorisation and recall of facts over a very long time as mentoring. Avalos explains that this culture is in contentment with the policy and people in charge of improving the quality of education and school environments with no strong challenge for change and has a traditional history in Sub Sahara African countries. In Nigeria, school-based or centralised in-service teacher education and training are neither well-designed, compulsory, nor effective (Asaya, 2011). These make it essential to enhance teachers' skills, attitudes, beliefs, comprehension, and pedagogy practices by focusing more on students, their histories, experiences, and degree of current and prospects of learning, as well as developing a deep awareness of whether or not the curriculum is matched to their needs. A good place to start is teacher education, which views education as primarily an interactive social exchange process that requires that supportive teachers are familiar with how their pupils fit into the curriculum.

Lufungulu, Mambwe and Kalinde (2021) submit that action research has been found to be a useful philosophy and a method of inquiry carried out by teachers as researchers of their own practice or by school administrators. This is done using the techniques of research to collect facts about their practices and thereafter enrich the mode of operation in their educational settings, the way they teach and how students learn. Action research is an ongoing cyclic process conducted in the workplace for practical problem-solving by avoiding research paradigms with isolation and control of variables. It is done collaboratively by identifying the problems and revising the aims and strategies as the action research process progresses (Hossni, 2019).

Hossni (2019) explained that planning, the first stage of action research, involves identifying the problem, reviewing the literature to understand the problem better, designing the process, and determining your data collection method. Employ various cycles of interventions, experimentation and various data collection, and because action research is reflexive, recurrent, cyclic, and continuous, data collection and analysis should be done in unison with action, analyse the data, report the result, share the work and take action based on

the results, the evaluate and reflect on the practice which will lead to new questions as the cycle continues and become a more skilled and creative teacher (Lufungulu, Mambwe and Kalinde, 2021).

O'Connor, Greene, and Anderson (2006), in an elementary 2-year master's degree program, examined the insight of 34 full-time and part-time practising students. The study found that action research elicits positive changes by effectively impacting the 34 teacher students' daily and future instructional practices, improving their skills as teachers and researchers, and improving their students' learning outcomes. Further, Kitchen and Stevens (2008), in an action research project designed by 2-teacher-educators, a teaching assistant and an instructor for themselves and for 32 pre-service teachers. They identified issues they wanted as projects, identified problems and drew questions and proposals, employed peer dynamics and personal commitment, positioned themselves in the field, used a collaborative, interdisciplinary approach, developed an action plan, executed the projects through reflection and inquiry, employ different perspectives found the majority of the pre-service students reported that they did not connect theory with practice, but many found the action research rewarding and planned to undergo action research in their in-service years further. The teacher educators' improved practices encouraged them to plan to enhance the action research design for another cohort of pre-service teachers.

These studies show that Nigerian teachers, teacher educators, and educational administrators can use a collective and reflective method to identify their own specific educational challenges, jointly proffer solutions, and act accordingly to solve educational problems.

5.1.1 Formal continuing education.

Postholm (2012) found that teachers initially had little formal competence in educational development in Norway but developed high formal competency within five to six years compared to other professional groups by participating to a large extent in training and Education. They added that the teachers continue to stimulate learning because they participate more in collaborative non-classroom time outside normal teaching time. Therefore, strengthening collaborative planning, implementation, and assessment of teaching and their

positive influence of practical on pupils' learning outcomes spanned for three to five years and continues in some cases after training.

According to the OECD (2009), a teaching and learning survey (TALIS) found out in a study among the OECD countries that qualification and research programmes for lower secondary school teachers are most crucial for their professional development. Parise and Spillane (2010) investigated the influence of formal and on-the-job learning opportunities on teachers' practice in 30 elementary schools. They found that American Mathematics and English language arts teachers value additional formal education if connected directly to their teaching. It was also found that formal education and on-the-job learning significantly change their instructional practices.

Hine (2013), a study of American and Australian teachers, shows evidence to suggest that action research is appreciative for teachers to undertake as it provides teachers with a systematic, collaborative, and participatory process of inquiry that effectively provides solutions to problem areas or right wrongs and omissions to issues deemed fit. Hine also found that action research gives teachers the technical skills and professional knowledge needed to impact positive change within classrooms, schools, and communities. Mill (2007) suggests that stakeholders, teachers, researchers, and school administrative staff should consider action research a brilliant option to be considered in the teaching and learning environment.

Buczynski and Hansen (2010) conducted an inquiry study of the influence of learning partnership for professional development on course attendance (exploratory teaching method, formative assessment and content knowledge and assessment of pupils' work) over a period of 80 hours a year on 118 mathematics and natural science teachers in two districts. They found that the teachers' learning in one of the districts influences the pupils' learning while the achievement of the other pupils in the second district remains the same. The pupils' achievements of teachers in the same school were best than the others in different schools.

Professional development in a one-off sit-and-get traditional approach may not be deeply rooted in the system or sustain the essence of continuous professional development (Nishimura, 2014), which is to reform or increase knowledge in order to strengthen and reinforce new practice till it becomes regular and rooted in practice (Nishimura, 2014). Desimone (2009) describes four qualities of effective CPD: individualised and school-based,

entrenches coaching and follow-up procedures, collaborates, and incorporates daily practice into teachers' classrooms. Desimone (2009) outlined five characteristics of teachers' learning: content, active learning, coherence, duration, and cooperation or collective participation. Nigeria could benefit from the above formal and school-based continuing education specific to individual schools' approach and directly linked to each teacher's teaching needs.

5.1.2 Reforms in teachers' practices through professional development activities.

There are many examples in the published literature of effective implementation of teachers' continuing professional development being associated with positive impacts. They include examples of individual active learning; collaborative learning; critical reflection and feedback (including group feedback); third-party input. Several examples are discussed in detail in subsequent sections of this chapter, and a brief summary follows here. Opfer and Pedler (2011) showed the effectiveness of teacher professional development in improving teachers' practice and school achievement in high-performing schools. Richter et al. (2011) found a positive relationship between teachers' work engagement, professional responsibilities, and changes over their careers. Parise and Spillane (2010) found that formal education and on-the-job learning significantly change teachers' instructional practices. Straus (2015) reports that teacher-teacher professional collaboration can be associated with increased student achievement. Goddard et al. (2007) showed that students achieve higher mathematics and reading achievement when they attend schools with higher levels of teacher collaboration for school improvement. Desimone, Smith, and Frisvold (2007) identified that teachers' continuing development and learning are important factors in improving the quality of U.S. schools; hence Desimone (2009) offers ideas to improve the quality of inquiry into teacher learning.

Frazier and Eick (2015) found that video was an opportunity for some teacher candidates to be more creative and more spontaneous with their reflective thoughts and that journals provided opportunities for other teachers to comfortably refine and revise written work to enhance their reflective process. Wall et al. (2009) showed that facilitating teachers' systematic evaluation of their experiences supports meaningful professional development activities and enhances teachers' awareness of their individual learning. Glazier (2009) shows that reflection in groups aids teachers' learning and that reflections make the teachers more aware of their own positioning and the impact this might have on their encounters with different pupils.

Blasé and Blasé (2002) found that principals who practise exemplary instructional leadership promote reflection, including making suggestions, giving feedback, modelling, using inquiry and soliciting advice/opinions, and praising. The positive impact of leadership support on teachers' practice was further shown by Peterson (2014), who found that the development of teachers' practice depends on factors such as leaders' positive attitudes, school climate, having sufficient time for activities, and collegiality. The positive impact of organisation support on teachers' practice was shown by Guskey (2000), who noted that educational leaders must consider organizational policies that can hinder success in the implementation of reforms, for example, in grading and reporting student learning.

They all show the effectiveness of CPD in strengthening self-efficacy, competency, confidence, emotional stability, and teachers' well-being. The changes in the level of teachers' practices depend on factors such as the extent of cooperation, time, coherency, consistency, quality, frequency, duration, culture, conviction, climate, understanding of the content and positive atmosphere. However, some studies argued that changes in teachers' classroom practices do not occur straight away (Hong and Lawrence, 2011; Alexander, 2018). Some factors must be considered despite the possible positive impacts on teachers' practices. Desimone (2009) argued on the duration of an effective CPD programme and suggested a consistent 20 hours per term, while Bakkenes et al. (2010) suggested a longer period for developmental activities or programmes. The quality of the developmental activities has been found to be of more importance than the frequency (Richter et al., 2013). However, the longer the teachers' experience or expertise in service, the longer the practice is sustained (Nishimura, 2014; Desimone, 2009).

As the researcher of the current study pointed out, either local or foreign literature was scarce on specifically conducted CPD interventions to improve or transform teachers' practices in Nigeria. This has also been shown in Westbrook et al. (2013) and Thalmayer, Toscanelli and Arnett (2021) and Hardman et al. (2008). There is a need for interventions targeting teachers in Nigeria with consideration of our cultural background, different learning needs, various classroom conditions, policies, and political situations.

5.2 Evidence of factors that support teachers' effective learning and practices.

5.2.1 In-school learning

Desimone (2009) presents suggestions for enhancing the quality of teacher learning inquiry, one of the main goals of education reforms. According to Desimone, research should use current research knowledge to enhance how we conceptualise, assess, and analyse how professional development for teachers affects teachers and learners. Teachers can learn and improve by processing and developing a more profound knowledge from their own past experience, day-to-day activity or teaching in the classroom. Desimone (2009) concludes that strong professional development occurs through self-reflection and practice in each teacher's classroom. Problem-solving sessions can be designed to address each teacher and staff's specific needs and challenges and provide support and training (Nishimura, 2014). Teachers can sit in specific problem-solving sessions to work and identify needed strategies and resources suitable for the demands of students in the classroom (Roach, 1996, as cited in Nishimura, 2014).

Frazier and Eick (2015) looked at how teacher candidates prefer written and video journals in action research to aid teacher candidates in critically evaluating the impact of their instructional practices. The findings enabled each teacher candidate was able to choose their favourite media for producing critical reflections. The findings also showed the dynamics of using many media for reflective journaling.

Postholm (2012) developed seven themes for teachers' school learning, incorporating Desimone's five characteristics of teachers' learning, previously discussed as the number one theme. The second theme consists of individual and organisational factors in teachers' learning, school culture, cooperation between external resource persons and the teacher, teachers as leaders of other teachers, a positive atmosphere, and teacher collaboration. Effective CPD must focus on content knowledge and how the students can acquire this knowledge. The content of the teachers' learning must be in agreement with the teachers' prior knowledge and convictions. Duration should be accrued to the activities and spread over some time, probably 20 hours of participants' contact time in a term as suggested by (Desimone, 2009). Collective participation among leaders and teachers at the same school, the same department, and the same level of the year is essential for teachers' learning.

5.2.2 Relationships between individual and organisational factors and teachers' learning.

Some research showed relationships between teachers' learning and how their classroom teaching influences their attitude, beliefs, values, conviction, and practice (Supovitz and Turner, 2000; Opfer and Pedder, 2011; Opfer, Pedder, and Lavicza, 2011).

Supovitz and Turner (2000), employing data from the National Science Foundation and applying a hierarchical linear model, found that the quantity of professional development that teachers participate in influences their inquiry-based teaching practice and investigative classroom culture. They also found that schools' socioeconomic status also affects teachers' practices, and the teachers' content preparation also strongly influences the teaching practice and classroom culture. Teachers may come across practices with lots of ideas but may be influenced by different factors, the stages in their training, the context they find themselves in, their previous experiences, and the type of pupils in their class.

According to Guskey (2000), organisational support was necessary to achieve high-quality implementation of new policies and practices. Guskey found that instructors said their involvement in CPD events was based on contractual duties that were frequently viewed as mandatory. Guskey (2000) contends that many evaluation programmes are ineffective because they fail to consider the factors that encourage teachers to participate in professional development and the typical mechanisms through which teacher changes occur. In addition, Guskey asserts that many educators believe professional development has little bearing on daily practice, while others think it is a waste of time.

Opfer and Pedder (2011) report in an analysis of a survey collected in a national study in England, grouped teachers' orientation into four groups (engaged learners, moderate learners, individual explorers, infrequent learners, and solitary classroom learners). They found that a minority of teachers are engaged learners, and the individualist learners approach prevails to show that the activities should align with teachers' characteristics and school context as essential factors to support teachers' learning. Opfer and Pedder (2011) also examined the quality and frequency of mentoring and their impact on the professional competency of 700 beginning German teachers and revealed that teachers, during their careers utilise the opportunities they have to learn differently. They also found that the quality of professional development programmes is more important than their frequency.

Richter, Kunter, Ludtke, Klusmann, Anders, and Baumert (2011), in a German study of 198 schools and 1939 secondary teachers), teachers use the possibilities they have to learn differently over the course of their employment. According to the survey, teachers cooperated more at the beginning of their careers than in the middle and at the end. However, the study revealed that more experienced teachers read more theories and studies on teaching and learning than newer teachers.

Some studies support mentoring with a knowledgeable person within the school as a resource in their school and an external network in development activities (Desimone, 2009; Baumert and Kunter, 2006). They believe that mentoring following the constructivist principle rather than transmission-oriented mentoring may foster the development of knowledge, self-regulation, belief, and motivation. Teachers should be allowed to point out their own learning objectives and plan, implement, and evaluate their practices through reflection by studying their own practice. They should be able to talk with their colleagues about their reflection on learning and develop a comprehensive joint vision about what should be the outcome of the development (Desimone, 2009; Smith, 2000; McLeod, 2015; Postholm, 2008).

5.2.3 Teacher cooperation and implication for teachers' learning.

The DfE's (2016) standard for teachers' professional development describes effective professional development as one that includes collaborative activities that aim to change teachers' practice and focus on the intended pupils' outcome.

Straus (2015), in an international large-scale assessment study, reports that some specific teacher-teacher professional collaboration is associated with student achievement. The increase in students' achievement was also found even when they were not from the same background. Straus also revealed that teachers who collaborate more with their colleagues report an increase in teacher-student relationships. The types of collaboration, however, depend on school climate and discipline.

Goddard, Y. L., Goddard, R. D., and Tschannen-Moran (2007) empirically tested the relationship between a theoretically motivated measure of teacher collaboration for school improvement and student achievement using survey data from a sample of 47 elementary schools with 452 teachers and 2,536 fourth-grade students. The results show that fourth-grade

students have higher achievement in mathematics and reading when they attend schools with higher levels of teacher collaboration for school improvement.

Bruce, Flynn, and Stagg-Peterson (2011), in a large-scale action research of 14 case studies spanning over two years, point out many positive outcomes of teachers' collaborative efforts; the team established a safe environment and strong networks to build strong team collaborative relationship, create and grow a deep sense of trust, commitment and accountability. The results highlighted strong team lead through regular meetings and teleconferences, engagement in collaborative lesson plans, discuss the way forward, adjusting their strategies and reflecting on their process and overall, development of skills in observation of classroom practice, development of a strong sense of purpose, improved teacher's confidence, and efficacy. The literature points out that professional support for the team is another gain for the teachers.

Griffin, Murray, Care, Thomas, and Perri (2010) employ an evidence-based approach in 19 schools focussing on students' reading comprehension and found that the gain in the students' reading comprehension progression surpassed the standardised benchmarks expected. The teachers were shown the data, and they collaboratively learnt to use and link the data to the development of each student based on their own choice of teaching style and teaching resources that complement that student's readiness to learn. This study also found a correlation between leadership roles and students' achievement, which supports the advocated Darling-Hammond's (1996) teachers' empowerment. Furthermore, Darling-Hammond (2006) shows that teachers' quality and ability to reflect on their instructional practice affects students' learning outcomes. Collaboration can be formal or informal, and special education teachers can informally collaborate with general education teachers to accommodate students with disabilities (Nishimura, 2014; Friend, Cook, Hurley-Chamberlain and Shamberger, 2010). Team teaching or co-teaching is useful in establishing an inclusive school (Villa, Thousand, Nevin, 2013). Friend et al., 2010 argued that the rights of students with disabilities and all other students are respected through the designing, implementation, and evaluation collaborative, inclusive framework.

5.2.4 School culture and teachers' learning.

The researcher's perspective of good school culture is one that possesses an atmosphere or climate where every stakeholder is mutually loved and respected with cooperation, and good teaching and learning outcomes are valued. When an environment is toxic or hostile, the organisms, humans, fishes, and other aquatic organisms will either not grow or die.

Hinde (2004) asserts that culture influences almost every aspect of the school: how teachers dress, what teachers talk about in the staff lounge, and teachers' emphasis on a specific part of the curriculum. When school culture changes, teachers' disposition to change also changes (Neumann, 2013). Morotti (2006) opines that schools reflect the norms of the society within which they are formed and argues that cultural values and practices shape the schools. Hargreaves (2019) explained that the importance of collaboration is a positive school culture that contributes to collaboration and cooperation among teachers and creates opportunities for teachers' learning and continuing professional development. Hargreaves argues that when schools cultivate a positive culture that leads to collaboration, then teachers become cooperative and non-isolative; they learn and share together to develop expertise.

Hargreaves and O'Connor (2018) interviewed two groups of district teachers: one promoting collaboration in planning and the other not promoting collaboration in planning, and found that the one needed more planning time. In contrast, the other one uses little time for planning and uses the remaining time for other activities like lesson preparation and grading. This was so because they shared their planning classes with the covering teacher. Rinke and Valli (2010) conducted a case study of three elementary schools with varying pressure levels to make adequate yearly progress. They found out that school culture, leadership, resources, and professional development structure and content influence teachers' learning experiences. They also found high stake accountability policies increase the quantity of professional development, and the quality of professional development opportunities depends on the delivery context.

5.2.5 Teacher-leaders working for other teachers' learning.

Crippen (2010) implies that teaching involves creating good human interpersonal relationships for future interactions and societal benefits. Lieberman and Miller (2005), in an elementary school interview conducted with four informal teacher leaders, established four requirements

for leadership: experience, knowledge, vision, and respect for children and Fullan's opinion placed teacher leadership in the community rather than individual and recognised six areas where teacher leaders impact school culture: teaching and learning, continuous learning, management of change, context, sense of moral purpose and collegiality (Fullan, 1994).

Taylor, Yates, Meyer and Kinsella (2011), in a one-year-evaluation study aimed at investigating a professional development initiative for subject teachers to be seconded to leadership roles using a semi-structured interview and online survey of 22 senior subject advisors (SSA), six regional managers and 1854 teachers found a high level of teachers satisfaction with the SSA initiative and support services, the SSA claim the initiative contributed to their personal and professional development in pedagogy, evidence-based assessment, leadership and change management, many of the SSA reports that at the individual level, their capacity to facilitate adult learning has been enhanced. However, none of them wanted to assume a new role or new career higher up in hierarchy or another career, and they viewed it as a great improvement in their professional development and their present career and an opportunity for school leadership management or as heads of their departments.

5.2.6 Cooperation between external resource persons to improve teachers' learning.

Glick (2017) investigates how to grow learning and teaching in Baltimore County schools and building instructional practice in secondary school communities, designed sessions on meaningful and measurable objectives, lesson planning and rigour, use of formative assessment to improve instructional practice and make learning personal for students, learner-centred instructional strategies. Library media specialists (LMS) were grouped into cohorts of 3-4 members and as hosts and shared a preview of the lesson with cohort members. There was a willingness to learn and grow; the LMS greatly welcomed their cohorts, visited each other, and took turns in the roles. Findings from the community show that it was the most powerful professional development experience, proving that exposure to more LMS experts leads to transformed instructional practice and professional development.

Teachers should have the ability to develop for themselves the appropriate knowledge, skills and attitude and, in collaboration with the help of others, become change agents through active learning, listening to lectures, being observed, or observing expert teachers, reviewing

students' work in the topic area, then interactive feedback and leading discussions (Banilower and Shimkus, 2004; Borko, 2004; Carey and Frechtling, 1997; Lieberman, 1996).

Wall, Higgins, Glasner and Gormally (2009), in a four-year project of Learning to Learn in 33 primary and secondary schools in the UK with a team of researchers from the Research Centre for Learning and Teaching, where researchers support and facilitate teachers' systematic evaluation of their experiences. This process was found to support meaningful professional development activities about teaching and learning. They jointly developed common themes for each year, and courses were allocated to teachers twice a year. Teachers engaged in exploratory activities with the researchers' guidance and support and attended conferences each year. Teachers became aware of their individual learning and understood themselves as professionals.

5.2.7 School climate and teachers' learning.

A good interpersonal relationship is essential for enhancing teachers' professional development and cooperation; thus, a positive atmosphere increases teachers' opportunities for interaction, and collegiality encourages teachers' learning and professional development (Shah, 2012).

Petersen (2014) revealed two kinds of a positive atmosphere: one, the principals work just like one of their teachers as a team in an ICT project, and the other, the atmosphere is more of a formal leadership where the principals have a positive attitude towards ICT development but did not participate in the projects. The study involved the qualitative interview and observation of mathematics, science, and language teachers in five Sweden schools, an EU project for one and a half years, after which two schools were selected. The teachers in the first school perceived their principals as role models. The research also found that the only challenge for the teachers in the first school was that time was insufficient for everything they would like to do and were encouraged to do.

Blasé and Blasé (2002) examined 809 teachers from public, elementary, middle, and high schools in the United States and found that instructional teachers were those teachers making suggestions in a non-threatening manner, giving feedback, modelling, using inquiry and soliciting advice and praises teachers. They also found that the principals encouraged teachers to attend conferences, and workshops, encourage reflective discussions and

collaborative activities among peers and distribute professional literature among teachers. Webb, Vulliamy, Sarja, Hämäläinen and Poikonen (2009) also conducted a comparative study using a semi-structured interview with 12 teachers from 6 Finnish primary schools and 206 teachers from 50 British schools. MAXqda was used to code the data. English researchers coded the English data, while the Finnish data were coded collaboratively by the English and Finnish researchers. Findings revealed that the principals in Finland experience work surge and verse roles that negatively influence their educational leadership more than their English principals. However, assigning staff with more responsibilities positively created a community of staff with more knowledge.

The headteachers in Finnish schools developed a cohesive school community with a collaborative shared vision. Another finding is that collaboration and accessibility to classrooms increased subject leaders' influence on their colleagues' practices and transformed them into stakeholders as well. The headteachers in Finland make all staff feel valued, while in England, the weight of accountability and change means teachers' collaborating under constraint, even though collegiality is a norm (Wood, Jeffrey, Troman and Boyle, 1997). In Finnish schools, the senior staff have more influence on the senior management board, and there were marked hierarchies between senior staff and other teaching staff and teaching assistants, while in the English schools, the ranking was not clearly marked and unstable.

5.3 Summary of the Chapter.

This chapter has shown with the literature reviewed that despite Nigeria's challenges discussed and reflected upon earlier in chapter two and extended to Sub-Sahara Africa in this chapter, we (teacher educators and administrators) need to start thinking of how to help teachers become effective (every little help). The literature reviewed showed a need to jointly create awareness among teachers in Nigeria about the need to reflect on their practices and create follow-up support groups, peer support groups, and head groups. There is also a need to help teachers develop positive attitudes and beliefs towards modifying their practices through training that reconciles our cultural background, different learning needs, and scarce resources with our classroom practices. The chapter reviewed the literature to provide insights into teachers' continuing professional development and action research in different contexts. It also reviewed the literature on some factors that support and promote teachers' effective professional development practices in different contexts that could apply to Nigeria.

Chapter Six: Methodology

6.0 Introduction

This chapter explores, explains, and justifies the research designs, data collection, and analysis approaches to answer the three main research questions. It delineates the sampling structure, describes the research instruments, and examines critical issues bordering on methodology and how they were addressed. The procedures and implications of the pilot study were also discussed, and methods of collecting and analysing the data were examined. This chapter outlines my positionality and reflexivity and reflects on their influences on the research process. It further describes the data entered into Stata 16, the output, the procedure for the manipulation process, and the weight of the significant results and inherent limitations of a 1-day intervention. The approach and evaluation of the intervention were discussed in this chapter. The ethical issues and trustworthiness of the research are detailed. This chapter also examines the efforts made by the researcher to avoid being biased throughout the study.

6.1 Research Methodology.

This section explains the research design and justification based on previously reviewed studies carried out on observations of classroom interaction patterns in Nigeria. The research paradigm is also described in this section.

Research methodology is the general research strategy that delineates methods employed by a researcher to carry out a particular research study and identify the methods used in the process (Igwenagu, 2016). According to Plonsky and Gass (2011), the research methodology is important to evaluate a specific study's quality and value. The methodology concerns the content, process, and structure of the research based on theoretical principles and theoretical framework guiding the research, and the context of a particular paradigm for understanding which method or sets of procedures or best practices should be applied in certain cases to arrive at specific results (Igwenagu, 2016).

6.1.1 Research design.

This subsection describes the research design used for the current study, and they are in three parts: the first part describes the mixed methods, the second part describes the case study

design, and the last part describes the aspect of the developmental research with elements of an action research design. A simple sample of the research design is shown in Figure 6.1 below, and the detailed sketch is shown in Figure 6.1.1.

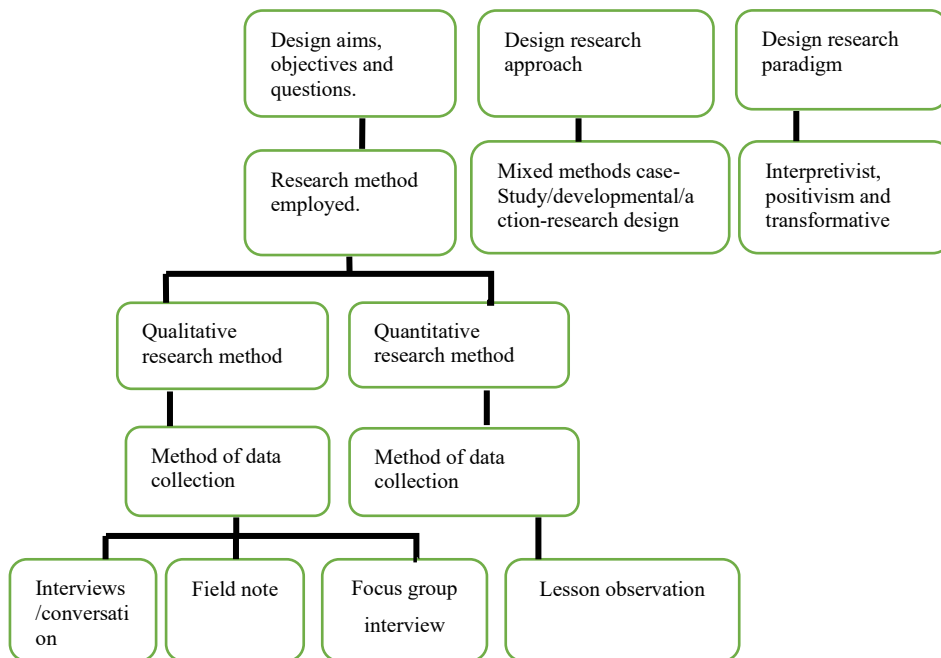


FIGURE 6.1: A BRIEF ILLUSTRATION OF THE STUDY DESIGN

The research design is the framework for collecting and analysing the data, determined by the study’s aim, objectives, justification, and the type of data to be collected (Creswell & Plano Clark, 2007, p. 58). It is all the plans concerning what the researcher will do to answer the research questions; it is the research strategies and methods related to the data collection and analysis (Dudovskiy, 2018). This study explores teachers’ interaction patterns in junior secondary school basic science classrooms in Ekiti State, Nigeria. After considering a range of research designs, the researcher decided to adopt a mixed methods case-study design and developmental research with some elements of action research design.

6.1.1.1 Mixed methods design

“A mixed-method case study design is a type of mixed-method study in which the quantitative and qualitative data collection, results, and integration are used to provide in-depth evidence for a case(s) or develop cases for comparative analysis” (Creswell and Creswell, 2018, p.116).

According to Creswell and Clark (2011), the mixed-methods approach has been developed and is appropriate for finding answers to various research questions. The research involves a quantitative and qualitative approach involving a case study design and development research, as shown in detail in Figure 6.1.2. The mixed-methods approach uses qualitative and quantitative viewpoints, data collection, and analysis techniques in a single study simultaneously or orderly manner. Mixed methods research aims to minimise the weaknesses and annex the strengths of both methods in a single research study (Creswell, 2003).

The use of qualitative study provides a deep insight through subjective interpretations of events. Integrating qualitative and quantitative approaches allows the researcher of the current study to draw empirical evidence from the teachers and the students regarding who, what, how, when, and why they interact the way they do in basic science classrooms. Creswell (2003) asserts that using mixed methods research provides strengths that offset the weaknesses of both quantitative and qualitative research. It also provides more comprehensive evidence for studying a research problem than using either quantitative or qualitative research alone.

The mixed-methods data collection approach was adopted, using both interview and observation techniques to achieve the research aim. In addition to interviews in this study, the motive for using observations was its ability to provide more detailed information about classroom events, such as teachers' and students' interaction patterns (Yin, 2010). Observation allows the researcher to view deeper classroom activities and events in an efficient way with relatively high validity due to their wide and deep non-verbal and verbal activity coverage (Wragg, 1999). The observation technique was also used to eliminate bias associated with interviews (see subsection 6.5.1 and Table 6.3). The interviews were aimed at obtaining detailed information, perceptions, and opinions or beliefs from teachers and students.

The use of a mixed methods design also allows the triangulation of data. Cohen and Manion (2000, p. 254) define triangulation as:

“an attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint”. The current study employed the methodological triangulation of Denzin (1970), which involves using more than one method to gather data; such as observations, interviews, questionnaires, and documents. Methodological triangulation was done to increase the validity and credibility of the study through non-bias inquiry and to

cross-check the study's findings. The different methodological triangulation used in designing this study includes observation for qualitative and an objective quantitative measure of frequency, breadth of verbal and non-verbal behaviours, motivation, and deep insights into gestures and silence. Semi-structured interviews and focus group interviews were utilised to inquire about teachers' opinions, beliefs, values, feelings, and classroom interaction issues. These techniques are described in detail in section 6.4.

Consideration of the compatibility of techniques with methodological triangulation was of great concern while designing this study. The matching of the research questions with the techniques is as shown:

What are the different teachers' interaction patterns presently used in teaching basic science in junior secondary schools in Nigeria?

- **Teachers' interview:** The focus of this interview is to discover the patterns and types of interactions that occur between the teachers and the students, between the student (s) and the student (s) in basic science classrooms, and how teachers feel about their classroom interaction patterns.
- **Observation of classroom lessons:** Video recordings of basic science lessons with detailed/accurate pictures of the present teachers' classroom interaction patterns to determine who talks, for how long, who initiates talk, what kind of talk, percentage of student and teacher talk, how teachers reinforce students' responses, what kind of questions teachers ask in basic science lessons, level of silence and confusion if any, and in general, the nature of classroom talk and non-talk activities.
- **Students' focus group interview:** The purpose of this interview is to ascertain students' views on how much talk occurs in the classroom and what type of talk. It also seeks students' opinions on their basic science lessons and how they are motivated.

What are the effects of the intervention on teachers' interaction patterns in basic science classrooms?

- **Follow-up teachers' interview:** Interview to seek teachers' views on how they have imparted the intervention and feedback on the overall process.

- **Post-intervention lesson observations:** Video recordings of lessons to determine the effects of the intervention on various classroom interaction patterns.

What are the issues that teachers say affect classroom interaction patterns in basic science lessons?

- **Teacher interviews:** teacher interviews to find out from the teachers what issues affect their classroom interaction patterns.

6.1.1.2 Case study design.

This research adopted a 5-case study in specific instances designed to analyse specific interactions within the classroom environment. A case study investigates and reports complex dynamic and unfolding interactions of events, human relations, and other factors, and it also analyses situations to establish cause and effect (Cohen, Manion and Morrison, 2007). The case study is descriptive and aims to describe and analyse the participant's behaviour in a sequence of interpersonal events in an accurate manner using an observational way to collect information (Yin, 2009). This is responsible for the researcher's choice of classroom observation technique.

The case study consists of five basic science teachers in five schools and answers questions about who, what, when, why, and how events occurred in basic science lessons before and after the intervention. The case study gathers quantifiable and qualitative data concerning teachers' and students' classroom behaviours during lesson observation and interviews. The case study attempts to discover key phenomena in the sequence of interpersonal classroom events. It further allows the researcher to explore, through lesson observation, the patterns of interaction teachers and students previously used in classrooms and later discovers the effects of the intervention on classroom interaction of teachers and students after the intervention.

6.1.1.3 Developmental research.

In order to achieve internal consistency and effectiveness in a programme, process or product, a developmental research design is used in the systematic design, development, and evaluation of such a programme (Richey, 1994). Longitudinal developmental research examines the behaviour of the same individual over a period of time. This research focuses on employing

awareness training as an intervention and its impacts on patterns of teachers' classroom interaction patterns. The results of the longitudinal developmental study in the current research provide valuable qualitative and quantitative data concerning the differences or changes in the teachers' and students' patterns of interaction in the pre-and post-intervention data.

In a general context, the quantitative method is used in natural science to count how much and how many (numerical), which explains the position of the positivist to establish a relationship or correlation between variables which can be used to test a theory or hypothesis whose result can be used to generalise a situation or population (Mohajan, 2020). This type of method is known to be less subjective to the bias of the researcher's judgment or interpretation. It tests or confirms hypotheses or theories and measures how much and how many. Data collected are numeric, which can result in findings that can be generalised within a large population. The use of the observation technique in the current study to observe and count verbal behaviours of both teachers and students gives rise to the measure of frequencies, proportions, percentages and average values of teachers' and students' classroom behaviours.

In contrast, the qualitative approach is based on interpretivism and constructivism (Lee, 2012). The emphasis is on processes and meanings. The result can be based on interpretation and description to which the researcher agrees. It measures how and why by investigating relationships between activities. Data collected is rich and in-depth, resulting in an interpretative and descriptive process, and finally, inductive, and deductive decisions can be made and applied to individuals. A single qualitative approach can be influenced or manipulated by the researcher at various steps, therefore subjective to the researcher's view.

The use of mixed methods is guided by the shortfall of the quantitative method, which does not provide an in-depth analysis of situations. Employing both quantitative and qualitative methods in this research supplies strengths that neutralise the weaknesses and annex the strength of both together. Another value of mixed method is integrating components, which gives the readers more confidence in the results and conclusions they draw from the study (O'Cathain, Murphy and Nicholl). One of the arguments for the combination of both methods is that they share the goal of better understanding the world we live in (Sale, Lohfeld and Brazil, 2002).

Quantitative and qualitative also share a unified logic, and the same rule of inference applies to both. However, some notable researchers argued against each of the approaches and lacked a basis for comparison because they are philosophically and methodologically different (Guba and Lincoln, 1994; Denzin and Lincoln, 1994). Many of these critics emphasised that merely using mixed methods does not justify that integration has been achieved (Bradly and Shaefer, 1998; Bryman and Becker, 2008; Symonds and Gorard, 2008).

Shifting the attention from epistemological and ontological reasons to the main reason for integrating qualitative and quantitative are: first, to achieve cross-validation or triangulation-combining two or more theories or sources of data to study the same phenomenon to gain a more complex understanding of it (Denzin, 1970), second, to achieve complementary results by using the strengths of one method to enhance the other (Morgan, 1998). However, Howe (1992) argued that researchers should forge ahead with what works. Mixed methods have been widely accepted and used (Creswell, 2009; Teddlie and Tashakkori, 2009). Moreover, it is preferable and essential to concentrate more on the quality of the techniques.

Denzin and Lincoln (1994) explain that qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative study investigates natural scenarios and strives to make logical interpretations of the phenomena according to meanings people ascribe to them. The qualitative, quantitative, mixed methods of transformative, interpretative and positivist paradigms are connected to the data collection process. It employs a mixed method of observation, interviews, field notes, cards for students' focus group interviews, pilot study, and major fieldwork.

6.1.1.4 Some elements of action research design.

Koshy (2010) defined action research as a context-based collaborative, participatory educational process entailing action, evaluation, and reflection to establish practical knowledge useful to improve the conduct of educational practices. Elements of action research also include a process to interpret knowledge, develop reflective practices and implement changes in practice. Other essential rudiments of action research are the constant creation of plans, implementation of the plan, and revision, then offers ongoing reflection and revision of actions or experiences to enhance related actions and experiences in future.

The above elements of action research were integrated into the current research. Action research offers an avenue for significant, deliberate, and critical reflection documented to boost teachers' practice (Koshy, 2010). It is a continuous method of how teachers and educators improve the teaching and learning process.

Kemmis and McTaggart's (2014) model of action research explains that action research involves a plan for a change, taking actions to implement the change, observing the process and results of the changes, reflecting on the process and results of the changes, then act, observe and reflect again. This research focuses on identifying the issue through exploring a baseline perspective of five teachers and myself as a teacher educator to ascertain context, thereby making the implementation process and suggestions/ gained knowledge an integral part of improving our classroom practices. With the results of this study, the researcher aims for personal enhancement and better learning experiences to develop reflective practices and a collaborative learning and teaching community.

6.1.1.5 The context of action research in this study.

The researcher had been a teacher educator for years prior to commencing this project and has had previous perspectives and experiences with classroom practices, so conversations and interactions with the in-service teachers in this study helped clarify our common values, beliefs, and principles guiding our classroom behaviour. The researcher and the in-service teachers shared a common belief in the power of teachers as change agents; possessing the ability to improve and empower students' lives. This belief was reinforced by years of classroom teaching experience. We agreed to understand our classroom cultures and recognised the need to adapt our classroom practices to the need of students in the context of our environment (Alexander, 2018; Hardman et al., 2008; Lyle, 2008).

The researcher's keenness in teachers' classroom interaction was based on the personal belief that some elements of action research could be explored by encouraging inquiry into our classroom practice; reflecting on our practices or actions and acting based on the new knowledge acquired; observing and reflecting again. Through these actions, we could have a wider understanding of our historical circumstantial limiting factors of the implication of what teaching means for our teachers and the researcher as teacher educators in order to improve our classroom practices and students' cognitive development. Context is important in creating

change strategies in classroom practices (Alexander, 2018; Hardman, 2008; Fullan, 2007; Lyle, 2008).

Inquiry into classroom pedagogy and practice starts from the classroom, school, and community. Therefore, it is vital that the knowledge we create is contextually specific to address our real-life problems. We need to look at how we interact with ourselves in social reality, what it looks like, the traditional power relation (how and who is interacting), our culture of children pleasing their teachers, elders, and mentors, and our ability to equally motivate students for a change. There is a need to work on these social contexts, considering these multiple factors of values and beliefs that are almost not in the teachers' control. Hence, with the values in place and the power relation, how do we improve student engagement and classroom practices? (Koshy, 2010). Lesson observations before and after intervention were employed to observe and collect results. The teachers' classroom practices in the lessons were subject to self-reflection, joint reflection, and critique. Post-intervention lesson observation was carried out to observe any changes, and the results were used to determine if there were improvements in teachers' classroom practices.

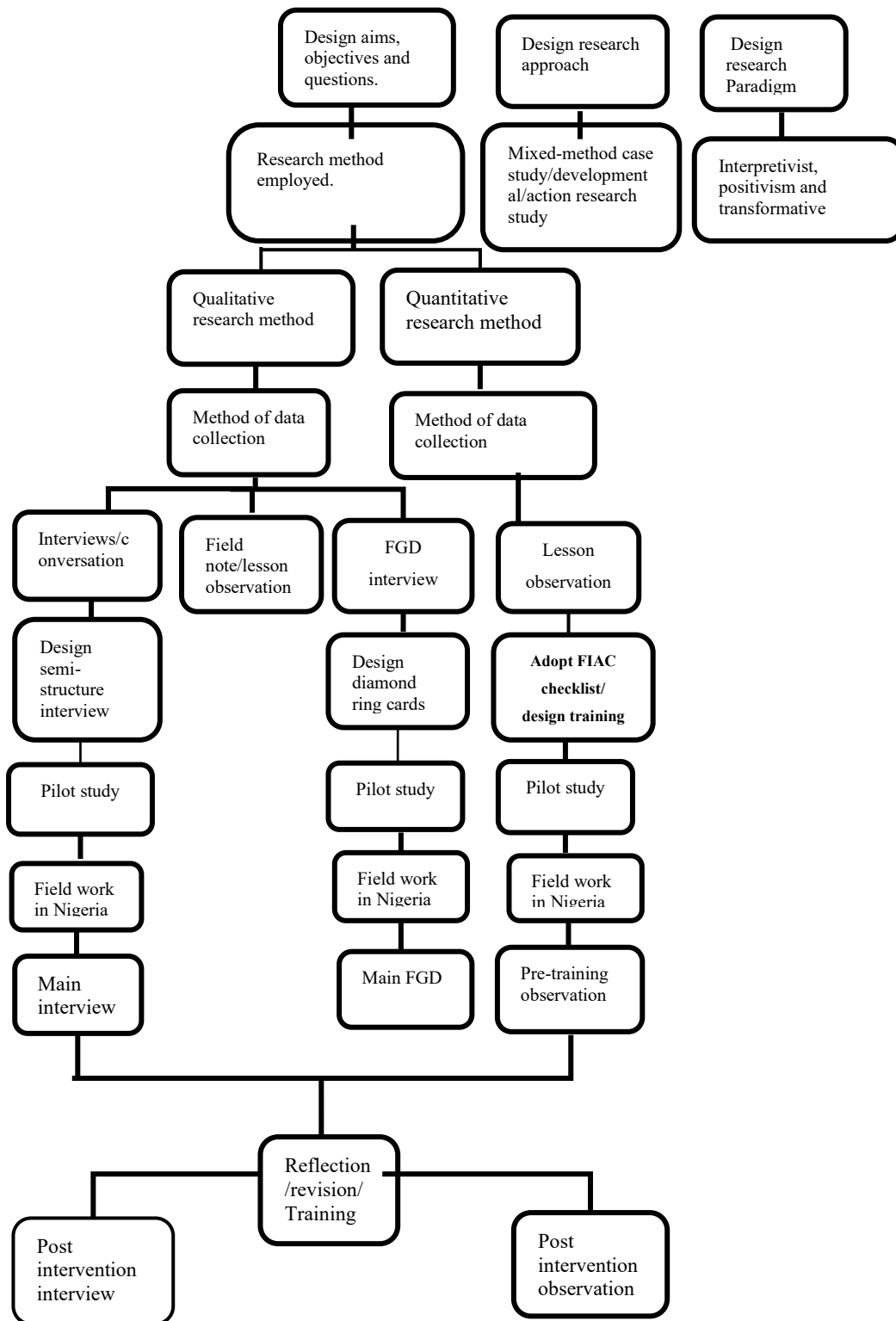


FIGURE 6.1.1: FLOW CHART OF THE RESEARCH DESIGN AND METHODOLOGY

6.1.2 Research Paradigm.

Schwandt (2001) explained that a paradigm is a common vision that characterises a discipline's ideas and values and directs how issues are resolved. Antwi and Hamza (2015) also inferred that a research paradigm indicates a research culture with a set of beliefs, values, and assumptions about: 1) ontology, 2) epistemology, 3) methodology, and 4) methods and stated that a paradigm is an approach to thinking about and doing research. It is simply about assumptions about how things work. Ontology is the nature of our belief about the truth or reality; epistemology refers to how or process of having knowledge about the truth (Guba and Lincoln, 1994). Methodology concerns the strategies and procedures that we can use to acquire knowledge. A theoretical perspective is an approach that can be applied to acquire or construct knowledge; the method concerns the tools that can be used to acquire evidence. Research paradigms commonly encountered in social science research include but are not limited to positivism, constructivism, interpretivism and pragmatism. The research paradigm gives the researcher an idea of the research method and design to employ (Makombe, 2017). The current study is situated within positivist, interpretive and transformative paradigms.

6.1.2.1 Positivism in the present study.

The positivist approach posits a single reality that can be measured and known, given a reliable and valid tool (Patel, 2015). The positivist's epistemology opinion is that of objectivism that only facts derived through scientific means can lay genuine claims to knowledge, which means that there are only one way and no two ways to look at issues. In relation to the current study, the positivist approach implies that there is an objective or logical truth about teachers' and students' classroom interaction patterns irrespective and independent of anyone's subjective interpretation. This involves using lesson observation and field notes to collect primary data in order to elicit the required information. Counting and noting the period for participants' different types of interaction patterns gives knowledge about the proportion of each participant's events ascribed to numbers in their classroom practices. The facts were presented in charts and further subjected to statistical analysis.

6.1.2.2 Interpretivism/action research or reflective paradigm.

However, the interpretive approach is subjective, and the interpretive stance is that there is no single truth or reality; therefore, reality needs to be interpreted. It stresses and seeks numerous ways to understand individual perspectives and opinions to have deep knowledge of occurrences and discover the underlying meaning of events and activities. Interpretive researchers believe in socially constructed multiple realities (Patton, 2002, p. 132), and reality and truth are creations which are influenced continuously or mediated by our senses. Observers access reality via their worldviews, concepts, and backgrounds. Flick (2004, p.89) states that “perception is seen not as a passive-receptive process of representation but an active constructive process of production”.

This study’s interpretive viewpoint involves eliciting the participants’ perceptions, opinions, feelings, and views about teachers’ and students’ classroom interaction patterns and practices. Primary data from the interview and focus group discussion provides the required information. The interactive process of being asked questions and giving responses allowed the teachers to reflect on their practices. The teacher participants watched the videos of the baseline classroom practices, reflected on their classroom behaviour, and replan for a change of action. Also, students reflected on their learning process and provided a better understanding of the basis of their learning. The description of participants’ behaviour in lessons during observation is based on social meaning, while the description and interpretation of the participant’s perceptions, views, opinions, and feelings provide knowledge about the research participants.

6.1.2.3 The transformative/element of action research paradigm in the present study.

The researcher’s experience and ideas about teaching and learning in Nigeria before undertaking a PhD were unequal classroom participation between the teacher and students. This impression came from the following anecdotal observations: Teachers appear to talk too long, giving students little time to express themselves, to the detriment of classroom dialogue. Narrative observations of the researcher include classrooms where students often seemed to be traditionally taught by recitation or rote learning, packaged through direct instruction. Other

anecdotal observations of the researcher were classrooms where students were told how to behave, how, when and what to learn, and when to talk or keep quiet.

Aside from making learning decisions for students and controlling most of their learning environments, the teachers generally referred to the classroom as “my class”, and the students referred to classrooms as the “teacher’s class.” Any student who commits grievous offences or disobeys authority is referred to as being rebellious and punished. Edang (2015) and Babatunde and Setiloane (2014) explained that the context of these behaviours is understood by everyone and embedded in the traditional values of the Yoruba, where elders mentor younger members of the family or society through positional and cultural authority so that children can develop to become self-respected and self-disciplined adults who are physically and emotionally stable.

Action research is a process of gathering evidence to inform the implementation of change in practice; it is participative and collaborative, and undertaken by individuals with a common purpose. The current study’s transformative and action research approaches stemmed from the above points that aimed to promote strategies to support power shifts or reconstruction through students’ meaning-making voices. The elements of action research employed include four stages - plan, act, observe, and reflect. In the planning stage, the researcher invited the teacher participants to get insight into their classroom practice at the early stage to seek transformation through a simultaneous process of actions to cope with peculiar classroom situations in Nigeria.

Also, the transformative/action research approach in this study involves drawing the teachers’ attention to the need to increase and improve students’ classroom participation through reflection and training. The required changes in practice were argued for on evidential premises from the literature, participants’ anecdotal experiences, and ethical grounds as a necessary basis for increasing students’ engagement, improving learning, and enriching education among science students in Ekiti State. In this study, students’ opinions about their interaction in the classroom, expressed through participatory focus group discussion, are incorporated. Baseline information is obtained to highlight the above-noticed unequal practices and document the present practice.

TABLE 6.1: OVERVIEW OF SOME PARADIGMS - ADAPTED FROM PATEL (2015) AND MACKENZIE AND KNIPE (2006).

Paradigm	Ontology What is reality?	Epistemology How can I know the reality?	Theoretical perspective Which approach can I use to know something?	Methodology How do I go about finding out?	Method What techniques use to find out?
Positivism	There is a single reality or truth (realist)	Reality can be measured with reliable and valid tools	Positivism	Experimental, survey	Predominantly Quantitative
Interpretivism/Constructivism/reflective	There is no single reality or truth; individuals in a group create reality	Reality needs to be interpreted. It is used to discover the underlying meaning of events and activities	Interpretivism (interactionism, phenomenology)	Observation or Ethnography, grounded theory, Action research, discourse analysis	Qualitative

6.2 My positionality and reflexivity as a teacher and researcher.

As a teacher trainer for over 20 years, it has been an essential part of my research into the classroom practice of teachers in secondary school that I ethically self-critique my conduct as a researcher and examine how personal experience might or might not affect the conduct and process of my research process. Before the start of this work, the following were my subjective opinions about classroom talk in Nigeria secondary schools:

- Teachers' talk dominates classrooms, and teachers mostly ask simple questions.
- Students are passive in classrooms because of cultural practices.
- Teachers view students' talk as a lack of respect.

- Students are viewed as too young to have their own ideas.
- Students' talk is viewed as subordinate.
- Students' talk is marginalised in the classroom.
- Students' voice is powerless in the classroom.
- Teaching practice exercise is not effective.

Articulating and reflecting on the fact that I came about these perspectives through personal experiences, I decided to find out if other teachers have personal experiences different from mine, so I listened to gain a deep awareness of my above subjective position that had shaped my opinion about the teachers' class practice. The awareness of my above perspectives and acknowledging that these things are difficult to ascertain outside the bounds of my perspective made me respect the views and findings of each teacher; and the broader the view, the more I understood the project. Through conversations, interviews, and reflection on our classroom practices, the researcher and the in-service teachers negotiated the tension between ourselves and our beliefs and values (context), personal life experiences, and historical circumstantial limiting factors.

I reflected on my position both as a teacher and researcher, which required participants' confidentiality and clarifications on the information and purpose of the research. I also provided written records of interviews and allowed comments from participants, and determined how the data will be used. As a teacher and an insider, I needed to shift my identity and, for ethical reasons, reined in my subjective beliefs. I considered the students' perspectives, sought to learn from the classroom experience of each teacher, and then internalised the different classroom interactions and used these to understand how and what teachers teach. My objective reflective stance on the observations and decision to learn from the teachers and consequently the research findings enabled me to ask myself how to support the teachers.

My interest was in making a change in classroom practices and also ensuring that this change was research-based. My professional work as a teacher who supervises student-teacher teaching practice made me reflect on the fact that I had a good relationship with the teachers; I was nice, compassionate, and considerate. This made me believe that the changes observed in the teachers might be a return of gesture, or it might be the teachers saying what they think I would like to hear and making the changes they think I am passionate about seeing, which

might mean the changes were deliberate and a good thing, and in another way, it may mean the changes are short term.

In order to prove if the changes are short-term or long-term, the researcher may need to make a future visit to investigate if the changes are permanent. As Vygotsky (1978) explained, long-term changes are difficult to make and therefore need consistent support. The teacher would thereafter plan a meeting with stakeholders to give feedback on the outcomes and development; listen to responses and suggestions for addressing limitations which might involve a plan for a longer, intensive intervention; suggest the establishment of a teacher's peer support group and involve more experienced teaching experts in the project.

Another influencing factor was my parents. They spent their service years as teacher educators, and through the years, I closely observed them contributing immensely to producing effective teachers in Nigeria in the early 1970s. My parents' teaching background, secondary school learning experience, and professional career thus combined to motivate me to explore and examine teachers' and students' interaction in the 21st century in the hopes that the results and findings would stimulate my further investigation into teachers' classroom practices and professional development.

My research commenced with a level of conscious awareness that my work as a professional teacher educator and teaching practice supervisor would be associated with power relations, as some of the participants could be my past student-teachers who are now secondary school teachers. I knew from the beginning that successfully navigating this process would go beyond filling out consent forms. However, I did not fully envisage the level of predicament that I found myself in, especially when one of the participants, as predicted, turned out to be one of my past students. At some point in the process, I perceived that to some of the participants, I was a supervisor with a superior international supervisor. Thus, I realised that conduct and positionality are practical issues. At this time, I sensed the possibility that my presumed colleagues might feel coerced into participating or that a particular teacher was under assessment. I realised that I had to shift ground through negotiation to balance the relationship; learn, adapt, and reflect as I sought the participant's consent to record the video without my presence which the teacher agreed would be best for her.

Arising from the above, my initial self-perception as a teacher-researcher had to change. This realisation helped me to constantly acknowledge the significance of observing my dynamic identity and how I react in my position as a teacher-educator and researcher. Analysis of classroom interaction brought my attention to understanding the past and present status of social interaction experience in my environment where adult dominance is evident and its public acceptance or rejection. Coming to know myself and my participants differently generated something new; a possibility for a change in the present and future classroom practices, and this added value to my research.

Understanding my beliefs, attitudes, values, perceptions, and background experience from a home where everyone was given the same opportunity to contribute ideas on issues enabled me to shift roles during conversations when I realised that the conversation was taking a different turn. For instance, I prioritised a teacher's conversation by listening attentively to her argument that the students are not intelligent enough to be engaged in classroom dialogue and that students would not know anything about a new topic. The ability to listen to others' opinions also enabled me to explore how individuals and their experiences produce social life through words and discourse. Knowing my participants' differences enabled me to concentrate on the research and develop deep insight beyond my experiences and knowledge. I was happy to bring a change to the teacher's understanding that student interaction matters in classrooms and social environments.

During my continuous engagement to seek the participants' consent, I addressed potential concerns and reassured the participants of their anonymity. As a researcher, my commitment to taking an ethical reflexive point of view and readiness to change my subjective beliefs helped me become a more skilful teacher-researcher and fluidly negotiate the ethical predicaments that came to play during my research (Rowe, 2014). Thus, I was able to sit unobtrusively in the classrooms during the lessons' recordings.

I reflected on a limitation of the study, as I was the sole researcher that conducted the interviews, pre-intervention, intervention, and post-intervention. The data interpretation and intervention process were very engaging and participatory, with the researcher and teacher participants' collaborative, reflective practices to jointly build knowledge about our classroom cultures and practices and make decisions on how to change and implement the changes to classroom practices. Therefore, I employed mixed data collection methods to holistically

understand the process of data collection, analysis, and interpretation to increase the credibility of the process. I also employed the support of PhD colleagues and participants in the transcription of the interview and regular checks for clarification of meanings and interpretations.

I reviewed my subjective position that teaching practice exercise is ineffective based on many problems I observed in the teacher training policy, malpractices, and lapses surrounding the implementation process. The researcher, however, found that Okoro (2019), Omo dan and Tsotetsi (2018), and Oyedeji and Adebowale (2021) are a few studies that established a positive relationship between teaching practice exercises and trainees' positive CPD and students' performance. However, I based my subjective opinion on my personal experience and Vygotsky's (1978) opinion that permanent behavioural change is difficult to attain. I personally found inconsistencies between these studies' findings and the present highly challenged TP exercises. I cannot make a sole decision about TP. Therefore, I propose that my argument above should be hypothesised, challenged and subject to validation to enable appropriate changes.

I completed my first round of data collection. Though I had informed the participants that I would be doing a post-intervention data collection, I maintained regular contact with them. I constantly questioned myself if I had gained enough of their trust and confidence that they were comfortable with me coming for the second data collection. I put my participants' needs first, and they discussed their issues of concern with me, which I allayed while supporting their hopes and aspirations. The second data collection was more trust oriented than the first. The post-intervention data collection process humbled me as a teacher-researcher, building me to become more meek, reliable, considerate, and adaptive to changeable situations and positionality.

I have carefully considered a responsible method of sharing the results and findings of the research, though it was anonymous. The state ministry of education requested that the results be shared with them and the larger public. I have considered inviting participants to a Zoom meeting where they have a choice of anonymity, so they can challenge my thinking, actions, and the methods I took in the research and be informed that I plan to make our work public.

6.2.1 Justification from previous baseline research in classroom interaction in Nigeria.

In Nigeria, available literature revealed that most studies considering poor performance and low enrolment with researchers mostly investigate teachers' science teaching methods, and very few explore the teacher's classroom interaction patterns. Most of these studies were carried out using questionnaires. According to Debois (2019), using questionnaires to elicit responses does not express the true feelings and emotions or non-verbal events that occur within the classroom. It translates data into numbers, which is useful for comparing tests and academic achievements. Wellington and Osborne (2001) explain that rather than using only chalk and talk methods, scientific ideas can be more memorably and effectively communicated by gestures and body language. For instance, the use of gesture and movement in describing tectonic movements, marbles can be used to describe a change of states and use images, charts and graphs for presentations and the use of senses of smell, touch, feel and sound.

The current study is in two strands; the first strand is pedagogical, and the second is developmental and transformational. The first strand of the research employs interviews and recorded classroom observations to explore teacher-pupil interaction and pupil-pupil interaction before and after the intervention. The developmental aspect was a 1-day awareness training that explained and described classroom interaction patterns and ways to engage students in active classroom participation (See Appendix 6C). The teachers are allowed to later reflect on their practices in basic science classrooms in Nigeria. Then the teachers are allowed to implement the changes in classrooms. This is followed by post-classroom observation to explore changes in teachers' classroom behaviours.

There is a paucity of classroom observational research in basic science classrooms in Nigeria; combining lesson observation with teachers' professional development with a follow-up observation makes it scarcer. The few available classroom observational types of research that were reviewed in (Chapter 5) correlate students' scores with teachers' interaction patterns using questionnaires and a few on lessons' observation using science laboratory settings. Many of them link achievement gain to a teacher's characteristics, such as experience and qualification. Hardman et al. (2008) employed natural classroom settings and questionnaires with interaction pattern analysis and discourse analysis of transcripts, but there was no teacher interview, no teacher reflection, and no training for development.

Darling-Hammond (2006) asserts that there is a disconnection between educational theories and the practice of education, and this study attempted to bridge the gap by encouraging teachers to reflect critically on their classroom practice to address the need of students from a social context perspective.

6.3 Research context and participants.

6.3.1 Context.

The current study took place in five public junior secondary schools in Ekiti State in the southwest part of Nigeria. According to Ayeni and Bankole (2015), the Ekiti people form an ethnic group in a location also called Ekiti (meaning “towns surrounded by mountains”) situated in the southwest of the wider Yoruba region. Ekiti existed as an independent state before the British conquest. Ekiti has three public universities and one private university that allow graduate entry into professions, including civil and teaching services.

The modern people of Ekiti State are educated, and the State is said to have the highest number of professors in Nigeria (Akindutire and Olanipekun, 2012); a town called Okemesi Ekiti is claimed to be responsible for providing Nigeria with more than 30 professors. So, most families aspire for their children to go to school and become teachers or civil servants, like in most homes in the State (Makinde, 2021). This keenness to send children to school and free education may have also contributed to classroom overcrowding. Ekiti is one of the African communities that have respect for elders and authority and promotes African values and culture that places elders and teachers in a position of mentors and models of children into disciplined, self-respect, physically, psychologically, mentally, and emotionally sound adults (Edang, 2015; Babatunde and Setiloane, 2014; Namubiru, 2021; Guthrie, 2011; Westbrooke et al., 2013)

Ayeni and Bankole (2015) stated that another factor that may contribute to the poor quality of classroom interaction is that Ekiti State is not economically buoyant like other states in Nigeria, as it is not along the major trade routes based on the mountainous terrain. Ayeni and Bankole further assert that the State’s economy is over-dependent on allocation from the Federal Government, and most parents are mainly salary earners with no other means of earnings. According to Akinde, Micah and Ademola (2020), irregular payment of salary and wages is typical in Nigeria and influences workers’ job commitment and affects teachers’ and

civil servants' physical and mental health in Ekiti and invariably may affect teachers' and students' classroom interaction.

Another factor that could generate a barrier to the quantity and quality of classroom interaction or the two-way flow of classroom communication and could probably be a barrier to change, as stated by Akindutire and Olanipekun (2012) and Oyebanji (2012) is free Education that benefitted Ekiti the most, and the programmes put Ekiti children on a trajectory to be the leading intellectuals in Nigeria. They further assert that free education encouraged Ekiti people to be more educated, liberated, and intelligent, which brought about the inherited motto of "fountain of knowledge." Okunola (2003) and Rotimi (2021) noted and supported that the above facts give the people of Ekiti confidence in the knowledge they acquire, so they hold value for their previous knowledge and beliefs.

Schools A, B, and C: These are located in urban areas of the State with similar environmental factors and modern social amenities where teachers and students have similar characteristics. Schools D and E: These schools are located in rural areas where teachers and students share similar characteristics with few or no social amenities. The basic science department in all five schools each has one basic science teacher with qualifications as follows: 2 (B.Sc. Biology), B.Sc. Basic Science, NCE (Biology/Physics), and B.Sc. Geography. This shows that not only teachers with basic science qualifications teach basic science, but any qualified science teacher can be assigned to teach basic science. NCE is the minimum qualification for teaching in secondary schools.

For effective communication, English language was adopted as an official formal language in Nigeria decades ago due to multilingualism and Population. According to Blench (2014), Nigeria has 525 indigenous languages. English language teaching and learning face many challenges: lack of quality teachers, inconsistency in government policy, and mother tongue interference. Despite the above, speaking English is compulsory in public secondary schools, and speaking one's mother tongue is a punishable offence.

The five teachers in the present study agreed to use a venue central to their school, and the state capital was selected for easy access. The training took place in a hall belonging to one of the secondary schools in the neighbourhood and was offered free to us.

6.3.2 Participants.

The current study was conducted with participants from junior secondary school 1 in Nigeria. The teachers were automatically selected, as there is only one basic science teacher in each school. In the JSS1 class, the age range of the students is between nine to thirteen years old. Each teacher selected nine students from each school to participate in the focus group discussion, making a total of 45 students. This arrangement reassured the teachers of confidentiality and elicited a sense of trust and collaboration from the teachers.

The JSS1 basic science is the foundation class for sciences in secondary schools in Nigeria, as it is capable of kindling students' interest in science. A good foundation is vital in learning the basic rudiments of science to improve students' interest in science, increase the numbers that offer science subjects at the senior secondary level, and consequently pass science at the West African Examination level; ultimately becoming future scientists.

6.3.3 Recruitment of the Participants.

The current study recruited its research location by opportunistic sampling, as stated in section 6.5. The recruitment began with an advocacy visit to the principal of one of the schools, who advised that I obtain a letter from the Ekiti State Ministry of Education to enable a smooth collection process. This took a long time due to public service bureaucracy and the non-availability of officers in charge. Advocacy to other schools was conducted within two weeks of initiation to familiarise and enlist participants' interest in order to reduce the risk of dropping out of the project.

During the advocacy, the researcher explained the project's significance; what it is and what it is not, and reiterated anonymity and confidentiality. The consent forms were handed over to principals for comments before handing them to the participants. The principals assured the researcher of the parents' consent for students' participation as they respect and trust the principals' and teachers' opinions (see Appendix 1A, 1B, 1C, 1D for Consent forms). At the end of each school visit, the principals and teachers gave the researcher their contact details. Table 6.2 shows the profile of participants for the main study.

TABLE 6.2 PROFILE OF PARTICIPANTS.

Location	Teacher Participant	No of Student-Participant	Qualification	Years of Experience	The age range of students	Gender of teachers
Urban	AD	9	B.Sc. Biology	15	10-13	Female
Urban	OL	9	B.Sc. Geography	19	9-13	Female
Urban	EK	9	NCE Biology	4	9-12	Female
Rural	AW	9	B.Sc. Basic. Science	7	10-13	Female
Rural	IR	9	B.Sc. Biology	10	10-13	Female

6.4 The research method.

This section outlines the different data collection methods used by the researcher, the rationale behind each approach, limitations, if any, and how the limitations were addressed. In the article ‘research method: what are research methods’ by the University of Newcastle (2020), it was explained that research method includes strategies, processes, or techniques employed in the data collection and method of analysis or evidence in order to uncover new information or a better understanding of a situation. For instance, interviews with observation, surveys or questionnaires, experiments, focus groups, and documents. The current study adopts the use of the mixed method of data collection with sources from observation, interviews, focus group discussion and note-taking.

6.4.1 Interviews.

A research interview seeks to describe and cover the meanings of themes in the world of the subject of investigation. The main aim of an interview is to understand what the interviewee is saying (Valentine, 2013). Boyce and Neale (2006) defined an interview as: “A qualitative research technique which involves conducting an intensive individual interview with a small number of respondents exploring their perspectives on a particular program, idea or situation”.

There are three types of interviews: structured, where questions are pre-determined and in a pre-set order; semi-structured, with pre-determined questions but flexible, while an unstructured interview is without any pre-determined questions; the interviewer has a general idea of the issue but guides the conversation within this area. I used a semi-structured interview to allow the free flow of information and probably insight into other issues the researcher has no prior knowledge of. Interviews can be used to acquire information about respondents' experiences around a topic and a follow-up to investigate individual respondents to questionnaires. An interview provides in-depth knowledge about a topic and allows the researcher an opportunity to probe or ask a follow-up question. Interviews are more personal methods of collecting information, with responses given directly by the respondents. It is easier for the respondents as it is based on the impression or opinion of the respondents. The interview technique is an excellent interpretive of the validity of information as both the interviewer and respondent can check for meanings and understanding of statements and views.

I have used interviews because it gives a broad view of teachers' understanding, experiences, practice, values, and opinions of classroom interaction. The interviews were semi-structured and video recorded to obtain detailed information. The disadvantages of an interview include its time-consuming nature and the possibility of the interviewee straying from the topic. Furthermore, an interview is susceptible to the interviewer effect. An interviewer can exaggerate a topic or point so that it becomes more salient to the respondent, whereas there could be more salient issues in their daily lives, and respondents can give the researcher information they think is more desirable and socially acceptable.

6.4.2 Observation.

Observation is the fundamental basis of the case study. It is a method used in collecting both qualitative and quantitative information about the way, frequency, feelings, and emotions, the

way of interaction between things, people, and the environment, which eventually allows the analysis and evaluation of behaviours. Qualitative observation is a measure of the quality of a teacher's classroom interaction, while quantitative observation is the observation of a thing or event based on number and measurement. Observation is a method of viewing and recording participants to collect information and generate data.

Jogan (2018) defined classroom observation as a deliberate investigation of teaching and/or learning events through systematic data collection and analysis processes. O'Leary (2013) explained that observation is a crucial instrument to launch how we observe, why we observe and how this can be employed to enhance teaching and learning. The reason behind my choice of classroom observation technique is to gather more information on participants, activities and materials used in lessons, including those displayed in gestures, facial expressions, and, precisely, non-verbal and verbal activities. The researcher equally can check for the accuracy of data collected by direct observation of participants' behaviour, so the data collected is more reliable than those collected through interviews or questionnaires. The advantages of observation are that the researcher no longer relies on what respondents say they do or do not; the researcher sees respondents in action. The disadvantages include that the researcher's presence may affect the participants' behaviour. The observation technique is time-consuming and not cost-effective.

6.4.3 Focus group interview.

The focus group interview is a group discussion where participants have the opportunity to react or reflect on others' viewpoints that they may agree or disagree with. The FGD is designed in combinations of students in groups of 2s (pairs) or 3s (triads) in a room or a quiet place to explore students' feelings and investigate any difference in students' opinions about issues. The researcher used FGD in this strategy to air different opinions as participants negotiated views and cross-checked each other's ideas. Besides, peers are comfortable discussing in each other's presence. Participants' interaction is quite advantageous and is one of the current study's objectives. I have also used the student focus group interview to cross-check or clarify their teachers' responses and elicit their ideas about their teacher's classroom interaction patterns and find out what activities students engage in during lessons in the classroom.

Focus group interview is time and cost-effective as data is gathered in one session rather than multiple sessions. This method allowed the researcher to access a range of views from the group and discover issues in students' classroom interaction patterns. However, the disadvantages of this approach include: if sessions are not moderated correctly, the researcher may not get the right responses needed; the possibility of a dominant participant is very high, but the researcher or moderator could manage this by clarifying the responses; and lastly, the questions may not be well understood or misunderstood, but since the interviewer has insight into participants' choice of opinions, the questions can be better phrased for easy comprehension.

Triangulation is a key component in mixed-method research. Triangulation is a method used to increase the credibility and validity of research findings (Cohen and Manion, 2000). Bashir and Tanveer (2008) defined credibility as trustworthiness and how believable a study is, while validity is the extent to which a study accurately reflects or evaluates the concept or ideas investigated. Attaining methodological triangulation was done to ensure non-bias inquiry and cross-check the study's findings. The different methodological triangulation used in designing this study includes observation for both qualitative and objective quantitative measurement of frequency and breadth of verbal behaviour, non-verbal interactions, types of questions, and deep insights into the use of silence and gestures. Semi-structured interviews and focus group interviews were used to explore attitudes, values, feelings, and classroom challenges in interaction patterns. The strength of observation complements the weakness of the interview. Information obtained in observation was compared with that in the interview and FGD. This also guided against biased conclusions.

The researcher's presence as the observer cannot be overlooked but should not disrupt or negatively influence the classroom. Mercer (1991) posited that "the most naive researchers would not expect their visible presence as an observer to affect the behaviour of those being observed" (p. 48), and Pollard (1996) asserted that this should rather be a deliberate attempt to create rapport with the respondents which is an "essential means of obtaining data about the subjective meanings of people's lives" (p. 302). In an instance of perceived negative influence, the researcher left the classroom.

To ensure the credibility of the research, at each interview or contact with the participants, the researcher re-stated and reassured the participants' confidentiality and stressed

anonymity and informed consent. The researcher transcribed the interview verbatim and analysed the data based on the participants' perspectives, and ensured that her preconceived notions did not affect the data. The interpretive paradigm approach is premised on making meanings, drawing from information inferences, making meanings of the subjective reasons, and meaning from some findings, and comparing with the information observed, where it tallies and makes contradictions where it does not tally.

TABLE 6.3. SUMMARY OF ADVANTAGES AND DISADVANTAGES OF THE VARIOUS DATA COLLECTION METHODS.

	Observation	Interviews	Focus group interview
Advantages	<ul style="list-style-type: none"> • Participants are in a natural environment, so they are likely to behave in a genuine way. • An observer can be objective if they are non-participant. • The participant is aware that they are covered by an ethical method. • All behaviours are recorded, so the data is broader and richer 	<ul style="list-style-type: none"> • Responses can be clarified to reduce misunderstanding. • Stimulates close interaction. • Responses can be probed for clarity and details. 	<ul style="list-style-type: none"> • Respondents can reflect /react/check for the truth from group members. • Encourages and enhances interaction. • Promotes teamwork. • Participants are unlikely to give false responses in the presence of other respondents. • An interviewer can get a range of views from respondents.
Disadvantages.	<ul style="list-style-type: none"> • The observer may not record all behaviour assuming that they are irrelevant or merely ignoring some actions; therefore, bias. • Some data collected may not be useful to the particular research. • Observation is time-consuming and not cost-effective. • The presence of the observer may affect the way participants behave. 	<ul style="list-style-type: none"> • Respondents can quickly stray from the topic. • Respondents can give responses they think desirable to the interviewer 	<ul style="list-style-type: none"> • A naturally dominant participant can take over the process if not effectively moderated

6.5 Sampling techniques.

Research sampling is a specific principle used to select a member of a population to be included in the study (Dudovskiy, 2018). There are two types of sampling techniques: probability sampling and non-probability. In probability sampling, every member has the chance to participate; this includes simple, stratified, cluster, and multistage sampling. In non-probability sampling, members are not selected on random bases, for example, convenience or opportunistic, quota and purposive or judgement sampling (Dudovskiy, 2018).

Ado Ekiti, Awo Ekiti, and Iropora Ekiti are the specific locations chosen for the study. The target population are the schools in Ado, Iropora and Awo Ekiti. The choice is influenced by special interests and relationships established in the town and villages. The researcher is interested in the development of her science teaching practice and that of teachers in schools within her immediate environment. The schools were chosen using opportunistic sampling based on their availability, readiness, and willingness to participate in the study. They were also chosen based on the researcher's convenience. The five-case study of mixed methods took a lot of time with video recordings of pre-training and post-training recordings; hence opportunistic sampling saves some time based on readiness and accessibility.

In each of the schools, one basic science teacher had been assigned automatically by the school Management to teach basic science at junior secondary school 1. Therefore, the teachers were selected purposively based on their professional role, experience, or expertise and because they have in-depth knowledge of the issue (Cohen, Manion and Morrison, 2007). The reason for using purposive sampling is to collect information from the only people who are in the position to provide it. The researcher assigned the choice of choosing the students to the teachers to feel a sense of collaboration and security about the students' responses.

6.5.1 Population and sample.

This subsection details the data population and sample used in the current study.

6.5.1.1 Population.

The research population is the entire collection of groups, objects, events, or organisations that is the main focus of the research query to which the research findings are applicable (Umair,

2018). The population in the current study is all secondary school teachers and students in Ekiti State.

6.5.1.2 Sample size.

The sample size is the number of individuals from the population who will participate in the primary data process (Dudovskiy, 2018). The sample size depends on the purpose of the research and the nature of the population under investigation. For practical reasons such as managing time and cost, handling large data for manual transcription, and analysis of the pre- and post-intervention and interviews in this exploratory study, the researcher employed one sample composed of 5 case studies. The 5-case studies were chosen based on some challenges faced by the researcher and listed among the limitations of this study, such as paying travelling costs for participants due to unpaid salaries and fear of looming industrial strikes.

The five cases employed were to produce a clear picture of the analysis and results rather than blurred results, and the use of theories in the design phase improved the study's external validity (Yin, 2015). In order to increase the construct validity, a further selection of a diverse case study in future will expand the results. Yin (2015) argued that case studies are for analytical generalisation instead of statistical generalisation. Moreover, Esene, Kotb and Hussieiy (2014) stated that the number of case studies for a descriptive case study describing individual behaviour is five (Esene, Kotb and Hussieiy, 2014).

The sample of the current study is five teachers in five public secondary schools in Ekiti, Nigeria, which have both urban and rural communities with various features of the classroom environment: for example, availability and accessibility to basic amenities. Schools A, B and C are located in urban areas with similar environmental factors, such as average modern social amenities, and teachers and students have similar characteristics of exposure to modernisation. Schools D and E are located in the State's village areas (rural), where teachers and students share similar and limited exposure to modernisation with few or no amenities.

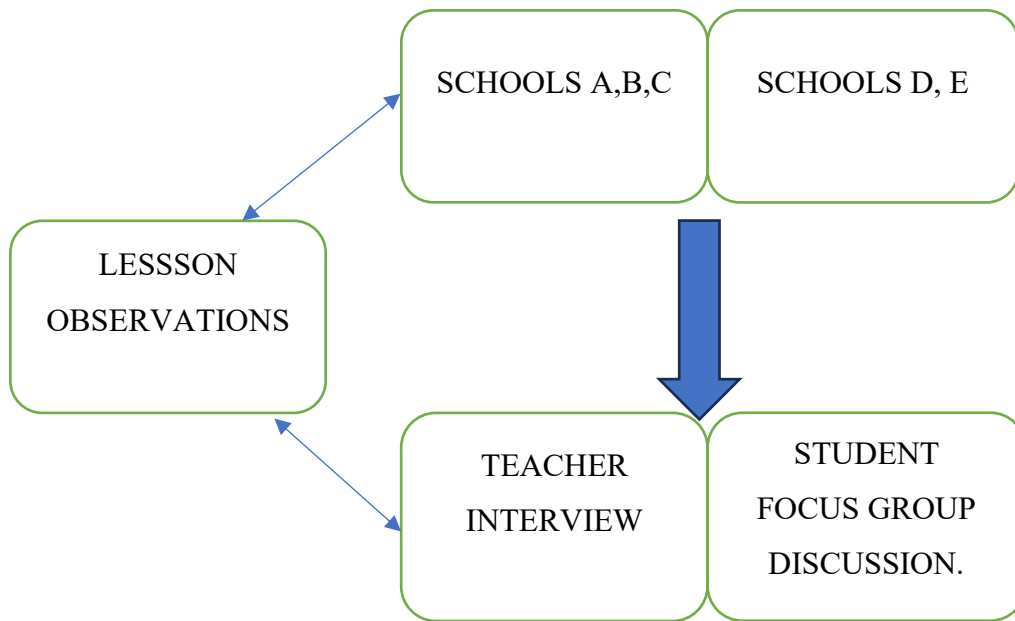


FIGURE 6.2: SAMPLE DESIGN AND RESEARCH TECHNIQUES

6.5.2 Research instruments.

The instruments used for the data collection are discussed and described in this section.

Research instruments are defined simply as tools used for obtaining information necessary for your research project (Wilkinson and Birmingham, 2003). It could also be the device for collecting, measuring, and analysing data related to research. The instruments used for the data collection are an observation schedule, focus group interview schedule for students, Interview schedule for teachers before and after the intervention and intervention material for in-service teachers were designed for data collection. The instruments were designed with consideration for time, place of use, policy, culture, and respondents-targeted sample and purpose of the current study.

6.5.2.1 Interview schedule for the teachers.

Two different semi-structured interview schedules were developed, one for data collection before the intervention and one for data collection after the intervention. Copies of the teacher interview schedules can be found in Appendix 2 and 3.

6.5.2.2 Interview schedule for the teachers (IST) before intervention.

The interview schedule for teachers developed for the collection of data before the intervention is a 16-item instrument designed with open-ended questions relating to classroom behavioural patterns and the teacher's genuine opinions about classroom interaction patterns. The open-ended questions are expected to generate and document in-depth conversations about the researcher's personal experience and subjective position as a teacher educator and the teacher participants' personal experiences, values, and culture that shaped our classroom practices and decide how to act and improve classroom practices to better learners' experiences.

The interview also addressed some factors that influence the teacher's classroom interaction patterns. This instrument aims to elicit information from teachers that would generate data for analysis to answer the researcher's questions and compare with those obtained from lesson observations. The researcher drew a cross-check by matching all the items on the instrument with the main research questions. It consists of six sections (A-F). The schedule was categorised as Section A, demographic questions; Section B, broad questions (1-3); Section C, questions relating to the teacher's direct talk (4-9); Section D, issues relating to the teacher's indirect talk (10-13), section E, questions relating to pupils talk (14-15) and section F, silence, and confusion (16). The instrument was validated with the assistance of an expert in the Mathematics Department and one lecturer in the Department of Education to see if it measured what it was supposed to measure. The interview schedule for teachers before intervention can be found in Appendix 2.

6.5.2.3 Follow-up Interview Schedule for Teachers (FIST).

Harland and Kinder's theoretical framework (1997) of the hierarchy of inset of outcomes is employed in the current study in two ways. Firstly, the conceptual framework informed the development of the teacher's post-intervention questions, and secondly, it was used in the analysis of the data. In the FIST, Harland and Kinder's theoretical model formed the basis for the 11-item instrument to find out how far, how well, and what and how the teachers felt about using the new various interaction patterns learnt and agreed on improving during reflection and the intervention. Related six themes out of the nine themes on the framework were adapted. The 11-item question was developed by generating questions from six related themes from the framework. The interview schedule was corrected and validated with the assistance of two

lecturers in the Mathematics Department and one from the Department of Education. The interview schedule for teachers used for data collection after the intervention can be found in Appendix 3.

6.5.2.4 Focus group interview schedule for students (FISS).

The purpose of the interview schedule for the students is to give a meaningful voice to students' opinions, ideas, and experiences about their classroom experiences, encourage students to share ideas and improve students' classroom experiences. Another purpose is to supply additional information to the one that will be provided by classroom observations of interaction patterns and cross-check the information from the teachers. The interview took forty minutes each. The focus group interview material was developed with statements in diamond ranking order using colour cards that were arranged in grids. The statements varied from how the pupils feel about their basic science; whether they learn better discussing with their peers or by just listening to the teacher talk; if they are confident to talk to their basic science teacher in the classroom; how they feel about reinforcement; and what type of questions they would like to be asked in basic science lessons.

The researcher made out a complete sheet of diamond-ranking, cut them out, and made coloured cards with statements written on them. Statements on the cards were open-ended statements that allowed expanded responses to be made within groups before concluding on the order of placement in the diamond. A sample of the statements on the cards can be found in Appendix 4. More cards than required cards with statements on them and plain cards were made, so the pupils could criticise or reject some of the researcher's ideas and add their own new views. The highest important idea of the pupil went to the top grid. The next two most important went to the next two, the next three most important went to the next three, the next two least important to the next two grids, and the least single important went to the last grid. The statements are arranged in the grid below:

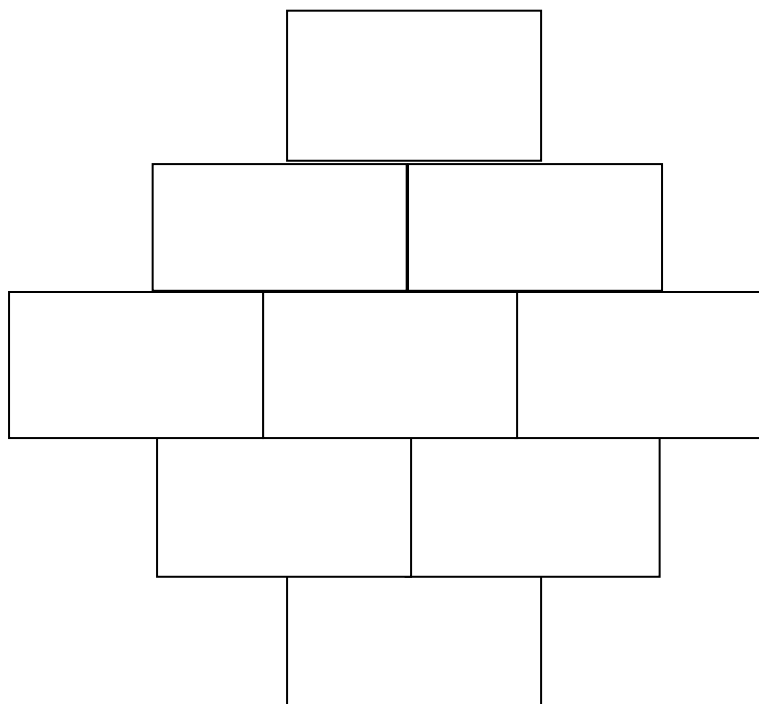


FIGURE 6.3 THE DIAMOND RING SHAPE.

6.5.2.5 Basic science interaction analysis category (BIAC).

BIAC was employed in collecting data from classroom observations. This was developed by adopting Flanders standardised instrument, Flanders Interaction Analysis Category (FIAC). This observation technique was used to gather information about how the teacher interacts with the student(s) and vice versa and how the student interacts with the student (s). The main sections are the teacher's talk which involves lecturing about facts on content, giving directions to students, types of questions teachers ask, criticising to change pupil's behaviour, building on pupil's ideas, and praising or accepting student's feelings. The students' categories are pupils' talk, including teachers' solicited talk and talk initiated by students. Silence was classified by the researcher as a period of articulating responses together, and noise or confusion as talk not understood by the researcher.

The basic science interaction analysis category adapted by the researcher has eleven main categories. The main categories are seven categories assigned to teacher's talk, two categories are awarded to student's talk, the tenth category is classified as silence caused by a period when students or teacher is trying to articulate their ideas and thoughts together, and the eleventh category is a period of confusion based on noise or talk that is confusing as defined by

the researcher. The seven categories assigned to teachers are subdivided into indirect and direct teacher talk. The direct teacher's talk is categories five to seven, while the indirect teacher's talk is categories one to four. Categories eight to nine represent students' talk. The basic science interaction analysis category for classroom observation can be found in Appendix 5.

6.5.2.5.1 Adjustments made to FIAC.

Category 4 was subdivided into sub-categories of 4a, 4b, and 4c. I ensured that the different types of questions did not overlap by making distinct differentiations between them. The non-verbal categories of classroom events, for example, gestures, eye contact, movements, smiles, nodding in acceptance or rejection, and so on, were captured and recorded at the time they occurred within the BIAC schedule to increase accuracy and capture activity at the right time of occurrence.

Though I do not totally agree with Flanders' assumption that the verbal behaviour of an individual is an adequate sample of his total behaviour, but tilt towards Wellington and Osborne's (2001) view that words are no doubt essential in communication, there is more to verbal communication in science, for example, messages in charts and graphs can never be replaced by written words, the smell of chemicals in laboratories and what we touch or feel in science experiences cannot be replaced by words. Employing gestures to explain rock layers or plates cannot be replaced by words. Colța (2010) argued that a majority of 90% of communication is non-verbal, although teachers often ignore this fact in classroom processes just as they ignore the fact that communication is a two-way process (Alston, 2020). In addition to BIAC, the lessons were recorded with the aid of a video camera.

6.5.3 Teacher intervention material.

The teacher intervention material is the training material used by the researcher for the 1-day awareness intervention/training for teachers in classroom interaction patterns. The researcher developed this simple material, consideration was given to the time available, and permission was granted to teachers by their principals, which informed the development of the content of the material for the intervention for one day. The material aims at increasing students' participation and teacher-student collaboration and fostering power-sharing to improve the quality of teaching and learning of basic science in Nigeria. The goal was to have teachers

become self-supervised, evaluate their classroom performance through reflection, and make informed decisions about making changes in their classroom patterns after the intervention.

The content of the material was outlined into themes such as the meaning of interaction, meaning and types of classroom behaviours, initiation response feedback- IRF mechanism, reinforcement, discipline, questioning, feedback, classroom climate, and student-centred teaching strategies. The agenda, timetable, and material can be found in Appendix 6A, 6B, and 6C, respectively.

6.6 Pilot Study.

According to Van Teijlingen and Hundley (2002), pilot studies can be referred to as small-scale feasibility studies that are trials done in readiness for the major study. It can be pre-testing or trying out specific research instruments (Baker, 1994). Pilot studies may help to identify potential practical problems or errors in the instrument or procedure of research. It could give a prior warning if the proposed instrument or method is too complicated or inappropriate, therefore helping to increase the reliability and validity of a research instrument (Cohen et al., 2007). A pilot study is also valuable for discovering the feasibility of the study, practicability, and an instrument's unclear or uncertain aspect. These were put into consideration during the pilot study.

The pilot study took place in the United Kingdom between May and June 2017 because the financial implication of travelling to Nigeria was unbearable for the researcher at that point. The interview schedule was piloted with four teachers in four tertiary institutions in the UK to ensure that the area covered in the questions was appropriate and not out of place to answer the research questions. Secondly, the pilot study was carried out so that the researcher could get acquainted with the technique in order to interview the participants effectively.

Four science teachers were interviewed from four tertiary institutions in the UK, the University of York, University of Sunderland, University of Newcastle, and Teesside University, who were acquaintances, interested in the topic, and willing to participate. The interview showed me the areas to improve in the main study interview. The interview schedule was redrafted to include some open-ended questions, and some ambiguous questions were eliminated. This was presented to some colleagues for discussion and suggestions. Thereafter, it was presented to my supervisors for further discussion and suggestions. After several

discussions and suggestions, the draft went through many revisions and redrafting stages. A good interview schedule was finally designed while I sharpened my presentation skills.

The diamond ring activity was conducted with two groups of undergraduate students who volunteered to participate. This took place in the PhD room in the Department of Education, University of York. A brief introduction and explanation of the process were provided to the participants before the activity. The researcher read out some of the statements on the cards. The ten statements on the cards went through rigorous scrutiny because there were observations that some statements were unclear for the proposed participants in the main study. Some of the statements were restructured to ensure simplicity and clarity. The process was explained at intervals. The drafted statements were presented to my supervisor for further discussion and suggestions. There were several stages of discussions and suggestions which led to significant changes in the statements before my supervisor ratified the final statements.

The researcher had a previous visit to the lecturer whose interest and consent were sought. The Chemistry lecturer agreed to use his lesson for the pilot study, so the classroom observation was piloted in the Chemistry lecture room at Derwent K Block of the University of York in May 2017. The observer sat in the corner of the lesson and recorded the classroom events per second. The recording was done by writing (in-text) using the basic science interaction analysis category and personal notes. After the recording, the researcher highlighted the instrument's challenges, assisted by the lecturer. These challenges were presented and discussed with my supervisor. Several suggestions were made, and the final document was ratified.

6.6.1 Implication of the pilot study on the main study.

In the process of improving the validity and reliability of the data tools and reflecting on the feasibility, practicability, and effectiveness of the study design, many changes were made. These ranged from discussions with and suggestions from colleagues, experts, and the researcher's supervisor. Technical difficulties were detected, especially with inputting classroom events on the schedule every second. The researcher detected a need to regularly explain the hierarchy of the diamond ring activity to avoid misplacement. The participants in the diamond ring were excited to express their opinions about their science classroom experiences. Their reaction implied a sense of collaboration and cooperation between the

students. It also signals a warning to look out for students with domineering natures that may unknowingly hinder others from participating. Regular clarification of anonymity and objectives of the project were also discovered to be of utmost importance, so teachers do not wrongly think they are being assessed.

The data tools were amended based on recommendations in the pilot study. Some questions and statements that could be misinterpreted were simplified to avoid confusion. Some categories in the BIAC were sub-classified according to the objective of the study, with allowance for non-verbal input. It was obvious that observing, video recording, and inputting activities into the schedule every second and note-taking could not be done at the same time. Thus, to ensure full coverage of the events, it was suggested that keying in the activities every second can only be achieved during the video transcription. Furthermore, the data keyed into the schedule and notes taken during the observation should be cross-checked with the transcribed version every second so that all events are captured and the time tallies.

6.7 Main data collection process.

This section outlines the main data collection that was employed to investigate each research question. The main data collection procedures were in two phases: the pre-intervention phase and the post-intervention phase.

6.7.1 Ethical approval procedure.

The ethical approval process started immediately after the progression examination. With the assistance of my supervisor and TAP member, the final instrument, general information page, and consent forms were sent to my supervisor, who made sure that the details of the study purpose, the design, the role of the participants, and ethical issues were stated. The researcher completed and forwarded the instrument, consent forms, and ethical questionnaire to the project supervisor, who made corrections, and the researcher effected them promptly. The supervisor signed and forwarded it to the TAP member, who also signed and sent it to the committee for Ethical approval, and it was approved on the 3rd of August 2017.

6.7.2 Ethical Consideration.

The study was carried out considering ethical issues in accordance with the code of practice and standards for ethical research with human subjects set out by the University of York (2016). Ethics is a matter of principle and sensitivity to the right of others whose responsibility rests with the researcher, Cohen, Manion and Morrison (2017) or moral principles that control or influence someone's behaviour (Hornby, 2001).

Respect for democracy is one of the ethical considerations of research, among which are freedom to participate, ask questions, access information, express ideas about the research findings, and criticise the published research findings. After the approval of the instruments and consent forms by the research ethics committee (Ethical Approval, see Appendix 1E), the researcher ensured that all the participants signed a consent form explaining the process, training session and their role. Also included is a method of storing, processing, and using the data to be provided (see Appendix 1A for general information and Appendix 1B, 1C, and 1D for consent forms).

The first part is the general information which explains the purpose of the study, what will happen to the data, how the data will be stored, who will have access to the data, how the data will be used for academic purposes, confidentiality, and anonymity (see Appendix 1A). The second part details their role as participants, elucidating the two phases of the project and explaining the process of classroom observation, video recordings, and photographs. The second phase of data collection, which entailed the training, was also well explained. The second part clearly stated that participation was voluntary, and participants could withdraw from the study at any time, up to two weeks after data collection.

The statements in the second phase were expected to be ticked by participants for approval and to indicate their acceptance of participating in the study. The participants were provided with two contact details; the ethics committee member and one from the department. Lastly, they were asked if they had further questions or queries before signing the consent form. In conducting the meetings and the data collection, the researcher was polite. The participants' privacy and confidentiality were of high priority to the researcher.

6.7.3 Participants' recruitment process.

Five secondary schools were recruited using an opportunistic sampling approach due to its easy accessibility and quick approval by the management. The researcher got approval from two of the three schools in the urban area on the same day of resumption: 18th of October 2017. Three schools from the urban area and two schools from the rural area of Ekiti State were used for the study. One of the three schools selected in the urban area requested and insisted on a permission letter from the Department of Education, Ministry of Education before the school could be accessed. This was sought and approved on the 29th of October, 2017. The researcher personally visited the principals and made a formal introduction; shedding light on the purpose of the project and the needed support. Approval by the principals and teachers of four schools was granted by the end of the first week. Most of the principals gave verbal consent but could not sign immediately and asked the researcher to return later for the signed forms. While some of the principals also explained that classes might not begin as expected since teachers have just enrolled the junior secondary school one class, and the students have to pay tuition before being allowed into classrooms. They provided two options; returning the following week or using junior secondary school two classes as participants. The researcher insisted that the current research sample is for junior secondary school one, and opted for the first option. Regardless, the teachers' consent forms were signed by the first week. It is noteworthy that all the schools have only one integrated science teacher each, so the researcher did not have to make choices between teachers.

The teachers selected the pupils used for the research; nine pupils that voluntarily signified were chosen from each school to avoid overcrowding. The teachers assisted in distributing the consent forms to the pupils and instructed them to take the parent's consent form home to their parents and return the signed copy. The pupils did this by the end of the first week and returned the signed consent forms.

6.7.4 The first phase: The pre-intervention phase of data collection.

This involved recording the teachers' interviews/ conversations, the students' focus group interviews/conversations, and recordings of the classroom lessons before the intervention was conducted. Table 6.4 below summarises the process of data collection stages.

TABLE 6.4 STAGES OF DATA COLLECTION PROCEDURE OF THE MAIN STUDY.

Phases	Stages	Period	Participants	
			Teachers	Students
1	Pre-Data collection	Week 0	Visits, introductions, and consent forms	Visits, introductions, and consent forms
	Pre-intervention data collection	Week 1	Interviews	
		Week 2		Focus group discussion
		Week 3-6	Lesson observation	Lesson observation
		Week 6	Intervention	
2	Post-intervention data collection	Week 1	Interview	
		Week 2	Interview	
		Week 3-6	Lesson observation	Lesson observation

NOTE: In week 0, there was no training or data collected.

6.7.4.1 The teacher interview.

The teachers signed their consent forms almost immediately. It was the first week of resumption; the students were busy trimming grasses and cleaning the school surroundings, so this gave the teachers enough time to attend to the research, and the teacher interview commenced the second week of resumption. The researcher sought the assistance of a recorder assistant who made video recordings of the interviews to make them audible and easy to transcribe. The teachers chose the time and venue for the interview, which were mostly under a tree in open spaces to prevent noise interference from the staff rooms.

The questions on the IST (see Appendix 2) were followed. Whenever teachers seemed to talk out of context, the researcher repeated the question and explained why the question was being asked. The context of the conversation was our various reflexive experiences, opinions, values, and cultures that informed our classroom practices as teacher trainers and teachers. A total of five teachers were interviewed. About an average of twenty to twenty-five minutes was spent to complete an interview which was shorter than the forty minutes scheduled for its completion.

6.7.4.2 Student focus group interview.

These student focus group interviews were designed and carried out to triangulate the information and data from the observation and the teacher interview. The principals provided quiet places for the activity within the school premises to prevent students from being distracted. The students were able to react to each other's contributions; they argued out ideas, disagreed, and agreed on decisions as a team. The teacher wrote YES and NO on papers, and the student volunteers drew lots to determine their focus discussion groups. The nine volunteers self-organised into three groups of three each. This allowed the individual student to provide context, draw ideas, reflect, and compare what they heard from others outside the group. The researcher allotted time to explain the meanings of the statements and the diamond ranking process to the students many times before the real activity.

More than the required cards with statements on them cards were handed to the pupils so that they could put down their new ideas (see Appendix 4). The researcher informed the students that the highest important issue goes to the top grid, the next two most significant go to the next grid, the next three most important goes to the next grid, the next two least important goes to the next grid, and the least single important goes to the last grid. The

researcher constantly repeated the process throughout the exercise to avoid misunderstanding and misplacement.

The researcher encouraged the students to work as a team, argue their points amicably and reach a consensus. The students were also encouraged to discuss their ideas within groups and make changes if convinced by the ideas of others. This measure was a check to prevent making untrue statements and to stimulate productive discussion of ideas. The researcher observed the occurrence of dominance among the students and moderated carefully. The sessions were interactive and exciting; probably because most of the participants were young and excited to jointly perform such novel activity. The diamond ranking exercise was repeated for the five schools. All student groups completed the diamond ranking exercise. Five student focus group interviews were conducted with fifteen categorised diamond rings activities, three from each school.

6.7.4.3 The classroom observations.

The recording of the classroom lessons started in the third week. The teachers were contacted by telephone, and they each fixed the lesson recording in accordance with their normal lesson time on the school timetable. The recording camera could not be erected on the spot due to poor illumination, as there was no electricity in any of the classes, and also to prevent background noises from the school environment. The researcher had to seek the help of a recording assistant throughout all the recordings to make the video clear and audible. The researcher sat in a corner in each classroom, inputting inside the BIAC schedule (see Appendix 5) and taking field notes of all recordings without interfering in any lessons.

In Nigeria, the normal time accrued for a single period of a lesson is 40 minutes. The recording took place during the standard classroom lesson and time. However, not all the teachers were time-disciplined, so the time of the recordings varied. All the activities could not be manually recorded per second as many events were occurring, so the missed-out events were inputted during transcriptions. A complete three lessons per teacher were recorded, totalling a number of 15 recorded classroom lessons.

6.7.4.3.1 Patterns categorised in the BIAC schedule.

The patterns of teachers' and students' classroom interaction were categorised and inputted into the BIAC schedule comprised of the initiations, responses, and feedback in the lessons.

The researcher recorded the interaction analysis coded with numbers, whether the teacher was lecturing, giving facts, directions, or commands, and whether the teachers asked questions and what type of questions were asked, closed-ended or open-ended. There were a number of teacher's questions that were not classified as real questions; for example, do you understand? Is it clear? Isn't it? The researcher made a clear distinction between these types of questions. No single question was classified and interpreted to be in between two or three types of questions.

The teacher's acceptance and use of students' ideas were also recorded; though quite rare. Praises and encouragement were also recorded. Instances the teacher clarified pupils' responses were also recorded. Statements and actions to change unacceptable behaviour were also recorded under a category. Pupils' genuine talks that were not implied by the teacher's tone in response to the teachers' talk and pupils'-initiated talks were also recorded. Periods of silence between teachers' questions and pupils' responses were recorded. The periods of non-verbal cues were recorded as they occurred, for example, gestures, body language, smiles, and eye contact. There were no periods of confusion in any of the lessons as teachers were the centre of the lessons, students mostly spoke when told to do so, and teachers had good control of the class.

6.7.4.3.2 Notetaking by the researcher.

The researcher's note-taking included actions not listed on the observation schedule; for instance, a teacher said to a student with a tone meant to embarrass, 'so you don't know what a fruit is?' Degrading comments or reactions were noted, as well as scenarios where the teacher was contextually wrong, and situations where a student was correct, but the teacher said the student's response was wrong or acted like the response was incorrect by moving straight to another student without any comment on the response. All these were written in a diary and kept in a safe place.

6.8 The reflection and intervention process.

The intervention was conducted on the 27th of November, 2017. The researcher developed the intervention material (see Appendix 6C), a timetable (see Appendix 6B), and an agenda (see Appendix 6A) for the intervention. The intervention sessions were recorded. The purpose of the intervention was to acquaint the teachers with patterns of classroom interaction (the what, how and why of classroom interaction and their various patterns).

The intervention started at 10:00 am with four teachers in attendance, and the fifth teacher joined at noon. The intervention aimed to explain sections of classroom interaction patterns so that teachers can integrate the patterns into the present classroom behaviours, thereby improving the quality of teaching and learning in basic science classrooms in Nigeria. The goal is to have teachers reflect on their practices, become self-supervised, evaluate their classroom performances, and make informed decisions about regularly changing their classroom practices to meet the topic objectives. The objectives of the intervention were stated on the agenda (see Appendix 6A). Some teachers from the school also joined the intervention, as they found it very resourceful.

The researcher thanked, praised, and encouraged the teachers to keep up positive collaborations. Reiterating the objectives of the project, the researcher reemphasised that the project was not meant to assess any teacher's skills but was purely a research study. The researcher asked for a volunteer teacher who would permit her lesson to be shown to all the participants. Two of the teachers volunteered. A video recording of the lesson was watched, and some clips were flagged. The researcher asked everyone to write down their observations from the video they watched. The intervention was very interactive, and some issues that emerged from the videos were discussed after the training. One of these issues was punishment/discipline, which was a bit challenging to reach a concession due to its cultural underlining.

The policy was also addressed, time to cover syllabus and time to allow student-student classroom dialogue. Teachers believe in the verbal delivery of lessons and topic presentation; thus, the time to cover the cumbersome syllabus for lessons was too short. It was also agreed that teachers should be allowed to practise some classroom patterns before a post-intervention recording takes place. The event ended at 4 pm, and the researcher gave each teacher an amount of £10 as transport fare as stated in the ethical approval form.

6.8.1 The researcher's reflection on the intervention process and reflection designed for a change.

The planning for the reflection and intervention was carried out in collaboration with the teacher participants, considering that the teacher participants were released by their principals for only a day. As the sole implementer of the intervention and lessons observer, the researcher constantly reminded the teacher participants of her role as researcher and teacher trainer, with a

shared aim to improve classroom practices to enhance students' engagement and cognitive development.

Thus, the researcher and the teacher participants reinforced the initial mutual agreement to reflect and discuss how and what we teach as teachers/teacher trainers and understand why we teach this way. In addition, decide the changes we want to make and see; how to make positive changes in the context of our school culture; and the limited resources in our environment which impede students' engagement.

6.8.1.1 Reflection of the baseline practices.

The researcher employed a pre-training oral assessment to explore shared values, beliefs, knowledge, and attitude at the start of the intervention. We reflected by forming groups, and each group discussed classroom interactions. The participants listed the types of verbal and nonverbal interaction, questions used in the classrooms, and why we use them. The participants also explained what students say in the classroom and the advantages of classroom observations. The participants presented their ideas on flip charts, and the researcher duly took note of these ideas.

The participants all agree on the following issues that arose in the initial reflection:

- too many teachers' talk was listed in all the groups.
- students can talk when requested by teachers.
- participants agreed that most of the questions they ask are 'what is so so and so?'
- the participants also agree that they have not been conscious of their body language in the classroom, especially smiles and eye contact in classrooms. Most of them insist that smiling can make them lose their students' respect.
- the teachers all agreed that prior to the current study, they presumed that the classroom observation method was only used to evaluate teaching; thus, the reflective practice was a new method.
- the teachers expressed that students would control their classroom if allowed to talk, so their authority would be at stake.
- the participants also stated that the students do not understand English language, which is the official medium of communication in schools.

- the teacher participants assented that a lack of teaching materials hinders classroom activities.

The researcher reflected on the fact that the intervention was time-constrained due to the teacher participants' primary work and her singular role as the sole presenter of the intervention, sole researcher, and teacher trainer. Therefore, the researcher reminded the teachers of her co-participation in learning from them on ways to improve classroom practices. The teaching styles explained by the researcher include the teacher-whole group teaching style, commonly present in our classrooms due to our cultural values of respect and discipline for authority (others can be found in Appendix 6C).

6.8.1.2 Teacher-whole group.

Smith et al. (2004), Burns and Myhil (2004) and Alexander (1996) and Pollard (1994) assert that the whole class teaching bears little difference from the old traditional didactic teacher-student interaction style. In UK and America, some studies of classroom discourse show that whole-class teaching across all school stages is dominated by a teacher-led recitation, revealed by Sinclair and Coulthard (1975) with three moves: initiation and response and follow-up as feedback.

This is the traditional method of teaching and learning, where the teacher is the authority in the classroom. The teacher controls the lesson. There is unequal classroom participation between the teacher and students in whole-group teaching and learning. A whole group method is teacher-centred, where students mostly respond to teacher-initiated talk. The teachers talk mostly in the lesson. Apart from dominating the classroom, the teacher employs routine, uses open negotiation, and manipulates students. This system leads to non-participation and sometimes personality issues or power struggles and disruption from the students. The teacher enjoys cultural authority over students based on tradition in a specific sociocultural context. As such, teachers wield a great deal of authority that students are to obey.

The lesson is planned for the students, and it is easier to plan as the teachers use fewer materials to plan. In this method, the teacher usually stands in front of the classroom where the lesson is presented in a chalk-and-talk style, followed by an exercise set for the whole class or a whole-class discussion initiated by the teacher. The low achievers will fail to keep up and eventually lose confidence in themselves, while the high achievers will be bored and, because

of the non-challenging nature or not providing new knowledge or skills, lose interest, and this may affect students' attitude toward school and learning.

6.8.1.3 The researcher explained different methods teachers could employ to increase students' classroom participation and improve learning and teaching.

(a) The IRF technique - Integrating student-centred teaching strategies into the IRF mechanism can improve the quality of the whole-class lesson strategy of teaching and learning. This can be done patiently by taking turns and running the IRF in a very participatory way. These methods include active learning in which students solve problems, answer questions, formulate questions of their own, discuss, explain, debate or brainstorm during class. In this method, the teacher initiates the topic at the introduction stage. Students can also be allowed to initiate conversations or discussions. For instance, extend the introduction to the students, and ask in pairs what they think about the introduction. Feedback should be specific, whether the response is correct or not correct, or good, and do not repeat the student's response in place of feedback and do not move the conversation to another student without giving proper feedback.

(b) Dialogic teaching - The teacher is almost passive; he accepts and allows students to use their own ideas; he builds on this with frequent praises and encouragement; he accepts and clarifies feelings and attitudes. Good quality questions can be used to aid classroom dialogue and hence enhances students' reasoning and challenge their level of knowledge.

(c) Questioning and feedback - Questions should be asked based on knowledge, comprehension, application, analysis, synthesis, and evaluation. Questions could be in two categories, low order or high order, low order or close-ended are those requiring recall of facts or information and high ordered or open-ended questions are those that involve the application of information, manipulation of information, reasoning, and evaluation.

High-order questions are important to elicit deeper thinking and high cognitive development and could also be used by teachers to initiate discussion to develop dialogic talk among pupils. This does not have one single answer, and answers could vary depending on individual creativity. Low-ordered questions could be used for simple checks, recall and summary of important learning points. Teachers should caution on how, types, numbers, and repetition of questions. All attempts of students to answer questions should be respected and valued in order to protect their self-esteem.

(d) Feedback - This is a sort of questioning process and a very powerful tool for learning and achievement. Cues provide aid to pupils as they try or struggle to provide answers to questions in the classroom. Feedback could be negative about correction or positive feedback on how well they have performed.

(e) Inductive learning - Students are first presented with questions and challenges that are inquiry-based learning, case-based instruction, problem-based learning, project-based learning, discovery learning, and so on.

(f) Reinforcement - Reinforcement is simply a method of getting a pupil to act in the classroom so as to maximise the pupil's reward, which usually comes after the response. Reinforcement is in two categories, positive and negative reinforcement. Behaviours that are positively reinforced are likely to be repeated. Teachers use praises and rewards like gifts as reinforcement for positive behaviours. However, specific praise for individuals should be used rather than general praise for a whole class.

(f) Motivation - There are two types of classroom motivation, intrinsic and extrinsic: Teachers can spark students' intrinsic motivation by getting to know them as individuals; developing a positive relationship; giving them ownership of their classroom; practising setting small achievable goals with them; give them a solid foundation; give students specific feedback- you are so smart, great job. Find out what interests your student, tap into their innate curiosity, relate this to pedagogical content or make connections between classroom activities and the real world. Give rewards and recognitions, you can set a reward for a whole class, but students tend to be more motivated if their reward is based on individual growth and achievement. Reward consistently good behaviour and high achievement. Recognitions and praises are tangible rewards that many students long for, acknowledging the good works and accomplishments of students.

(g) Discipline - Varieties of skills and techniques could be used to keep students organised, orderly, focused, and attentive to classroom tasks. Rather than teachers becoming aggressive, caning, and making students lose interest in science, there are simple methods of discipline in the classroom: Focusing- Get the attention of everyone. Start only when everyone is settled down; Direct instruction- tell them what you will be doing together and set a time; Monitoring- move around almost every 2 minutes, check on their progress, and provide individualised instruction where necessary.

(h) Classroom climate - This is the classroom environment, social climate, and the emotional and physical aspect of the classroom, which influences students' growth and behaviour and affects peer interaction. It is the prevailing mood, attitudes, standards, and tone that teachers and students feel when they are in the classroom. A negative classroom climate can be hostile, chaotic, and out of control, while a positive climate feels safe, respectful, supportive, and welcoming for students learning.

(i) Non-verbal behaviours - This complex part of communication involves implicit and explicit meanings of words. It is a process of sending and receiving messages without using words, neither spoken nor written. Some researchers believe that 93% of our communication is non-verbal and 7% verbal. This type of communication in some cultures can be very complex and misinterpreted if not well understood. They can reinforce the meanings of verbal words and give information about our emotional states, such as posture, gesture, body language, smiles, facial expressions, eye contact, tone of voice, closeness, or personal space. The interpretation of non-verbal messages differs in communities, societies, and countries.

6.8.1.4 Watching the videos and reflecting on our classroom behaviours.

The researcher requested volunteers from the teacher participants whose videos from classroom lessons will be viewed, and they observed the following during reflection based on the new knowledge learnt from the intervention:

- The teachers talk almost throughout the lessons.
- The students' talk was mostly through teacher-initiated students' responses by the teacher's use of mid sentences rise in tone.
- The responses are always in the form of repetition or completion of a phrase or word to which pupils already know, whether to provide individual or choral answers. For instance, wash your teeth----- (stressed by the teacher) every day (students' choral responses). Or a repetition by saying, what did I say? Students repeat, and teachers respond by requesting a chorus clap from everyone.

The researcher then explained to them that such classroom behaviour is called the teachers' elicited designed method of drawing out responses from students. The questions we need to ask ourselves derived from the new knowledge following the intervention are: do students voluntarily want to respond, or is the teacher soliciting responses? Are the questions really questions? Of what purpose is the question? What form of question should I ask? Closed or

opened ended questions? Is the question too wide or complex? Individual or choral responses? Are they all active? Are they participating intelligently? Are they giving choral responses? Are we affirming, probing, or elaborating on students' responses? Does the teacher ask another pupil to answer the question? How do we give good feedback? How do we reinforce students' responses?

6.8.1.5 Teachers' reflection on emerging issues that teachers think are beyond their limits.

- The teachers were concerned about changing the school's culture and traditional way in which lesson notes are commonly written and presented as "write and read out." The teachers expressed concerns about school management and the state education inspectors.
- The participants bemoaned the inadequate time allotted to cover the syllabus and to allow for student-student classroom discussion. The teachers believed in the verbal delivery of lessons and topic presentation, but the time for lessons was too short.
- The teachers raised concerns about the lack of access to policy documents on reforms in education.
- The teacher participants lamented the government's lack of provision for teaching materials.

The researcher and teacher participants' discussion and reflection on the issues are below:

The researcher and teacher participants deliberated on using locally available materials. We agreed this would require the assent and cooperation of the school management, and we might ask the pupils to bring some material from home. The researcher and teacher participants encouraged themselves to check for the latest policy document online and reference these as evidence to school management for the provision and dissemination of hard copies.

The researcher and teacher participants discussed the issue of time and concluded that a change in practice or style does not necessarily mean more time is needed; the same time accrued to each lesson is good enough to integrate different teaching styles and improve the quality of classroom interaction. We also agreed that English language and the language of the immediate environment could be intermittently used when students seem not to comprehend or use the adopted English language or get stuck with English words.

6.8.1.6 Actions agreed to change.

At the end of the intervention, the researcher and participants came to a consensus on the following in classroom practices:

- Improve their teaching strategies by increasing students' talk and ideas about lesson topics. Thereafter, build upon them through students' participation.
- Design integrative strategies with their previous classroom practices to accommodate the new knowledge developed in the intervention, which would enhance students' engagement. - Improve complex thinking among students by asking open-ended questions.
- Allow more time for students' responses.
- Keep in touch with other participants.
- Improve on non-verbal cues in consideration of community values.
- Be confident in asking questions about classroom practices from education authorities and school management.

6.8.1.7 The intervention evaluation form.

This intervention evaluation form was designed in an attempt to mitigate against demand characteristics (i.e., reduce the pressure on teachers to tell me what they think will please me). The evaluation form ranked from 1- 4 (poor, satisfactory, good, and outstanding).

Ten teacher participants rated this intervention, as five other teachers joined from the host school, and because the form was anonymous, it could not be separated. The intervention evaluation form can be found in Appendix 6D. The items rated are content covered/materials, clarity/audio/videos and integrative with real classroom practice: impact on your level of knowledge, impact on your own teaching, impact on your attitude towards classroom interaction, is the time for the intervention enough? What are your immediate thoughts on how today's training will impact your own planning and teaching? List the actions you want to take forward and general comments, suggestions and others, if any.

Nine teacher participants rated the presentation of the intervention as good (90%) and one as outstanding. Eight teacher participants rated the content and materials as good (80%)

and 2 (20%) as outstanding. The clarity/audio/videos of the intervention were rated by seven (70%) teachers as good and three (30%) of the teacher participants as outstanding. The intervention's impact on teachers' knowledge level was rated by six (60%) as good, and four (40%) teachers rated this as outstanding. Seven teacher participants rated the intervention as integrative, with actual classroom practice as good (70%) and three (30%) as outstanding. The intervention's impact on the teachers' classroom practice was rated good by nine (90%) and by one (10%) as outstanding by the teacher participants. The intervention's impact on the teachers' attitude toward classroom interaction was rated good by six (60%) and by four (40%) as outstanding by the teacher participants. The time for the intervention and reflection was rated satisfactory by nine (90%) and one (10%) as good by the teacher participants.

In the section for comments and suggestions, the teacher participants' other comments and suggestions varied from the continuity of the training and request for other teachers outside the population to benefit.

6.8.1.8 Researcher's reflection as the sole conductor of the research.

The study was limited by the fact that the researcher solely conducted the interviews, pre-intervention, intervention, and post-intervention exercises. The researcher, therefore, reflected on action research elements of the study that was underpinned by shared aims and objectives to understand our classroom cultures/practices and adapt our practices to the need of students in the context of society. Hence, rather than being an instructor or dominating the conversation, the researcher facilitated and mentored the intervention by joint reflective, collaborative, and participatory methods to collectively make decisions to implement changes in classroom practice.

The realistic, practical, and reflective views and decisions from the intervention and reflective practices were from the participants. The teacher participants basically owned and led the intervention process. The researcher employed mixed data collection methods to holistically understand the process of data collection, analysis, and interpretation to increase the credibility of the process. The researcher was able to triangulate data from multiple sources and designs to capture complex situations in real-life situations. These may not adequately address the above limitation, but this study could be a step in enlarging the concept of the new knowledge, attitude, and practice about our classroom practices. The study's extension could include various other participants and more samples.

6.8.2 The second phase: The post-intervention data collection.

There were speculations of an industrial strike due to teachers' unpaid salaries for six months, so the supervisor agreed that the researcher should commence the post-intervention data collection earlier than planned. The post-intervention data collection was carried out between the 29th of January and the 28th of February, 2018. The aim was to explore the impact of the intervention on teachers' classroom interaction patterns in Ekiti State of Nigeria.

The follow-up interview schedule for teachers (FIST) consisting of 11 follow-up questions developed from Harland and Kinder's theoretical framework (1997) was used to document and reflect on how far and how well about implementing the changes we agreed on (see Appendix 3), the limiting factors making the changes difficult to implement, and if necessary, plan again. The teachers were ready to work but found it difficult to be regular at work for a lack of transport fare; the researcher tried to resolve this by sparing some money for their transportation. A lot of time was wasted trying to lobby through telephone and tracking so the teachers could be available for the lessons. One of the teachers was heavily pregnant, so I spent extra time following her up in order to record her lessons.

6.8.2.1 Follow-up teacher interview.

The teachers' interview was carried out to discover how far and how well the teachers were able to use the interaction patterns learnt during the training; if they found the interaction patterns useful, and what aspect of the lessons they found more or less useful. Each of the teachers chose the venue to be used for the interview video recordings. A video camera was used for the recording. The recording started when the teachers were set and stopped when the interview ended. Overall, five teacher interviews were conducted. There were no time restrictions to the interviews, so each took an average of 25 minutes, with only one over 30 minutes. Evidence from the teachers' responses showed that they responded to all the questions in the FIST.

6.8.2.2 The classroom observation.

The researcher sat at the corner of each class, taking field notes. The recorder started the recordings as soon as the teachers started the lessons. The recorder adjusted the video camera's position according to the direction of the activities and away from the noise outside the classrooms. The recorder stopped recording as soon as each teacher ended the lesson. Three

classroom observations were recorded, three each for three of the teachers, totalling nine, and two observations each from two of the teachers. The heavily pregnant teacher went into delivery on the last day of the data collection.

The second teacher, who was a familiar junior colleague of the researcher, kept postponing the recording for no apparent reason. Her first lesson was recorded, but she continued postponing the remaining two lessons yet to be recorded. The researcher perceived that her presence might be responsible, so we both agreed that only the video recording assistant would be present. The researcher stayed outside during her second lesson recording. Overall, a total of 13 basic science classroom lessons were observed and recorded.

The researcher used the BIAC schedule and took notes in a diary to input the activities as occurred in the pre-intervention lesson observations. The video recordings were later transcribed per second and reconciled with the categories and coding on the schedule and personal notes taken. The challenges of the second phase were more intense due to the financial status of the teachers; their salaries were not paid for months; hence they were not punctual and regular at work. The researcher had to bear the cost of making more calls and sometimes paying the teachers' transport fare to lessons. Some teachers still insisted on extra time in addition to the official 40 minutes allotted to each lesson to enable the students to participate effectively.

6.9 The data analysis process.

This section discusses the process and framework adopted for data analysis and outlines the rationale for their uses. The flow of activities in the current study's data analysis process adopted Miles and Huberman's interactive model for the thematic analysis process (Figure 5.4). Three simultaneous activities are identified at every stage of the analysis.

According to Miles and Huberman (1994), a data reduction stage is a form of analysis that sorts, focuses, sharpens, discards, and organises the data to allow the final conclusions to be drawn and analysed. Miles and Huberman suggest reducing and transforming data can be done through selection, summary or paraphrasing and subsumed in larger patterns. Data reduction is in three phases: 1) Transcribing, drawing a table, reading, and hunting for themes and patterns. 2) Identifying participants' accurate excerpts that are related to the research objectives. 3) Coding and identifying themes, then validating and building reliability in the themes. Data display is the second main step, and it complements the data reduction process

and is the organised, compressed assembly of information that allows actions and conclusions to be drawn (Miles and Huberman, 1994). It makes the data more practicable (Alhojailan, 2012). Data display organises data and helps in thought and concept arrangement (Miles and Huberman, 1994). This includes visual format in the form of figures (graphs, charts, maps, drawings, and photographs), tables and graphic format. The third step is the process that summarises, interprets, and discusses the findings; drawing conclusions and verification based on the literature reviewed.

Qualitative and quantitative data analysis was employed to transform the data into findings. The qualitative data best describes and illustrates the data from the interview and gives an in-depth description of data about interactions from classroom lessons. Miles and Huberman (1994) state that qualitative data focus more on naturally occurring events that occur in natural settings to have a clear insight into actual or real life. Qualitative data transforms data into findings. There is no fixed method for the transformation. The final findings of qualitative data depend on the competence of the guidance and direction laid down in the analysis method. The interpretive also varies as creative approaches can be used. The qualitative data analysis in the current study is based on interpretive philosophy, which answers ‘what’, ‘how’, ‘why’, and the meanings of some symbolic contents of the data.

6.9.1 Transcription of the data.

The researcher considered some methods of transcribing the data; some software applications for transcription were tried out and found that the transcribed texts were different from the meanings of the recordings due to misunderstanding and misinterpretation of Nigerian English accents. The researcher concluded by watching, listening, and manually text-typing the data word for word. This took a lot of time.

6.9.1.1 Transcribing the teacher interview.

Five pre-intervention teacher interviews and five follow-up teacher interviews were transcribed word for word; this took a lot of time as videos were watched repeatedly for effective transcription. Each of the teacher interviews was an average of 20 minutes of video recording. The pre-intervention interviews were transcribed according to each interview question related to the classroom interaction patterns (see an excerpt of the transcript in Appendix 8A). The transcript of the follow-up interview was based on the six themes (see Appendix 7 for the themes) adopted from the thematic framework of Harland and Kinder’s CPD outcomes. The

post-intervention transcript (see an excerpted sample in Appendix 8B) was further organised with the aid of Nvivo (see an excerpted sample in Appendix 9B).

The transcribed interview was given to a person well versed in Yoruba and English language, and most importantly, understands the values and culture of the Ekiti State for verification of the correct interpretation of some verbal cultural messages. The transcripts were then sent to my supervisor, who suggested a reduction. The data was subject to a lot of trimming; sorting, simplifying, discarding, organising, and transforming the data in order to make interpretation and findings easier. The researcher regularly read the transcripts and reflected on the data; summarising where necessary and trying out themes to extract key messages. I read the transcripts many times and carefully ensured messages were not lost while reducing the transcripts.

6.9.1.2. Noding by Nvivo.

Braun and Clark (2006) developed an approach that involves categorisation and coding data into themes. This formed the basis for noting patterns, coding, and categorising the interview data collected in the current study. The thematic approach enabled the processed data, themes, and categories to be placed side by side, displayed, classified, and compared (Miles and Huberman, 1994). This provides associations between the issues and variables to arrive at logical evidence (Braun and Clark, 2006; Miles and Huberman, 1994).

The pre-intervention teacher interviews were structurally coded according to the sub-research question (Namey, Guest, Thairu and Johnson, 2008). The codes were inputted as nodes into Nvivo Software which helped in the final organisation and archiving of the data for easy access. This resulted in sorting the responses into 16 nodes, files (total number of respondents) and references, cases, and classifications. Each of the respondents' (files or cases) responses were read and scrutinised in the transcript, and all related responses were matched and dropped in related nodes. All the responses for each node were stored as references under individual files. This organised approach allowed the researcher to identify more patterns and generate some sub-nodes from the responses (see excerpted sample in Appendix 9A). The post-intervention interviews were also inputted into the Nvivo software under the matched themes adapted from Harland and Kinder (see excerpted sample in Appendix 9B).

6.9.1.3 Coding the focus group interview for Students.

Three data were gathered from each group of students in each school using the Miles and Huberman (1994) data reduction framework. A keen examination of the three data was carried out, with the help of two PhD colleagues who also checked the trends of the ranking. We found out that similarities occur in each school's ranking to reduce the data; therefore, one diamond ranking was picked for each school. With the cooperation and expertise of a Mathematics expert from the Maths skills centre of the University of York, the researcher assigned categories to the diamond ring grids (highest to lowest) and codes to the ten statements (see Appendix 10 for a coded sample).

6.9.1.4 Transcription of basic science lesson video recordings.

The total number of video recordings from the pre-intervention is 15, and post-intervention, 13. After carefully watching, listening and transcribing all the videos; the researcher, assisted by two other colleagues, found that the three videos recorded for each teacher bore the same patterns of behaviours and decided to choose one video transcript out of the three [as described by MacQueen and Milstein (1999)] to be graphically analysed and statistically for each teacher. A total of 10 lesson transcripts were chosen; five for pre-intervention observation and five for post-intervention observation. The basis for recording three lessons for each teacher is to obtain certainty in the consistency of patterns in each teacher's classroom behaviour. According to MacQueen and Milstein (1999), framing the analysis by limiting the analysis to one or two sources of data or the categories of participants' data reduction is a necessary decision that is clearly defined in the analysis objective, accompanied by an analysis plan. This form of triangulation during data analysis can be specifically helpful when dealing with massive data sets.

The researcher transcribed the videos using the basic science observation schedule, BIAC, adopted from Flanders Interaction Analysis Category (see Appendix 5). Some adjustments were made by adding some specific patterns as sub-categories under the same category. The researcher watched and listened to the videos and recorded every verbal and non-verbal activity that occurred every second (timeline analysis). A total of 28 videos of basic science classroom lessons, with each recorded for 40 minutes, were transcribed. 1 pre-intervention recording and 1 post-intervention recording were chosen for each teacher, making a total of 10 transcripts; 5 for pre-intervention recording and 5 for post-intervention were

further analysed graphically and statistically. The verbal responses were produced more automatically than the non-verbal, making it easier, so the possibility of conflicting messages was minimal. Recording every activity in seconds was possible by watching, listening, and transcribing against the use of a stopwatch, where the researcher could lose important events while trying to struggling with a stopwatch and catching up with classroom activities.

To ensure that patterns of interactions were correctly categorised, the transcripts and videos were cross-checked by two PhD colleagues from Nigeria who understand the cultural environment; value of tone, non-verbal messages, and implicit verbal messages that are predominant in the State. Thereafter, the transcripts were presented to my supervisor for discussion and comments (see Appendix 11 for an excerpt from the transcript). Using Microsoft Word, each category was extracted by highlighting and expunging all other categories from the original transcript, which left the researcher with the expected category. Invariably, this method gave the researcher the different separate transcripts for each category (see Appendix 12 for an excerpt of the separated transcript). This was done for each lesson. Using Microsoft Excel, the frequency and time for each category were also obtained.

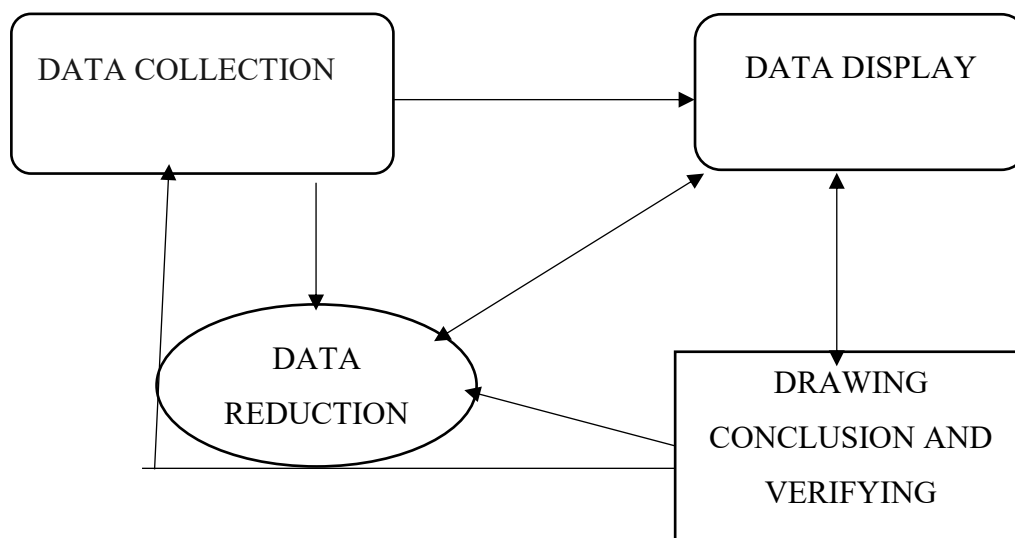


FIGURE 6.4: COMPONENTS OF THE INTERACTIVE MODEL OF THE DATA ANALYSIS

(Copied from Miles and Huberman 1994, p.12)

6.9.2 Data display stage.

The qualitative aspect of the observation data was displayed in categories on the BIAC. During transcription, the precise categories in the lessons were also placed, merged, and matched with the categories in BIAC while watching and listening to the videos. The data was further

reduced, as shown in Appendix 12. Each category was transformed into numbers, mean, percentages, and frequency and finally displayed in cluster column charts and pie charts on Microsoft Excel Software.

In the pre-interview data, the references generated by precise categories previously effectively coded and linked to the data in Nvivo were compared with discourse analysis and contrasted extensively with the qualitative data displayed in the categories coded in the BIAC and those quantitatively obtained from the BIAC. The students' focus group interviews were displayed in a table of means using Microsoft Excel. In the post-intervention data, the precise, effective themes identified and adopted through the reduction and coding process were displayed in the figure, and an extensive discourse analysis approach was employed to compare and contrast the data with those displayed in charts and lessons' categories coded. Statistical analysis of the quantitative data in Chapter 8 was done through various consultations and trials. Finally, Wilcoxon and Chi-square statistical analysis were employed to find associations between the variables.

6.9.2.1 The procedure for the statistical analysis, input, and output.

The Wilcoxon sign rank was employed as a paired difference test when the difference between the average of the two samples can neither be assumed nor considered a normal distribution. It was used to understand whether there was a difference in teachers' and students' patterns of interaction before and after intervention (two related groups or two sets of scores from the same participants) while the independent variable is the intervention. The Wilcoxon sign rank was employed based on the assumption that the dependent variables are measured at a continuous level of interval and ratio variables, and the independent variables consist of the same subjects in a related group. The distribution of the differences between the two related groups was symmetrical in shape.

(1) The teachers talk as a percentage of the total talk time (data input).

The transcripts provided the frequency and time intervals between the different patterns of interaction and were obtained in percentages of the total talk and total lesson times. Now the teachers' mean talk time as a percentage of the total talk time before and after (TTPTTB and TTPTTA) was inserted into the Wilcoxon software with the assumption that there is no difference in the median between ranked pre-intervention and post-intervention variables (No

difference between the median of ranked TTPTTB and ranked TTPTTA) or (ranked TTPTTB = ranked TTPTTA).

The description of the data output of the Wilcoxon test in subsection 7.8.1 (data output) is described below:

To test if there was no difference between the median of sum ranked TTPTTB and sum ranked TTPTTA) or (sum ranked TTPTTB = sum ranked TTPTTA), calculated as Negative ranked and Positive ranked from the above. We now calculate if (the sum of the ranked actual calculated value and the sum of the ranked expected values are equal. The standard deviation (SD) was calculated, and the Z value, which was the sum of the ranked actual calculated minus the sum of the ranked expected divided by the SD.

At 95% confidence and 0.05 statistical significance, the statistics for the Wilcoxon test showed that p-value 2(tailed) $0.0431 < 0.05$. The p-value is lower than 0.05, meaning that the intervention had a statistically significant effect on teachers' talk time as a percentage of the total talk time.

(2) For the students' talk as a percentage of the total talk time.

The students' mean talk time as a percentage of the total talk time before and after (STPTTB and STPTTA) was inserted into the Wilcoxon software with the assumption that there is no difference in the median between the ranked (pre and post) intervention variables (No difference between the median of ranked STPTTB and ranked STPTTA) or (ranked STPTTB = Ranked STPTTA). Statistics for the Wilcoxon test from subsection 7.8.1 showed that at 0.05 statistical significance and 95% confidence, the p-value 2(tailed) $0.0431 < 0.05$. This showed that the intervention had a statistically significant effect on students' talk time as a percentage of the total talk time.

(3) The teachers talk as a percentage of the total lesson time.

The teachers' mean talk time as a percentage of the total lesson time before and after intervention (TTPTLB and TTPTLA) was inserted into the Wilcoxon software with the assumption that there is no difference in the median between ranked pre-intervention and post-intervention variables (No difference between the median of ranked TTPTLB and ranked TTPTLA) or (ranked TTPTLB = Ranked TTPTLA). At 0.05 statistical significance and 95%

confidence, the statistics for the Wilcoxon test showed that $p\text{-value } 2 \text{ (tailed)} 0.0431 < 0.05$, which shows that the intervention had a statistically significant effect on teachers' talk time as a percentage of the total lesson time.

(4) The students talk as a percentage of the total lesson time.

The mean of the students' talk time as the percentage of the total lesson time before and after the intervention (STPTLB and STPTLA) was inputted into the Stata 16 with the assumption that the students' pre-intervention talk is equal to students' post-intervention talk. Statistics for the Wilcoxon test at 0.05 statistical significance and 95% confidence showed that $p\text{-value } 2\text{(tailed)} 0.0431 < 0.05$. Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on students' talk time as a percentage of the total lesson time.

(5) The teachers' direct talk time as the percentage of the total teachers' talk time.

The mean of the teachers' direct talk as a percentage of the teachers' talk before and after intervention (TPDTB and TPDTA) was inserted into the Wilcoxon software with the assumption that there is no difference in the median between ranked pre-intervention and post-intervention variables. The assumption is that the teachers' pre-intervention direct talk is equal to teachers' post-intervention direct talk. $TPDTB = TPDTA$. At 0.05 statistical significance and 95% confidence, the Wilcoxon test showed $p\text{-value } 2\text{(tailed)} = 0.0431 < 0.05$. Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on teachers' direct talk time.

(6) The teachers' indirect talk time as the percentage of the teachers' total talk time.

The mean of the teachers' indirect talk as a percentage of the teachers' talk before and after intervention (TPITB and TPITA) was inserted into the Wilcoxon software with the assumption that there is no difference in the median between ranked pre-intervention and post-intervention variables or that the teachers' pre-intervention indirect talk is equal to teachers' post-intervention direct talk. $TPITB = TPITA$. Statistics for the Wilcoxon test showed that, at 0.05 statistical significance and 95% confidence, the difference between the population median and the hypothesised median is statistically significant, $p\text{-value } 0.0431 < 0.05$). Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on teachers' indirect talk time.

(7) Wait time.

The mean of the teachers' wait time as percentages of total lesson time before and after the intervention was inserted into the Stata 16, assuming no difference in the median between ranked pre-intervention and post-intervention variables or the assumption that the teachers' pre-intervention wait time is equal to teachers' post-intervention wait time. $WTPB=WTPA$. Wilcoxon test at 0.05 statistical significance, the p-value is greater than the significance level, so we fail to reject the null hypothesis. We do not have enough evidence to conclude that the population median is significantly different from the hypothesised median, p-value $0.7855>0.05$). Wilcoxon signed-rank test showed that the intervention did not elicit a statistically significant change in the wait time.

(8) The percentage of the students' nonverbal cue time.

The mean of the students' nonverbal cue time in percentages before and after the intervention were inputted into Stata 16, assuming no difference in the median between ranked pre-intervention and post-intervention variables or the assumption that the students' pre-intervention non-verbal cue time equals to students' post-intervention non-verbal cue time ($SPCB$ and $SPCA$) = zero. At 0.05 statistical significance, the p-value is greater than the significance level, so we fail to reject the null hypothesis. We do not have enough evidence to conclude that the population median is significantly different from the hypothesised median, p-value $0.1380>0.05$). Wilcoxon signed-rank test showed that the intervention did not elicit a statistically significant change in the students' nonverbal cue time.

(9) The teachers' non-verbal cues in percentage.

The teachers' non-verbal cues in percentages before and after the intervention were inputted into Stata 16 with the assumption that no difference in the median between ranked pre-intervention and post-intervention variables or the assumption that the teachers' pre-intervention non-verbal cue time equals teachers' post-intervention non-verbal cue time ($TPCB$ and $TPCA$) = zero. At 0.05 statistical significance, the p-value is greater than the significance level, so we fail to reject the null hypothesis. We do not have enough evidence to conclude that the population median is significantly different from the hypothesised median, p-value $0.0797>0.05$). Wilcoxon signed-rank test showed that the intervention did not elicit a statistically significant change in the teachers' nonverbal cue time. The procedure, process and data input and output into the chi-square analysis table are detailed in section 7.8.2.

(10) The teachers' types of questions.

The chi-square contingency table of the five teachers in Table 7.8.7 at 0.05 level of significance showed that for five teachers, the frequency of the teachers' pseudo questions and closed-ended questions reduced while the frequency of opened-ended questions increased.

6.9.2.2 The weight and purpose of the statistical analysis.

The above statistical analysis provided only a little evidence for generalisation but provided a basis for hypotheses in relation to similar situations. This is especially in the case of 5 cases studied. A larger sample with multiple cases will facilitate replication of the results, provide more insight into the above relationships, and help improve the validity of the statistical analysis. The use of theories was employed in the designed stage to improve the external validity. The purpose is to make an analytical proposition and expand the proposition but not to make a statistical generalisation to a population. The case study enabled an enhanced understanding of issues surrounding teachers' classroom practices in an African-Yoruba context. The analytic components of the current study detailed the underlying situations, while the statistical analysis supports understanding the situations.

6.9.3 Summaries, interpretations, discussions of findings and drawing conclusions.

Conclusions were induced, and finally, the triangulation of the findings from qualitative and quantitative data displayed in the teachers' / students' interviews and the classroom observations in chapters 6 and 7 based on evidence verified from reviewed literature, a deductive approach was employed to make decisions. The process of data analysis comprised an interactive and collaborative process of reflection, references to personal notes, and consultation with colleagues and experts for clarifications and verifications to ensure the validity and production of reasonable quality results. Final conclusions, interpretation and verification were made when data collection, data reduction, and data display were complete.

6.9.4 Summaries of the stages.

Stage 1 is the data collection stage involving the sub-categorisation data reduction process, which involves coding and transcription of interviews. Transcripts of the lessons were obtained by watching and listening, coding, and categorising the observation transcripts using BIAC, which helps to categorise the various activities. The coded interviews were entered into Nvivo

under Nodes which reduced the cumbersome interviews into organised folders in a safe Nvivo software.

Stage 2 infers the stage for further reduction, display, and analysis of the interviews and lessons using themes, codes, column charts, pie charts, and tables with percentages, mean, and frequency.

Stage 3 summarises, interprets, and discusses the findings based on the literature reviewed.

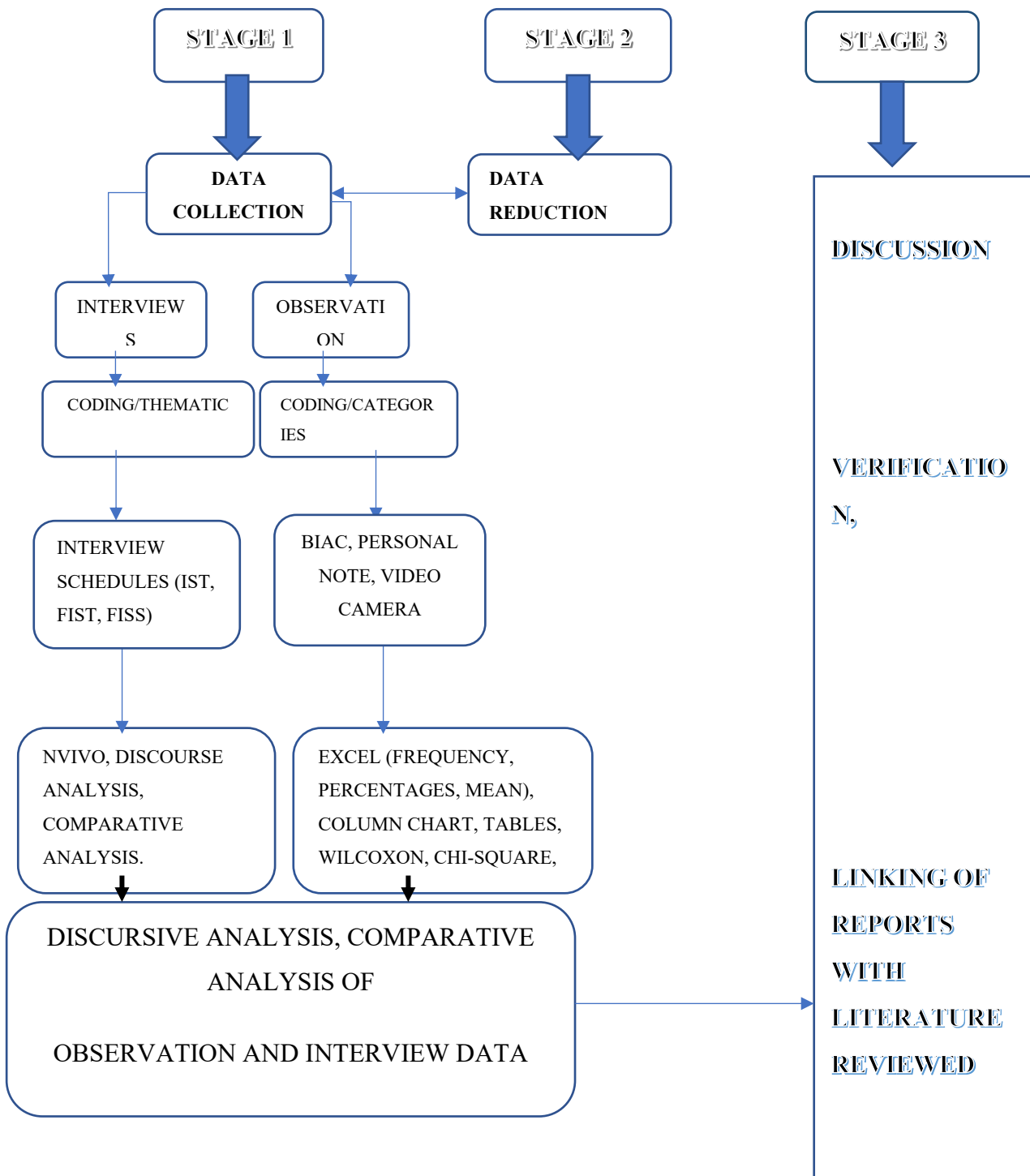


FIGURE 6.5: CONCEPTUAL FRAMEWORK FOR DATA ANALYSIS

6.10 Data management and storage.

This section explains data management and the measures taken to ensure the data is well-managed and properly stored for effective analysis. Data management is a plan for synthesising, categorising, and storing to make the data efficiently retrievable and duplicable (Lin, 2009). Easy data storage, access, and management are essential for effective data analysis. Data management is vital in both quantitative and qualitative studies as it guarantees the truthfulness of the data and safeguards the participant (Lin, 2009). The vast amount of data gathered during research through proper data management can be stored in many forms, for instance, hard copies, computer files or location, while maintaining its security. Data can be transformed into retrievable forms to prevent loss or degradation (Lin, 2009).

The data in this study were stored electronically in a password computer; in files, folders, and zips and manually in fieldnotes. These were regularly checked for miscoding, mislabelled, mismatched, and then retrieved for corrections. The video-recorded interviews and lessons were copied on the computer as soon as completed to ensure that there were backups. The field notes served as references for verification and confirmation of information. Each transcript of the pre-intervention and post-intervention was correctly assigned codes and labels to ensure they were not missed. The precise themes, codes, and nodes in the interviews were stored in Nvivo software.

6.11 Reliability and validity of the study.

This section details the steps taken to ensure the reliability and validity of the tools for data collection and results generated in the current study. The reliability and validity of the mixed-method approach of the qualitative and quantitative aspects of the study were considered. In quantitative research, reliability implies the consistency of specific measurements, and validity refers to whether the measurement “measures what they are to measure”. At the same time, reliability in qualitative research is being careful, honest, and thorough throughout the research (Rose and Johnson, 2020; Cohen et al., 2007). The reliability and validity of the qualitative (interview schedule for teachers, follow-up interview schedule for teachers, and focus group interview schedule for students) and quantitative (basic science analysis category system) data tools are presented below in this section.

6.11.1 Reliability and Validity of the basic science analysis category (BIAC.)

The BIAC was adopted from FIAC, developed by Ned Flander (1970) is a standardised ten-categorised instrument whose reliability has been ascertained. In the case of the validity, however, in order to measure what it is supposed to measure, the non-verbal aspect that was not taken into account by FIAC was directly inputted into the BIAC as it occurred during the transcription of the recorded videos. Inputting the activities each second seemed unattainable during the pilot study, so to ensure the data validity, the activities were precisely inputted into the instrument every second during transcription. These were later matched and merged when compared with the hard copy of the BIAC filled in during lesson observation.

For the research to be reliable and produce similar results under the same condition, a pilot test was conducted. Three lessons were recorded for each teacher with the assistance of two colleagues and my supervisor, who watched the videos and saw the consistency in the patterns of the transcripts. The triangulation approach of cross-checking the process of data recording was employed by describing classroom interaction patterns in the transcripts and transforming them into numbers to heighten reliability and validity. In order to ensure the validity of transcripts, two colleagues and an expert ensured that interpretations of actions and activities were correctly, adequately, and appropriately categorised.

6.11.2 Reliability and Validity of the qualitative tools.

Validity is essential for effective research, and if research is not valid, then it is worthless (Cohen et al., 2007), considering that the subjectivity of participants' opinions could contribute to some degree of bias. Hence validity is important in qualitative research. The concurrent methodological and theoretical triangulation approach helps enhance the current study's validity and reliability. The information collected with the focus group interview schedule for students was cross-checked with information from the interview schedule for teachers. The data collected using the basic science analysis category was also used to cross-check those of the IST and FISS. This allowed converging conclusions to be made from the various data findings and prevented respondents' bias.

In the post-observation, the data from the BIAC was used to verify the information collected using the follow-up interview to ensure validity.

Theoretical triangulation also helps heighten the validity of the current study; comparing the key principles of different related studies, drawing from these a theoretical framework for the study, and employing different theories for the analysis also ensures the study's credibility.

6.11.3 A long period of observation.

This study took place over a period of 10 weeks; the pre-intervention took five weeks, and the post-intervention took six weeks to ensure the credibility of the research, as supported by (Lietz and Zayas, 2010; Lincoln and Guba, 1985). This increased the trust and familiarity between the researcher and the participants, coupled with the fact that the researcher comes from the community. In the post-intervention study, the researcher noticed a reactivity behaviour (a teacher was avoiding recording her lesson) from a certain teacher who happened to be a former student of the researcher, so the researcher informed her that only the camera recorder would be present. The teacher agreed to this, and the lesson was recorded, but the researcher was only able to record two lessons from the class. This was the only class that seemed to react negatively to the researchers' presence. Throughout the recording, the researcher did not contribute to any of the lessons or make her presence obvious. The researcher avoided being biased by presenting the data's honest findings as obtained, even when some findings seemed to be against the assumptions of the study's design.

6.11.4 Participant involvement or collaboration.

The details of the research tools were described and presented to the participants from the beginning of the project for comments and to increase their interest, cooperation, and collaboration. The teachers' request to select student participants for the project was granted, and students were allowed to choose their pairs during their activities to ensure a sense of trust/ownership and elicit full cooperation. The themes and codes were presented in detail to the teachers. The recorded video through camera recordings made the videos available to the teachers, as some collected copies of their recorded lessons. Some clips were watched and listened to by the teachers. The researcher was constantly in touch with the teachers and the principals during data collection and analysis, confirming some interpretations of the themes during the analysis.

6.11.5 Peer input through cross-examination.

Details of the research questions and the full description of all the tools used to collect the data were presented to peers, which helped to verify the consistency of the themes, coding, and dependability of the findings. The in-depth explanation of the process of analysis, terminologies and concepts was detailed for their input and critics. The recorded classroom lessons were watched by two peers who helped in verifying the consistency of the coding and categories to ensure the correct activity was assigned the right category. A PhD colleague assisted in examining the themes in Harland and Kinder that met the intervention's objectives and looked for related patterns, then merged them with the follow-up interview responses and checked for related codes. The themes they identified agreed with 90% of those coded by the researcher.

6.12 Summary of the Chapter.

This chapter justified the adoption of a mixed-methods case-study design and developmental research with elements of action research design. The chapter explained the data collection and analysis approaches, the positivism, the interpretivism, action research or transformative or reflective paradigm employed. The chapter explained the sample structure and context and the research instruments. The chapter also explained the procedures and implications of the pilot study and methods of data collection and analysis. This chapter outlined my positionality and reflexivity and their influences on the research process.

The chapter presented the highlights of the statistical analysis, details of the procedures and manipulation, and a description of the data input and output in Stata 16. This chapter explained the procedure for the manipulation of the results and the limitations of how much weight can be placed on the small sample of five cases explored, and the approach and inherent limitation of the 1-day intervention. The chapter explained the efforts made by the researcher to avoid being biased throughout the study. Details of the ethical issues involved trustworthiness, reliability and validity of the study were also discussed.

Chapter Seven: The Baseline (Pre-intervention) and Post-Intervention Results and the Effects of the Intervention on The Patterns of Classroom Interaction in Basic Science Lessons.

7.0 Introduction

After conducting the five teachers' interviews, to triangulate the interviews, the researcher considered it relevant to observe the five teachers' lessons to confirm the veracity of the teachers' statements. This chapter aims to present the reports of baseline assessment and the post-intervention results and changes in the classroom interaction patterns after the awareness intervention.

This chapter presents the results of data obtained under research question one (RQ1 and RQ2). (RQ1: What are the different classroom interaction patterns currently used in basic science classrooms in junior secondary schools in Ekiti State, Nigeria?) and (RQ2: what are the effects of the intervention on teachers' interaction patterns in basic science classrooms?). In answering the research question (RQ1), the results reported were presented according to the data collected from these sources: five lessons' observations, responses from five teachers' interviews, and five students' focus group interviews. In RQ2, the results obtained from the post-intervention classroom observations from the same data source will be presented. The changes will then be obtained by comparing results obtained from the pre-intervention observation data in Chapter 6 and the post-intervention observation data.

The reports of the results presented in this chapter are from the data obtained before and after the researcher had an intervention with the basic science teachers. These are presented in the following outline. Section 7.1 presents the illustration in Image A (seating arrangement before intervention) and Image B (seating arrangement after intervention), a sketch of the sample of all the classroom seatings and the changes in the classroom seating positions and describes the characteristics of the observed five pre and five post-intervention lessons. In section 7.2, the pre-and post-intervention results of the lessons' talk time in minutes are presented concerning the following: the total lesson time, the total talk time, teachers' and students' talk time as percentages of total talk time, and total lesson time.

Section 7.3 presents the pre-and post-intervention results of the teachers' direct and indirect talk, the teachers' direct and indirect talk as percentages of the total talk time and total

lesson time in minutes. Section 7.4 presents the teachers' and students' non-verbal cues (minutes) before and after the intervention. Section 7.5 presents the frequency and time spent in minutes on teachers' pseudo, open-ended, and close-ended questions before and after the intervention. Section 7.6 will present the proportion of the lessons' silence (wait time) in minutes in pre-and post-intervention. In section 7.7, the responses from the five students' focus group interviews will be presented, and in section 7.8, the results of post-intervention teachers' interviews will be presented. In section 7.9, the statistical analysis of the results is presented.

Subsection 7.2.2 presents tables of the extract from the transcripts of classroom discourse patterns (Table 7.2.2.1 (Extract from the transcript from pre-intervention discourse pattern) and Table 7.2.2.2 (Extract from the transcript from post-intervention discourse pattern)). Sections 7.2.1, 7.3.1, section 7.4.1, section 7.5.1 and section 7.6.1 present the changes in the pre and post-intervention observation data of teachers' and students' talks, the changes in the teachers' pre and post-intervention direct and indirect talk, the changes in the nonverbal cues between pre and post-intervention will be presented, the changes in pre- and post-intervention question time and frequency of question forms and the changes between the pre and post-intervention wait time. Section 7.2.3, section 7.3.2, section 7.4.2, section 7.5.2, and Section 7.6.2 compare the pre and post of the teachers' interview responses, the lessons' observations, and transcripts of discourse analysis results about classroom talk, teachers' direct and indirect talk, lessons' non-verbal cues, different types of question and wait time.

Each of the above sections will address the main question from the perspectives of the following sub-questions:

(1). What are:

a. What are verbal interaction patterns used before and after the intervention by teachers in basic science lessons?

b. What are direct and indirect verbal interaction patterns used before and after the intervention by teachers in basic science lessons?

(2). What are verbal interaction patterns used before and after the intervention by students in basic science lessons?

- (3). What are non-verbal interaction patterns before and after the intervention used by teachers in basic science lessons?
- (4). What are non-verbal interaction patterns before and after the intervention used by students in basic science lessons?
- (5). What are the frequency and time teachers before and after the intervention spend on types of questions in basic science lessons?
- (6). What are teachers' and students' silence (wait time) used before and after the intervention in basic science lessons?

As discussed in detail in the methodology chapter, the researcher transcribed three lessons every second for each teacher. One lesson was selected by simple random sampling and analysed for each teacher. The five teachers' interviews were transcribed in their original form to preserve their authenticity. NVivo was employed to classify, sort, and arrange the statements into related nodes linked with the themes. They were analysed by linking or matching the teachers' responses with the themes in the model.

TABLE 7.1 DESCRIPTION OF THE LESSONS OBSERVED.

Teacher ID	PRE			POST		
	Topic	No of Students	Teaching and learning materials	Topic	No of Students	Teaching and learning materials
AD	Living things	50	Chalkboard	Growth and development	52	Chalkboard
EK	Family Health	55	Chalkboard	Disease vectors	55	Chalkboard
IR	Family Health	50	Chalkboard	Growth and development	55	Chalkboard
OL	Family Health	55	Chalkboard	Growth and development	56	Chalkboard
AW	Family Health Sanitation	60	Chalkboard	Energy	60	Chalkboard

7.1 Description of the images of seating arrangements, including the characteristics of the pre-and post-observation lessons.

The Image (Image A) below shows all the students facing the teacher and the chalkboard. The desks and chairs are arranged in neat rows with little spaces as passages between them. The lesson note, which guides the instruction and curricula, is placed on the desk in front of the teacher. All the students focus on the teacher, who explains the contents of the topic to the students. In Image B above, the students tried rearranging the desks and chairs to fit into small group discussions. This is to allow students' convenient engagement in the collaborative co-construction of ideas with equal opportunity to talk and think together. The image in B is clearer in Table 7.2.2.2 of the transcript of the post-intervention discourse analysis with students Turns S-26, 28, 30, 33, 35, 45 and 60, showing where students came together to engage in active and participatory group discussions and shared ideas within and between groups.

Table 7.1 shows the lessons' characteristics; four teachers taught the same topic in the pre-intervention lessons, and three taught the same topics in the post-intervention. The chalkboards are the only teaching and learning materials in all the classrooms. The average number of students in the pre-intervention lessons is 54, and the average in the post-intervention lesson is 56.

Image A: Sketch of the classroom settings before the intervention.



Image B: A sketch of the classroom seating after the intervention.



7.1.2 Changes observed in seating positions from the Images.

Compared to the sketch in Image A above, Image B includes re-arranged seating positions to fit the small-group peer discussion, where students engage in collaborative co-construction of ideas with equal opportunity to talk and think together, share ideas and opinions, and help one another. Some students can be seen moving between and within groups to gather opinions about the task. Their responses are chained together as they react to each other's ideas. The teacher walks around the groups, facilitating, mentoring, and encouraging students' individual talk, asking questions, and providing clues where necessary. This is evident in the differences between the transcripts of pre and post-intervention classroom intervention discourse patterns in Table 7.2.2.1, where T (Teacher) takes Turns (T-20, 21, 23, 25, 27, 29) in front of the class and Table 7.2.2.2, the teacher divided the students into groups, moving around the classroom in Turns T- 9,15 and 17 and encouraging teamwork in Turn 27 and students discussion took place in (Turns S-26, 28 and 30).

7.2 The teachers and students talk (minutes) in basic science lessons before and after the intervention.

The results will be discussed under the following steps in order to answer the sub-research questions 1 (a) and (2), what are verbal interaction patterns used before and after the intervention by teachers and students in basic science lessons?

- Identify the total lesson time.
- Identify the total talk time.
- Determine the proportion of the lesson occupied by the teacher's talk.
- Calculate the proportion of the lesson occupied by students' talk.
- Identify the proportion of the total talk time that is occupied by the teacher's talk.
- Identify the proportion of the total talk time that is occupied by the students' talk.
- Compare the statements from the five teachers' pre- and post-interview responses and the intervention observation data results.

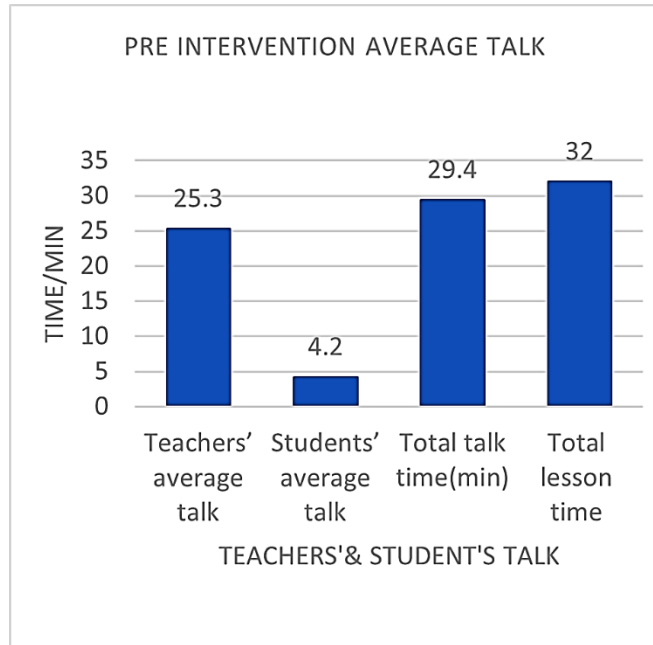
TABLE 7.2A: THE PROPORTION OF LESSONS OCCUPIED BY THE TEACHERS' AND STUDENTS' TALK IN BASIC SCIENCE BEFORE THE INTERVENTION. (MINUTES).

Teacher ID code	Total teachers' talk(min)	Total students' talk(min)	Total lesson talk time(min)	Total lesson time(min)	Total teachers' talk (% of total talk) (min)	Total students' talk (% of total talk) (min)	Total teachers' talk (% of the total lesson) (min)	Total students' talk (% of the total lesson) (min)
AD	25.9	1.6	27.5	31.6	94.2	5.8	82.0	5.1
OL	27.2	5.0	32.2	34.7	84.5	15.5	78.1	14.4
EK	32.8	6.1	39.0	40.3	84.0	15.6	81.4	15.1
IR	21.2	5.5	26.7	30.2	74.4	20.6	70.2	18.2
AW	19.2	2.6	21.8	23.4	88.1	11.9	82.1	11.1
AVERAGE	25.3	4.2	29.4	32.0	85.0	13.9	78.8	12.8

TABLE 7.2B: THE PROPORTION OF TOTAL LESSON TIME AND TOTAL TALK OCCUPIED BY STUDENTS AND TEACHERS IN BASIC SCIENCE LESSONS AFTER THE INTERVENTION(MINUTES).

Teacher ID code	Total teacher talk (min)	Total student talk (min)	Total lesson talk time (min)	Total lesson time (min)	Total teacher talk (% of total talk) (min)	Total student talk (% of total talk) (min)	Total teacher talk (% of total lesson time) (min)	Total student talk (% of total lesson time) (min)
AD	28.6	8.7	37.3	40.4	76.7	23.3	70.8	21.5
OL	21.5	4.3	25.8	28.6	83.3	16.7	75.2	15.0
EK	25.3	6.1	31.4	36.8	80.6	19.4	68.8	16.6
IR	22.1	7.7	29.8	33.0	74.2	25.8	67.0	23.3
AW	21.6	11.5	33.1	36.8	65.3	34.7	58.7	31.3
AVERAGE	23.8	7.7	31.5	35.1	76.0	24.0	68.1	21.5

Pre-intervention talk (min).



Post-intervention talk (min)

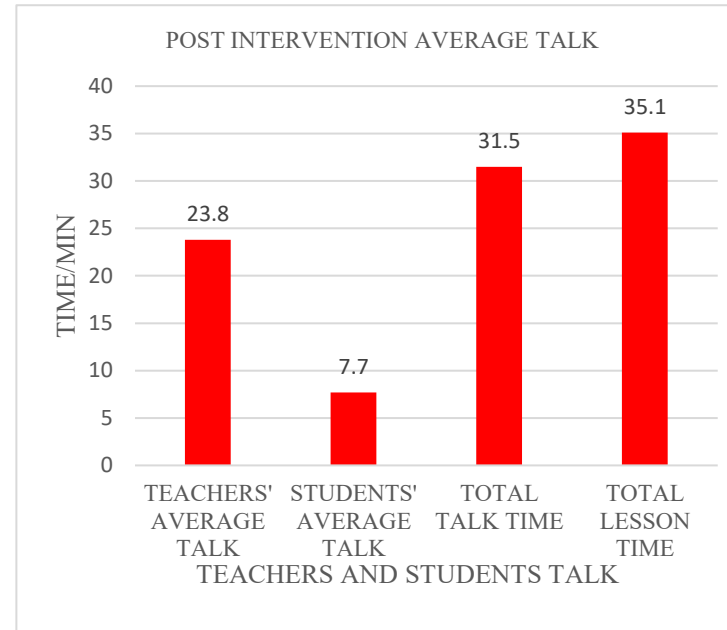


FIGURE 7.2: AVERAGE OF THE LESSONS' TALK IN BASIC SCIENCE LESSONS BEFORE AND AFTER THE INTERVENTION

Tables 7.2a and 7.2b reflect the pre- and post-intervention results of the lessons' talk in minutes concerning the total lesson time, total talk time, the proportion of total lesson time, and total talk time occupied by teachers' and students' talk. Figure 7.2 is the average classroom talk.

In the pre-intervention result, the teacher's talk is 78.8% of the total lesson time and 85% of the total talk time. The student's total talk is 12.8% of the total lessons' time and 13.9% of the total talk time. In the pre-intervention talk, the teachers' talk dominated the lessons by occupying 78.8% of the total lesson and 85% of the total talk time, while the students' talk occupied 12.8% of the lessons' time and 13.9% of the total talk time. Furthermore, about 91.6% of the total lesson time is dominated by talk. The ratio of teachers to students' talk is 6:1, which means the teachers' talk is about six times greater than the students' talk. These findings show that the teachers leave the students with very little time to talk and be active in the classrooms.

The transcripts of the discourse analysis in Table 7.2.2.1 showed the T(teacher's) Turns, T(1, 2, 4, 7, 9, 12, 14, 17, 18, 20, 23, 25, 27, 29), and S(students) takes Turns S-11,16,19,22,24,26,28 and 30. For instance, in Turn 20, the teacher says, "We want to look at the meaning of personal sanitation. How are we going to take good care of our own? We are going to make mention of parts of the body, then how the parts of the body are going to be cleaned," and in Turn 23, "So the number one thing that we want to examine is the meaning of personal... sanitation (stretches the last word designed for students to completes)". The students' turns were majorly repetitive responses to the teacher's pseudo question like S-11,19,22 "ChorusYes", and chorus responses to teachers stretched the last word, for instance, S-16-(Health in chorus), 24, 26, 28- (complete teacher's last word in chorus--personal sanitation).

In the post-intervention results, the teachers' talk dominated the lessons by occupying 68.1% of the total lessons' time and 76% of the total talk time. However, the students' talk occupied only 21.5% of the total lessons' time and 24% of the total talk time. These show that the ratio of teachers' talk to students' talk is 3:1. The transcript of discourse analysis after the intervention showed that the teacher takes Turns (T- 9, 15, 17, 19, 34, 73, 79) and students take Turns, S-26, 28, 30, 33, 35, 45 and 60. For instance, in T-15, where the teacher said, "So, this set is going to be group 1, group 2 and moving around the class to indicate different groups for groups, using hand gestures for demarcation", and turn 27, where the teacher said, "Work together". Students S-33 showed where a student presented for a group.

7.2.1 Changes in the teachers' and students' classroom talk.

The changes in the teachers' and students' talk will be obtained by identifying and comparing the differences between the pre-intervention and post-intervention proportion of the lessons' time and total talk time occupied by teachers and students.

TABLE 7.2.1: THE CHANGES IN THE TEACHERS' AND STUDENTS' TALK AS PERCENTAGES OF THE TOTAL LESSONS TIME AND TOTAL TALK TIME.

Identity	Teachers		Students	
	Post-Pre (Change in teachers' talk as % of total lessons' time) (min)	Post-Pre (Changes in teachers' talk as % of total talk time) (min)	Post-Pre (Change in students' talk as % of total lessons' time) (min)	Post-Pre (Changes in students' talk as % of total talk time) (min)
AD	-11.2	-17.5	16.4	17.5
OL	-2.9	-1.2	0.6	1.2
EK	-12.6	-3.4	1.5	3.8
IR	-3.2	-0.2	5.1	5.2
AW	-23.4	-22.8	20.2	22.8
AVERAGE	-10.7	-9.0	8.8	10.1

As a percentage of overall talk in minutes, the teachers' talk was reduced for all the teachers, and students' talk increased in all the lessons. On average, student talk increased by 8.8%, and teachers' talk reduced by 10.7% when related to overall lesson time. The picture becomes clearer when the talk is related to talk time (rather than lesson time), with teachers' talk dropping by 9% while students' talk increased by 10.1% on average. This general shift from teachers' talk to students' talk can be associated with the intervention.

The extract of the transcript of classroom discourse is in Table 7.2.2.1 below, where T (Teacher) takes Turns (T-20, 21, 23, 25, 27, 29), and S(students) takes Turns (S-22, 24, 26, 28 and 30), where the teacher employed lecture method and students' responses are mainly chorus responses. Whereas, below in Table 7.2.2.2 (Turns S-26, 28, 30, 33,35,45 and 60) where the students engaged in active and participatory group discussion, sharing of ideas within and between groups, and the teacher takes Turns (T- 9, 15, 17, 19, 34, 73, 79 mentoring and probing students for more responses and clarification and encouraging teamwork in Turn 27.

Therefore, from the above findings, it can be inferred that the students were allowed more time to be involved in small group discussions and were more actively engaged in their responses to questions.

TABLE 7.2.2.1 EXTRACT FROM THE TRANSCRIPT OF THE PRE-INTERVENTION CLASSROOM DISCOURSE.

Turn partition	TIME IN SEC	TEACHERS ACTIVITY	STUDENTS ACTIVITY	BASIC SCIENCE OBSERVATION SCHEDULE BIAC.	TYPE OF QUESTION	FIELD NOTE
1	31	verbal		5		Writes on the chalkboard
2	1	verbal		2		Teacher-good morning class
3	1		Verbal	8		Good morning ma
4	1	verbal		2		Teacher- you are welcome back to school
5	5	verbal		5		I want to welcome you back to secondary school. You know you are just coming from primary school.
6	1		verbal	8		Chorus yes
7	1	verbal		4c	pseudo	Is that not so?
8	2		verbal	8		Chorus “yes”.

9	8	verbal		5		This is another stage in your academic life. So, I am teacher OL by name.
10	1	verbal		4c	Pseudo question	The teacher asks,” Do you understand me now?
11	1		verbal	8		Chorus response - “Yes”
12	11	verbal		5		I am going to be taking you basic science. The first topic we are going to examine in this term is family health. What do I call it?
13	3		verbal	8		Family health (Chorus)
14	7	verbal		5		Teacher writes on the chalkboard.
15	1	verbal		5		Family.... re-initiate and stretches the word.
16	1		verbal	8		Health. Students complete the teacher’s sentence in Chorus.
17	13	verbal		5		Under family health, these are the things that we want to copy under family health. We want to look at the meaning of personal sanitation.

18	1	verbal		4c	Pseudo question	Do you understand?
19	1		verbal	8		Chorus response Yes
20	5	verbal		5		We want to look at the meaning of personal sanitation. How are we going to take good care of our own? We are going to make mention of parts of the body and then how the parts of the body are going to be cleaned.
21	1	verbal		4c	Pseudo question	Do you understand me now?
22	1		verbal	8		Chorus response Yes
23	6	Verbal/nonverbal with hand movement in front of the class		5		So, the number one thing that we want to examine is the meaning of personal.... sanitation (stretches the last word designed for the student to complete)
24	2		Verbal	8		Chorus response- (sanitation.... completes teacher's last word-personal sanitation
25	1	verbal		5		Meaning of what? Stretching to elicit a repetition

26	2		verbal	8		Chorus -Personal sanitation
27	7	verbal		4c		Meaning of what?
28	1		verbal	8		Chorus -Personal sanitation
29	1	verbal		5		- meaning of- personal... sanitation stretches the last word with chorus responses by all
30	1		verbal	8		Chorus -sanitation
31	1	verbal		5		I am going to give you a little definition that you are going to read, and then you can understand.
32		verbal		4c	Pseudo question	Do you understand me now?
33	1		verbal	8		Chorus response “yes”
34	13	verbal		5		What do you mean by personal sanitation? Personal sanitation can be described by the stage of keeping oneself away from dirt or the act of making the body..... stretching the last word for the student to complete (clean)

35	1		verbal	8		Chorus – (clean), Student completes the last word.
36	5	Verbal/hand gesture		5		When you say something is personal, you are talking about yourself (Lectures).
37	1	verbal		4c	Pseudo question	Do you understand?
38	1		verbal	8		Chorus response YES
39	9	verbal		5		If I am talking about myself, I cannot be talking about you, if you say something is personal, you are referring to yourself and not any other person.
40	1	verbal		4c	Pseudo question	Do you understand me now?
41	1		verbal	8	a	Chorus YES
42	3	verbal		5		So, how do you take care of yourself? What do you mean by personal sanitation? -the way that you take good care of yourself, and what does yourself mean? Your body. (Teacher lecture)

43	1	verbal		4c	Pseudo question	Teacher asks: Do you understand
44	1		verbal	8		Chorus YES
45	3	verbal		5		Lecturing, stretching the last word, designed for students to complete together with her,” from what, from.... germ.”
45	2		verbal	8		Chorus repeating after teacher -”: germ.”
47	1	verbal		4c	Pseudo question	Do you understand?
48	1		verbal	8		Chorus YES

TABLE 7.2.2.2 EXTRACT FROM THE TRANSCRIPTS OF THE POST-INTERVENTION CLASSROOM DISCOURSE

Turn partition	TIME IN SEC	TEACHERS ACTIVITY	STUDENTS ACTIVITY	BASIC SCIENCE OBSERVATION SCHEDULE BIAC IN CODE	TYPE OF QUESTION	FIELD NOTE
15	06-1:21,46	Verbal and non-verbal		6		So, this set is going to be group 1, group 2 and moving around the class to indicate different groups for groups, using hand gestures for demarcation.
16	22	verbal		4c	pseudo	Can you hear me (No student response)
17	23	Verbal/non-verbal		6 and 4a	Opened-ended	Join them there (ordered a student). Group 3, group 4, and now group 5, so we have different 5 groups. I want to know your idea on the topic, growth, and development (while moving around the classroom group students according to seat settings)
18	46-47		Non-verbal			A student stood up from the group the teacher allocated him to and moved to his own chosen group.

19	47-52	verbal		6 and 4a	Opened ended	Then, after telling me, I want to see you start working now, you tell me. What do you mean by growth, the definition of development, and how you understand it? I want to know.
20	52-53	verbal		4c	pseudo	Do you understand me now?
21	53-54		Verbal	8		Few says yes
22	54-2:10	verbal		4a	Opened ended	Then when you talk about one, then you give me your ideas, then you tell me what you know. Start brainstorming now, then tell me,
23	10-11	verbal		4c		Do you understand me now?
24	11-12		Verbal	8		A student says yes.
25	12-50	Verbal/nonverbal		7 and 2		Acknowledge a student sitting alone, the says-points to a student “. Why are you isolating yourself? Join your group. Teacher continues to provide guidelines and encourages the student sitting alone to join group work so that they can work as a team
26	50-3;15		Verbal	9		Students begin discussing the task.
27		verbal		2		Work together (teacher mentoring, encouraging teamwork)
28	5-27		Verbal	9		Students discussing within groups

29	27-33	verbal		4a		Not about definition alone. Tell me about the stages.
30	33:4:38		Verbal/non-verbal	9		Students discuss within groups, the team leader writes points made by members down, and some students are seen peeping between groups.
31	38-42	verbal		4a		Is any group ready for presentation? (Short time for group discussion)
32	42-54	verbal		6		Group 4, come out and tell us your ideas.
33	54-5:16		Verbal/non-verbal	9		A member of the group volunteers walked out to present the group work.
34	16-30	verbal				Among group members, can anyone add more explanation (more group ideas and from other group members
35			Verbal	9		Another student's voluntary response
36	30-45	verbal		2		Good of you (Teacher accepted the presentation)
37	45-6;04		Verbal	9		Volunteer walked to front for presentation, added own ideas about growth and development and further differentiated them.
38	04-05	verbal		2 and 3		Good (rewards student)

39	05-11	verbal		1 and 3		Repeat what you are saying for clarification.
40	11-31		Verbal	8		Student repeats idea-growth means a physical change we can see in living and non-living things, and development is overall development in life, socially in the community.
41	31-50	Verbal		3		The teacher accepts the idea and says Good)-reward.
42	50-7:07	verbal		3		Teacher builds on students' ideas, adds his own ideas, and encourages other group presentations.
43	07-47	verbal		5		Teacher writes ideas of group one on the chalkboard at the same time and reads them out
44	47-58	Verbal/nonverbal		1		-You). (Teacher points and recognises another speaker from group 4)
45	58-8:41			9		A volunteer gives his own idea from group 4, different from other students
46	41-42	verbal		3		Again-Teacher asks a student to repeat for affirmation.

7.2.3. Comparison between the statements about verbal patterns of interactions from the five teachers' pre- and post-interview responses and the results of the verbal interaction patterns of the observation data and transcripts of the discourse analysis.

The statements from the five teachers' interview responses to the question, "How long do you talk in a single basic science lesson?" will be matched with the findings from the pre-observation talk data. The excerpt can be found in Appendix 8A. The following were the findings made from the teachers' responses.

Teacher AD's response was, "... then for the next 15 minutes; I will do the talking, then ask them questions on the previous topic been taught....so usually, I do the talking for about hmmm, 15-18 good minutes."

OL's response was, "The regular period schedule for a lesson is 40 minutes; if it is a new topic, I can use the whole 40 minutes to explain the topic; at times, I may exceed the 40 mins for that lesson; I normally exhaust the 40 minutes."

Teacher EK's response was, "Ummm, as a teacher, at least I talk for 30 minutes."

Teacher IR's response was "...at least for about 25 minutes.

Teacher AW's response was "...at least 30 minutes because in teaching, even....

The statements above reveal that three teachers said that the period of their lessons' talk is between 30 and 40 minutes. One of the teachers said that she could talk throughout the whole 40 minutes of the total lesson time. Only one of the teachers said that she talks for 15-18 minutes, and one said she talks for 25 minutes. Three of the five teachers attested to talking almost throughout the lessons, while the teacher only said that she talked only a little less than half of the total lesson time. The teachers' statements are in support of the pre-intervention observation talk, with teachers' talk dominating the lesson by occupying 78.8% of the total lesson time and 85% of the total talk time. This was also shown in the pre-intervention discourse analysis transcript in Table 7.2.2.1, where the teacher's Turn is (T-20, 21, 23, 25, 27, 29, 31, 34).

To further show that the teachers' talk dominated the lessons, I asked the five teachers what they felt about students discussing teachers' questions or the lesson's topics within

themselves in lessons. The teachers' responses were classified into two: negative attitude and positive attitude, and below are the statements from their responses:

The positive attitude:

Teacher IR's response was, "... It is very good", but It's not so common in my class.

Negative attitude:

Teacher AD's responses were, "I do not give students the room to talk anyhow," "... It leads to a rowdy class," "I do not allow this," and ".....I do try as much as possible to maintain class control, not to talk in my class."

Teacher OL's response was, "This does not normally happen during my teaching in class."

Teacher EKs response was, "Not acceptable or allowed in my class."

Teacher AW's response was, "When I am teaching, they have to listen." And "...during teaching, they do not discuss."

The above statements from the five teachers described their attitudes and practices toward student (s)-student (s) classroom discussion.

The researcher's interpretation of the above findings is that only teacher IR said that student-to-student classroom discussion is good but not common in her class, so despite acknowledging the importance, it was not practised. The other four teachers see student-to-student classroom discussion as an intolerable classroom activity. These are for different reasons varying from being an offensive act to making the class rowdy. Teacher AD believes that it leads to a lack of classroom control on the part of the teacher.

In the ranking of students' personal experience in basic science lessons, the students comment that they should be given more opportunity to talk in basic science lesson ranked 2nd out of 10, which indicate an agitation to get more engaged and participate more in classroom talk. This is shown in Table 7.7.1 in section 7.7, "I would like more opportunities to talk in basic science class, and I learn best when listening to the teacher in basic science class". The students ranked at the lowest level of the diamond ranking, "I get to talk to other pupils in the class about the teacher's question", and I think everyone participates fairly in basic science class at the bottom(lowest).

Further, when teachers were asked, “What sorts of talk do students engage in during basic science lessons?”

The statements analysed from the teachers’ responses include the following.

Teacher OL responded, “.....and students talk based on the teacher asking them questions, and the students respond.”

Teacher EK’s response was, “It is when I ask questions that they respond.”

Teacher IR’s response was, “I initiate the student talk by asking them to read.”

Teacher OL’s response was, “... students talk based on when I ask them questions, and the students respond.”

Teacher AD’s response was, “I ask questions, and they respond.”

Teacher AW’s response was, “I can ask them questions to know what is in their mind” and “I will point to them, mention their name, and then they talk.”

The teachers gave the above various instances that students are allowed to talk only when teachers initiate students’ talk by calling on students or asking students questions. However, in the post-intervention classroom talk, the teachers’ talk dropped by 9% while students’ talk increased by 10.1% on average, and the post-intervention interview with Harland and Kinder’s (1997) model of change indicated a new awareness outcome where one of the teachers stated that:

Teacher AD comments, “...I had not been able to tolerate students discussing among themselves in my lesson before, but I now allow student-student discussion.” The rest can be found in section 7.8 of the Harland and Kinder outcome of change. This statement shows that the teacher has developed a positive attitude towards students’ talk, which is in contrast to her pre-intervention comment above on page 248. This statement was supported by students’ group discussion in Turns S (26, 28, 30, 33, 35, 45, and 60) in Table 7.2.2.2.

7.3 The teachers' direct and indirect talk (minutes) before and after the intervention.

In answering the sub-research question (1b), what are teachers' direct and indirect verbal interaction patterns in basic science lessons? The report of the results will be presented following the steps below:

- Calculate the teachers' total talk.
- Calculate the teachers' direct talk.
- Determine the teachers' indirect talk.
- Calculate the teachers' direct talk as a percentage of teachers' total talk.
- Calculate the teachers' indirect talk as the percentage of teachers' total talk.
- Compare the teachers' interview responses with the findings of the teachers' direct and indirect talk.

TABLE 7.3A: THE PROPORTION OF THE FIVE TEACHERS' TOTAL TALK OCCUPIED BY DIRECT AND INDIRECT TALK BEFORE THE INTERVENTION (MINUTES).

Teacher ID code	Total teachers' direct talk(min)	Total teachers' indirect talk(min)	Total Teachers' talk (min)	Total direct (% of total teachers' talk) (min)	Total indirect (% of total teachers' talk) (min)
AD	21.5	4.4	25.9	83.0	17.0
OL	22.1	5.1	27.2	81.3	18.8
EK	30.0	2.8	32.9	91.2	8.5
IR	18.1	3.1	21.2	85.3	14.6
AW	17.7	1.6	19.2	92.2	8.3
AVERAGE	21.9	3.4	25.3	86.6	13.4

TABLE 7.3B: THE TEACHERS' TOTAL TALK OCCUPIED BY TEACHERS' DIRECT AND INDIRECT TALK AFTER THE INTERVENTION(MINUTES).

Teacher ID code	Total teachers' direct talk(min)	Total teachers' indirect talk(min)	Total teachers' talk time(min)	Total teachers' direct talk (% of total teachers' talk) (min)	Total teachers' indirect talk (% of total teachers' talk) (min)
AD	21.3	7.2	28.6	74.5	25.2
OL	9.3	12.2	21.5	43.3	56.7
EK	15.2	10.0	25.3	59.6	39.7
IR	15.3	6.6	22.1	69.5	30.0
AW	15.8	5.7	21.6	73.1	26.4
AVERAGE	15.4	8.3	23.8	64.0	35.6

Teachers' direct and indirect pre-intervention talk (min).

Teachers' direct and indirect post-intervention talk (min)

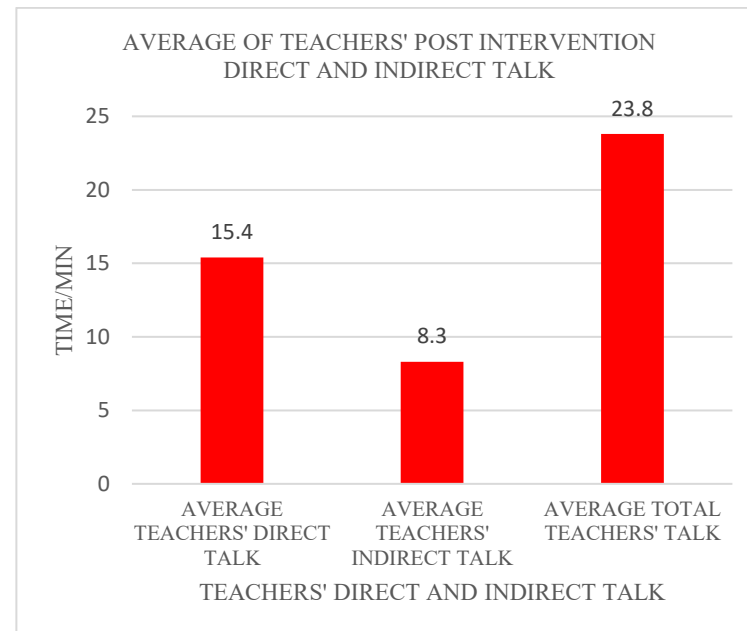
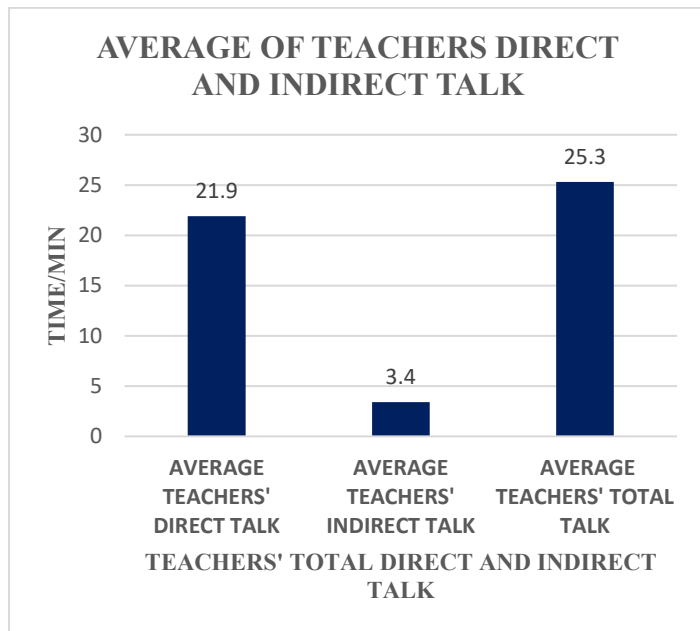


FIGURE 7. 3: AVERAGE OF TEACHERS' DIRECT AND INDIRECT TALK BEFORE AND AFTER INTERVENTION IN BASIC SCIENCE LESSONS.

Table 7.3a and 7.3b and Figure 7.3 show the pre-and post-intervention results of the teachers' direct and indirect talks; the teachers' total talk; the teacher's total direct talk as a percentage of the teacher's total talk; the teacher's indirect talk as a percentage of the teacher's total talk. Figure 7.3 shows the average of the pre-and post-intervention talk.

In the pre-intervention results, the teachers' total direct talk as a percentage of the total teachers' talk is 86.6%, and the teachers' total indirect talk as a percentage of the total teachers' talk is 13.4%. The findings show that about 87% of the teachers' total talk is direct talk, while only about 13% of the teachers' talk time is indirect talk. More than three-quarters of the teachers' total talk is direct talk. These results imply that the teachers' direct talk dominated the teachers' total talk mainly by lecturing, giving directions, and justifying the authority of the students. The ratio of the teachers' direct to indirect talk is 6:1. The transcript of pre-intervention classroom discourse analysis in Table 7.2.2.1 presented the teacher's direct talk in Turns (1, 5, 9, 12, 14, 15, 17, 20, 23, 25, 31, 34, 39, 42, 45, 42). The indirect talk in Turns (2, 4, 7, 10, 18, 21, 27, 32, 37, 40, 43, 47) with highly routine pseudo questions like (do you understand me now?) and very few closed-ended questions and repeats of students' responses that served as affirmation), for instance, Turn 7(Is that not so?), and Turn 27 (meaning of what?). Very few examples from the videotaped transcript reveal actions that justify or criticise authority.

The post-intervention results reveal that the teachers' direct talk occupied 64.0% of the teachers' total talk, and the teachers' indirect talk occupied 35.6% of the teachers' total talk. The ratio of the teachers' direct to indirect talk is 2:1. About half of all the lessons' talk is teachers' direct talk, and the teachers' direct talk is almost twice the teachers' indirect talk. This result implies that about half of the lessons' time was occupied by the teachers' lectures, giving directives, and controlling the class. The discourse analysis shows the teacher's direct talk in Turns (7, 9, 12, 15, 17, and 19, 25, 32, 43) and indirect talk in Turns T (22, 25, 27, 34, 36, 38, 39, 41 and 42).

7.3.1 Changes in the teachers' pre- and post-intervention teachers' direct and indirect talk.

The changes in the teachers' direct and indirect talk will be obtained by calculating the differences between the findings from pre-intervention and post-intervention of the teachers' direct and indirect talk occupied by total lessons' talk.

TABLE 7.3.1 THE CHANGES BETWEEN THE POST-INTERVENTION AND PRE-INTERVENTION RESULTS OF TEACHERS' DIRECT AND INDIRECT TALK(MINUTES)

Identity	Teachers	
TEACHER ID CODE	POST-PRE (Change in the total direct talk (% of total teachers' talk) (min)	POST-PRE (Change in the total indirect talk (% of total teachers' talk) (min)
AD	-8.5	-8.2
OL	-38	-37.9
EK	-31.6	-31.2
IR	-15.8	-15.4
AW	-19.1	-18.1
AVERAGE	-22.6	-22.2

Table 7.3.1 depicts the changes in the teachers' direct and indirect talk in minutes before and after the intervention and the teachers' direct and indirect talk before and after the intervention.

They reveal that the teachers' direct talk, which was 86.6% of the teachers' total talk before the intervention, came down to 64% after the intervention reflecting a -22.6% change. The teachers' indirect talk is 13.4% of the teachers' total talk before the intervention, and the teachers' indirect talk is 35.6% after the intervention. The teachers' indirect talk increased by 22.2%. Since one of the purposes of the intervention is to encourage teachers to reduce the quantity of time spent on lecturing and improve other activities that can enhance students' interest and ability to learn, this increase in indirect teachers' activities can be associated with the intervention.

The extract from the transcripts of the classroom discourse analysis explained more of teachers' lecture strategy practices in Table 7.2.2.1 shows direct talk of Turns (23, 25, 30, 34, 39, 42, 45, 49, 42) and indirect talk in Turns (7, 10, 18, 21, 32, 37, 40, 43, 47). This transcript of pre-intervention discourse analysis showed routine that usually lacks follow-up, build-up of students' ideas, acceptance of students' feelings and genuine praise. In Table 7.2.2.2, Turns (7, 9, 12, 15, 17, and 19, 25, 32, 43) and indirect talk in Turns T (22, 25, 27, 34, 36, 38, 39, 41 and 42) where the teacher engaged the students more in discussion method, probing, acceptance of feelings, genuine praises, acceptance and clarification of ideas and open-ended questions and fewer direct talk time of Turns (7, 9, 12, 15, 17, and 19, 25, 32, 43) where the teacher lectures and give directions.

7.3.2 Relating the comments from the five teachers' interview responses to questions in categories of teachers' direct and indirect talk with the pre- and post-intervention observation data results.

When the researcher asked how long teachers spend on the presentation of facts and concepts in a lesson. The comments related to teachers' direct talk were as follows:

Teacher AD responds, "I do take more than 10 minutes."

Teacher OL's response was "A minimum of 30 minutes for the presentation of facts and concepts."

Teacher EK responded that "at least 20 minutes will be used on that subject to explain the concept."

Teacher IR responded, "I spend 15 to 20 minutes; it depends on the way the students are ready."

Teacher AW's response was, "It can be more than 20 minutes."

The five teachers' comments revealed that three of them expressed that the presentation of facts takes between 15 -30 minutes in their lessons. One teacher said more than 10 minutes. The teachers' claimed that their direct talk takes a minimum of 15 minutes and a maximum of 30 minutes. When compared to the results obtained from the observation, all the teachers' talks took an average of 25 minutes. The above shows that the teachers' talk time took about two-thirds of the average total lesson time, total talk time, and teachers' total talk time (32, 29, 25 minutes), respectively. This is in line with the results obtained from the lessons' observation and the transcripts of the discourse analysis of the pre-intervention in Table 7.2.2.1, which showed the dominant teacher's direct talk in Turns (23, 25, 30, 34, 39, 42, 45, 42). However, in the post-intervention results, one of the teachers' comments in the post-interview showing teachers' awareness of the new strategy in Section 7.8 is:

"Lessons learnt from the pre-training showed that I do most of the work in class, looks like a one-way traffic class and not given the students room to contribute, so I now allow students to talk". (Teacher AD).

This is in line with the teachers' direct talk time of post-intervention Turns (9,12, 15,17,27, 36, 39 and 42) with a reduction of 22% of the teachers' direct talk time. When asked how teachers give directives in class, the following quotes emerged from their responses.

Teacher AD's responses were, "I have to be firm in class", "I do not give room for laughing", and "I just give them the order, and they do follow it."

Teacher EK's response was that "...do this, you, do that."

Teacher OL's response was "...order to them or an individual order."

Teacher IR's response was, "...just give the information."

Teacher AW's response was, "... just command them."

Six of the eight comments from the five teachers confirmed that they command or dictate to give students directives in the classrooms, mandating students to obey orders. Only one teacher mentioned passing instructions with firmness. In contrast, one teacher comments that laughing implies the inability to give a directive. However, from the analysed field note, all the teachers give students directives only by instructing, commanding, and mandating the students. The analysis captured the comments below when the five teachers were asked how they correct for perceived unacceptable behaviour.

Teacher AD's response was, "I will say ok, get out", "...stay at the back of the class", and "...I will tell the student to stand up."

Teacher IR's responses were "... warn the student", "... then give student punishment", or "...kneel down.

Teacher AW's response was, "I correct them in love, "...words of advice." or "I cane them.

Teacher EK's response was, "... It is either I ask them to kneel down or cane them, or "... give him simple punishment.

Teacher OL's responses were, "ask the student to stand up, stay at the back of the class or ask the student to come and see you in your office, then give the student punishment."

In the analysis of the five teachers' methods of correcting students' perceived misbehaviour, the researcher identified and classified these twelve comments into two

categories (negative and positive). Nine negative comments varying from simple punishment, caning, standing up, kneeling, sending out, or staying at the back of classrooms were analysed as preferred methods of changing students' unacceptable behaviours. One teacher expressed a preference to correct students with love, and one testified to favour words of advice. One of the teacher's respondents expressed a preference for a warning to correct students' perceived misbehaviours. The field note analysis of the teachers' method of correcting students' misbehaviour confirmed that teachers cane students, send students out of classes, fling notes, and ask students to kneel or stand up. Only one teacher preferred to advise the students. When asked how teachers clarify or accept students' feelings, either negative or positive feelings, the analysis of the teachers' comments expressed the following.

Teacher AD's responses were, "If time permits, we trash it immediately" and "I can let the student know that the feeling is not right or nod my head if right."

Teacher EK's response was, "We talk together."

Teacher AW's response was, "I will encourage her by smiling."

Teacher AD responded, "I am very friendly and do not frown at students."

Five quotes were analysed from the teachers' responses. Four of the quotes showed the teachers support students' right to express their feelings and will accept them; either way, students show these feelings. One teacher, however, did not specify acceptance or rejection of students showing their feelings. However, from the analysis of the field note taken by the researcher during the classroom observation, acceptance of students' feelings by teachers was not observed or recorded.

When asked how the teachers praise or encourage students in the class, the following quotes were from the teachers' responses.

Teacher AW responded, "I can ask others to clap."

Teacher OL's response was, "I can give rewards by giving a textbook."

Teacher AD's responses were, "before, I will give out money", but now, "I will ask other students to clap for the student."

Teacher IR's response was, "I ask other students to clap" or "I give gifts."

Teacher EK's response was, "I will ask other students to clap."

Of the seven quotes from the teachers, four preferred to reward students by asking other students to clap for their peers. Two of the teachers preferred to give gifts and textbooks or give money. The analysis of the research field note taken during the lessons' observation reported that clapping of hands is the only significant activity teachers employed to encourage or praise students in lessons. When asked how and if teachers accept or use student's ideas in their lesson or follow up on student's responses, the teachers' quotes from the analysed responses are:

Teacher AD's responses were, "I do appreciate the student's idea, and I affirm it by repeating it", "... but if wrong, "... then say you have not got it", and "...and ask another pupil to help the student out.

Teacher EK's responses were, "If the idea is right, I will accept the idea. If the response or idea is wrong, I will just tell the student the correct answer."

Teacher OL's responses were, "I welcome students' ideas", "I will just state that the student's response is right and "If the idea is wrong, I will say that your response is not correct" I try to reshape my question in another form", and "...I give clues. If no student can respond, then "...and move to another student who can respond better.

Teacher AW's responses were, "If the idea is good, I will do the following:

"I will acknowledge it. "I will talk about that idea and contribute to it.

Teacher AW's response was, "I will add it to mine and build on it.

Teacher IR's responses were, "If the student's idea is wrong, I will say, I will just ask the pupil to sit down" though you have tried, why not this?

"I will provide another option and clues to encourage him.

The nineteen quotes range from five teachers' choice of acceptance by either verbally acknowledging a right or wrong response: one of the teachers preferred affirmation by repeating students' correct responses. Three quotes from the preferred calling on another student to respond and four of the teachers' quotes showed the provision of clues or alternatives to students' responses if the responses were wrong. Two of the teachers' quotes

revealed building on students' responses. One teacher preferred to order the student to sit down. Another teacher prefers to provide the correct response if a student's response is wrong, and one teacher prefers to move straight to the next student, who is ready to respond. The quantitative analysis showed that the teachers' pre-intervention indirect talk took 13.4 % of the teachers' total talk and 35.6 % after the intervention, which increased by 22.2 %. This is supported by a commitment to change and positive affective outcome, analysed in the Harland and Kinder outcome in Section 7.8, for instance, in teachers' post-interview responses; "I have been awarding gifts to the individual student". "I have also been given clues to questions that seem not to be understood", and "I am not condemning students for wrong responses anymore?".

The transcripts of the discourse analysis of the pre-intervention indirect talk in Turns, T (7, 10, 18, 21, 32,37, 40, 43,47, and 3) and the post-intervention indirect talk in Turns T (22, 25, 27, 34, 36, 38, 39, 41 and 42) explain the changes in the teachers' indirect talk. The difference in the patterns of the conversation shown by the transcripts showed the teachers' recognition of students' feelings, reward, affirmation, and acceptance of ideas. Of importance, during the recording of the observation of the lessons, the analysis of the researcher's field note stated that the significant activities teachers engaged in for accepting or building on students' responses were: -affirming them by repeating the responses where they are correct, furthermore, requesting that other students clap for correct responses provided. Generally, the findings above showed that building on students' correct responses was few. Instead, teachers move straight to the next student. Further analysis of the field note shows that teachers moved on to call other students when one student's response was wrong or sometimes gave the answers themselves.

Here is a brief interpretation of the above, the teachers' direct and indirect talk results from the pre-intervention observation data showed that the teachers' direct talk was more than six times that of indirect talk. These findings agree with the analysed field note of the teachers' direct and indirect talk, where few teachers' indirect activities were noted. However, the teachers' post-intervention results showed a reduction in the amount of time for teachers' direct talk.

7.4 The teachers' and students' non-verbal cues (minutes) in basic science lessons before and after the intervention.

In answering the sub-research questions 3 and 4, what are non-verbal interaction patterns currently used by teachers in basic science lessons, and what are non-verbal interaction patterns currently used by students in basic science lessons? The report of the results will follow the steps below:

- Calculate the total non-talk cues and total lesson time.
- Calculate the proportion of the lesson occupied by teachers' non-talk cues.
- Calculate the proportion of the lesson occupied by students' non-talk cues.
- Determine the teachers' non-talk as a percentage of total non-talk time.
- Find the students' non-talk as a percentage of total non-talk time.
- Compare the teacher's interview responses with the results of the lessons' non-talk cues.

TABLE 7.4A. THE PROPORTION OF THE LESSONS OCCUPIED BY STUDENTS' AND FIVE TEACHERS' NON-VERBAL CUES IN BASIC SCIENCE LESSONS BEFORE THE INTERVENTION (MINUTES).

Teachers' ID code	Total teachers' non-verbal cues(min)	Total students' non-verbal cues(min)	Total non-verbal cue time(min)	Total lesson time(min)	Total teachers' non-verbal (% of total non-verbal cues) (min)	Total students' non-verbal (% of total non-verbal cues) (min)	Total teachers' non-verbal (% of total lesson time) (min)	Total students' non-verbal cues (% of total lesson time) (min)
AD	3.7	0.2	3.9	31.6	94.9	5.1	11.7	0.6
OL	2	0.4	2.4	34.7	83.3	16.7	5.8	1.2
EK	0.6	0.7	1.3	40.3	46.2	53.8	1.5	1.7
IR	0.6	2.9	3.5	30.2	17.1	82.9	2	9.6
AW	1	0.1	1.1	23.4	90.9	9.1	4.3	0.4
AVERAGE	1.6	0.9	2.4	32.0	66.5	33.5	5.1	2.7

TABLE 7.4B. THE PROPORTION OF THE LESSONS OCCUPIED BY STUDENTS' AND FIVE TEACHERS' NON-VERBAL CUES IN BASIC SCIENCE LESSONS AFTER THE INTERVENTION (MINUTES).

Teacher ID code	Total teachers' non-verbal cues(min)	Total students' non-verbal cues(min)	Total non-verbal cues time(min)	Total lesson time(min)	Teachers' non-verbal cues (% of total non-verbal cue time) (min).	Students' non-verbal cues (% of total non-verbal cue time) (min).	Total teachers' non-verbal (% of total lesson time) (min)	Total students' non-verbal (% of total lesson time) (min)
AD	2.2	0.5	2.7	40.4	81.5	18.5	5.4	1.2
OL	0.7	2.4	3.1	28.6	22.6	77.4	2.4	8.4
EK	0.2	3.7	3.9	36.8	5.1	94.9	0.5	10.1
IR	0.7	2.4	3.1	33	22.6	77.4	2.1	7.3
AW	1.4	2.2	3.6	36.8	38.9	61.1	3.8	6.0
AVERAGE	1.0	2.2	3.3	35.1	34.1	65.9	2.8	6.6

Average teachers' and students' non-talk cues before intervention(minutes). Average teachers and students' non-talk cues after intervention

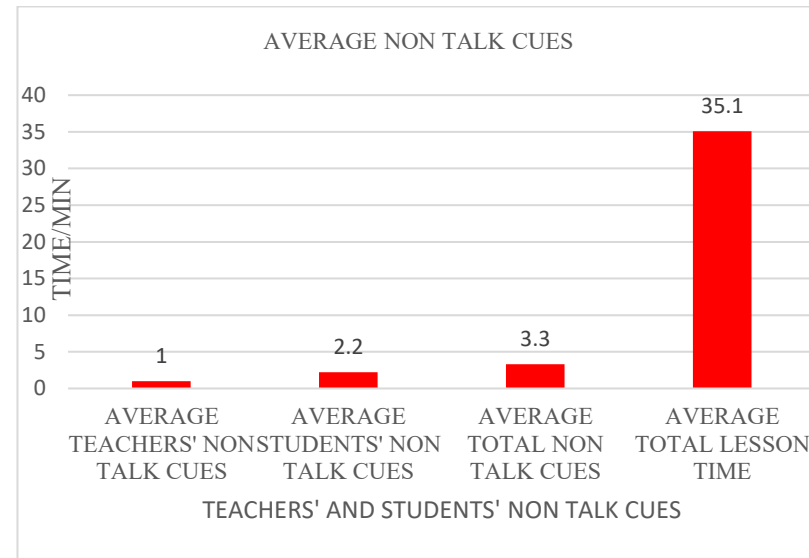
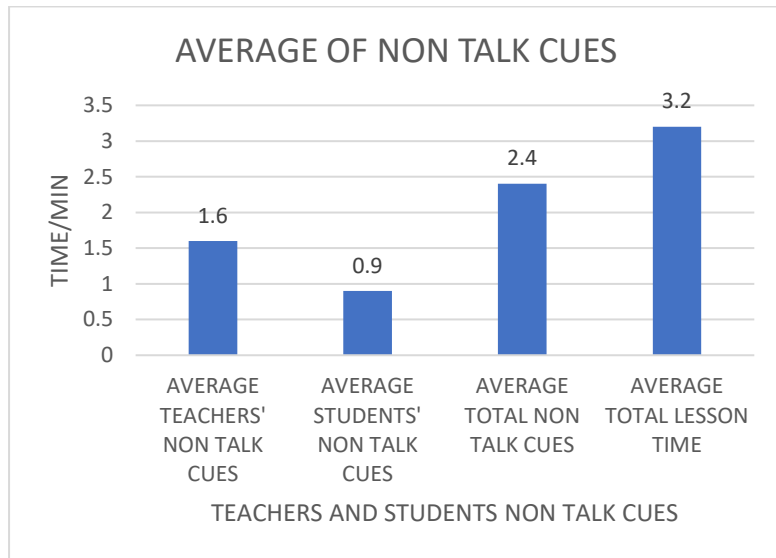


FIGURE 7.4: AVERAGE NON-TALK CUES OF THE LESSONS OCCUPIED BY STUDENTS AND FIVE TEACHERS BEFORE AND AFTER THE INTERVENTION IN BASIC SCIENCE (MINUTES).

Table 7.4 reflects the pre-intervention of non-talk cues in minutes concerning the total lesson time, the total non-talk cues times, and the teacher's and students' non-talk as percentages of total non-talk cues and total lesson time. Figure 7.4 shows the average non-talk cues occupied by the lesson in minutes.

In the pre-intervention results, the teachers' total non-talk as a percentage of the total lesson time is 5.1%, and the student's total non-talk as a percentage of the total lesson time is 2.7%. The teacher's total non-talk as a percentage of all non-talk is 66.5%, and the student's total non-talk as a percentage of the total non-talk is 33.5%. The findings from the above reveal that the teachers' non-talk cues occupied two-thirds of the total non-talk cue, and the students' non-talk cues occupied only one-third of the total non-talk cues. The teachers' and students' non-talk cues occupied only 7.8% of the mean total lesson time. The ratio of the teachers' non-talk cues to students' non-talk cues is 1.8: 1; hence, the teachers' non-talk cues almost doubled the students' non-talk cues. The transcript of the discourse analysis shows the teachers' non-talk cues in T (23 and 36), and the students' non-talk turns can be found in the complete copy of the transcript of the discourse analysis S-Turn 110 on pages 10,15, 30 and 35 (Students' non-verbal clues were whole-class clapping of hands and eyes fixed on the teacher and chalkboard throughout the lesson.

The post-intervention results showed that the teachers' non-talk cues occupied 2.8% of the total lesson time, while the students' non-talk cues occupied 6.6% of the total lesson time. The proportion of the lessons' non-verbal cues occupied by the total teachers' non-verbal cues is 34.1%, and the proportion of the lessons' non-verbal cues occupied by the students is 65.9%. The students' non-t almost doubled that of the teacher. The ratio of the teachers' non-talk to students' non-talk is 0.45 to 1. The teachers' non-talk cues in the post-intervention analysis can be found in T (15, 17, 25, 44) and S (18, 30, 33 and 37)

7.4.1 Changes in pre-intervention and post-intervention non-verbal patterns.

The changes in the proportion as a percentage of the total lesson time and total non-talk time occupied by teachers and students will be identified, and the data from pre-intervention and post-intervention will be compared.

TABLE 7.4.1 CHANGES IN CLASSROOM NON-TALK AS A PERCENTAGE OF NON-TALK CUES AND TOTAL LESSON TIME (MINUTES)

Teachers' ID code	Post-pre change in the proportion of students' non-talk cues (% of lesson time) (min)	Post-Pre-change in the proportion of teachers' non-talk (% total lesson time) (min)	Post-Pre change in the proportion of students' non-talk cue (% of total non-talk) (min)	Post-pre change in the proportion of teachers' non-talk (% of total non-talk)(min)
AD	0.6	-6.3	13.4	-13.4
OL	7.2	-3.4	60.7	-60.7
EK	8.4	-1.0	41.1	-41.1
IR	-2.3	0.1	-5.5	5.5
AW	5.6	-0.5	52.0	-52.0
AVERAGE	3.9	-2.2	32.4	-32.4

On average, the students' total non-talk cues in minutes increased by 3.9% of the total lesson time after the intervention, while the time utilised by teachers on non-talk cues was reduced by 2.2% of the total lesson time. Students' participation in non-verbal cues, measured against all non-verbal cues, also increased by 32.4 %, while teachers' non-verbal cues participation dropped by a similar number (32.4%) of all non-verbal cues. In Table 7.2.2.1, the transcript of the discourse analysis of the pre-intervention shows very few times where the teacher pointed at students to answer questions and made hand gestures while lecturing in front of the class T (23, 36). Students' non-verbal clues were the whole class clapping of hands and eyes fixed on the teacher throughout the lesson.

In Table 7.2.2.2, the transcript of the discourse analysis of the post-intervention results showed more non-verbal activities involving the students' movements, gestures, peeping, and smiling within groups and the teacher's acknowledgement of student's feelings in S (18,30,33,37, and Turns-T (15, 17, 25 and 44. Teachers were majorly evident by moving around the classrooms. Essentially students' non-verbal cues rose after the intervention, while generally, the teachers experienced a drop in non-verbal cue participation rates. Consequently, it can be concluded that the shift in teachers' non-verbal cues and students' non-verbal can be linked to the intervention. Though, the change in nonverbal cues was not really significant.

7.4.2 Relating the pre-and post-intervention statements from the five teachers' interview responses with the results obtained from the lessons' non-verbal interaction patterns.

When trying to find out why total non-talk cues occupied only 7.8% of the total lesson time by comparing the teachers' interviews responses to the question, "What do you feel about the use of gestures, smiles, eye contacts, frowns, tone of voice and body language during basic science lessons?". The following statements that were coded and analysed will be compared with the results obtained from the lessons' non-talk cues.

Teacher AD's statements were, "Yes, it is important", "I do not normally frown", and "... but I have to be very firm."

Teacher OL's responses were, "We cheer them up to make the class interesting" and "They are very good."

Teacher EK's comments were, "... everything is not about flogging, so they are good", "We just make a little joke in class", and "that will make them participate more in what you are teaching."

Teacher IR's comments were, "they are essential", and "It is good."

Teacher AW's comment was, "It will enhance learning."

Here is a brief interpretation of the findings from the above statements: They show that nine out of the eleven statements reveal that the five teachers feel that the use of the different types of non-talk cues improves the quality of teaching and learning. One of the teachers feels that by been firm in the class maintains class control. The teacher probably believes that using non-talk cues will result in the loss of class control, and one other confirms making just a little joke in the classroom. This could be why the teachers' non-talk cue is 66.5% of the total non-talk cues and 5.1% of the total lesson time.

The statement from the post-intervention analysis of the teacher interview, using Harland and Kinder's (1997) model of change in the practice, supported the negligible change in students' non-verbal cues and decreased among teachers reported in the quantitative analysis and the transcript of the discourse analysis as stated below.

Teacher OL's comment was, "I just move around groups to explain to students."

Teacher AW's comment was, "I make eye contact with students now."

Teacher EK's response was, "I have not done a lot in that aspect."

Teacher IR commented, "I have not been noticing myself doing that, really."

Teacher AD commented, "I have not been able to be laughing with students."

The transcript of the discourse analysis also confirmed that the teachers' non-talk cues in the post-intervention analysis were about movement around the classroom T (15, 17, 25, 44) while the students engaged in more movement, peeping, smiling S (18, 30, 33 and 37).

7.5 The frequency and time spent in minutes on teachers' pseudo, open-ended, and close-ended questions before and after the intervention.

In answering the sub-research question 5, what frequency and time do teachers spend on questions before and after intervention in basic science lessons? The reports of the results will be presented following the steps below:

- Identify the total question time and total questions.
- Determine the proportion as percentages of the total question time and total questions occupied by pseudo questions (spontaneous and not genuine questions used by teachers to act like questions).
- Determine the proportion as percentages of the total question time and total questions occupied by closed-ended questions.
- Determine the proportion as percentages of the total question time and total questions occupied by open-ended questions.
- Compare the five teachers' interview responses with the findings of the frequency and time of the teachers' pseudo, closed, and open-ended questions.

TABLE 7.5A. THE TIME (MINUTES) AND FREQUENCY OF THE TEACHERS' QUESTIONS BEFORE THE INTERVENTION.

Teachers ID	Frequency of pseudo questions	Time for pseudo questions(min)	Frequency of closed-ended questions	Time of closed-ended questions(min)	Frequency of open-ended questions	Time of opened ended questions(min)	Total teacher s' questions	Total no of questions	Pseudo questions (% of all questions)	Pseudo time (% of total question time) (min)	Closed Questions (% of all questions)	Closed time (% of total question time) (min)	Opened Questions (% of all questions)	Opened Time (% of total question time) (min)
AD	30.0	0.7	24.0	1.3	1.0	0.0	55.0	2.0	54.5	35.0	43.6	65.0	1.8	1.0
OL	134.0	12.4	15.0	0.7	3.0	0.1	152.0	13.2	88.2	93.9	9.9	5.3	2.0	0.8
EK	9.0	0.3	30.0	1.3	3.0	0.2	42.0	1.8	21.4	16.8	71.4	72.2	7.1	11.1
IR	3.0	0.1	18.0	1.4	7.0	0.4	28.0	1.9	10.7	5.3	64.3	73.7	25.0	21.1
AW	22.0	0.5	14.0	0.3	0.0	0.0	36.0	0.8	61.1	62.5	38.9	37.5	0.0	0.0
AVERAGE	39.6	2.8	20.2	1.0	2.8	0.1	62.6	3.9	47.2	42.7	45.6	50.7	7.2	6.8

TABLE 7.5B. THE TIME IN MINUTES AND FREQUENCY OF THE TEACHERS' QUESTIONS AFTER THE INTERVENTION.

Teachers' ID	Frequency of pseudo questions	Time teacher spent on pseudo questions(min)	Frequency of closed-ended questions	Time teacher spent on closed-ended questions(min)	Frequency of open-ended questions	Time teacher spent on open-ended questions(min)	Total no of questions	Total question time(min)	Total pseudo questions (% of the total question	Total pseudo time (% of total question time) (min)	Total closed-ended questions (% of the total question	Total closed-ended time (% of total question time) (min)	Total open-ended questions (% of the total question	Total open-ended time (% of total question time) (min)
AD	29.0	0.5	20.0	1.0	11.0	1.5	60.0	2.9	48.0	15.4	33.3	32.5	18.3	52.1
OL	20.0	0.3	9.0	0.5	11.0	2.1	40.0	2.9	50.0	11.3	22.5	17.9	27.5	71.5
EK	13.0	0.3	25.0	3.3	11.0	2.0	49.0	5.6	26.5	5.0	49.0	59.0	22.4	36.0
IR	18.0	0.3	7.0	1.2	1.0	0.02	26.0	1.5	69.2	19.7	26.9	78.9	3.8	1.3
AW	13.0	0.6	25.0	2.3	11.0	0.5	49.0	3.3	26.5	17.6	51.0	68.8	22.4	13.6
AVERAGE	18.6	0.4	17.2	1.6	9.0	1.2	44.8	3.2	44.0	13.8	36.5	51.4	18.9	34.9

Average Frequency and Time of Questions before intervention

Average of the Frequency and Time of Questions after intervention.

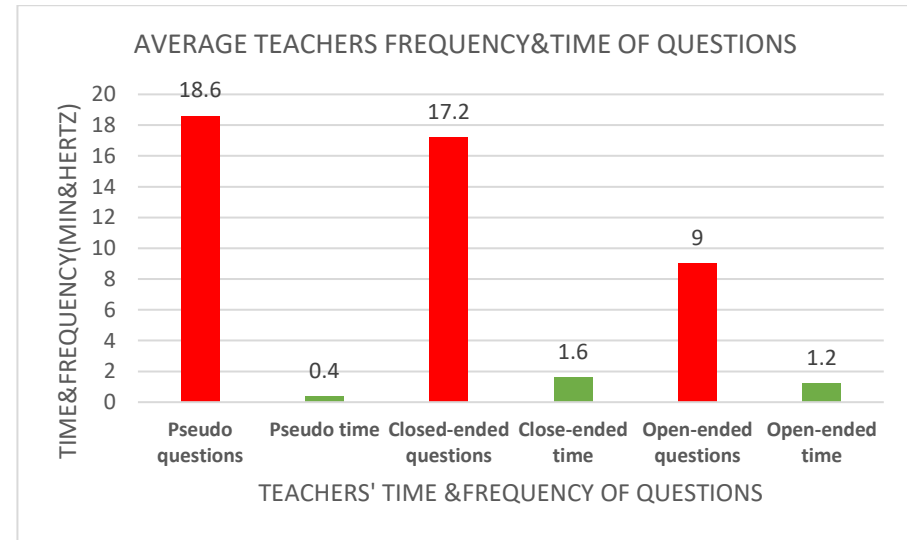
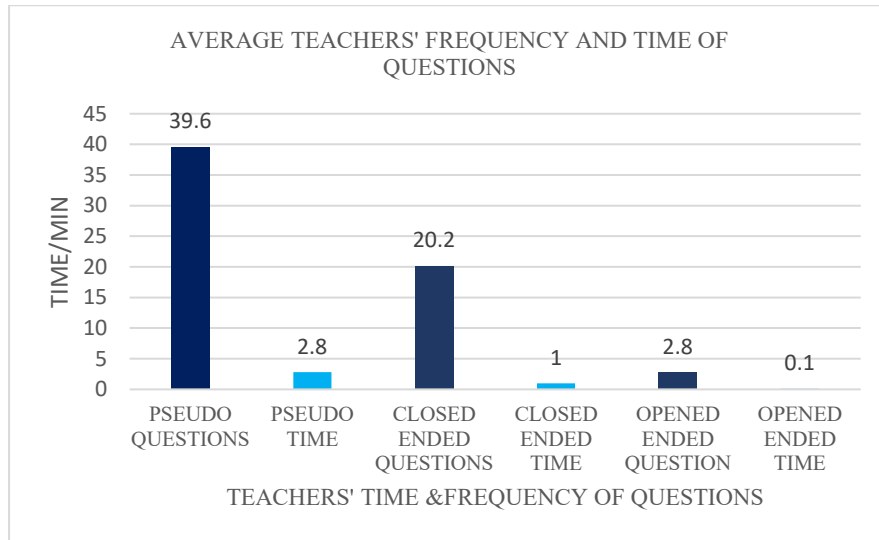


FIGURE 7.5: THE AVERAGE FREQUENCY AND TIME OF PSEUDO, CLOSED AND OPEN-ENDED QUESTIONS BEFORE AND AFTER THE INTERVENTION.

Table 7.5a and Table 7.5b show the proportion of all question time and all questions occupied by time and frequency of pseudo questions, time and frequency of closed-ended questions, and time and frequency of open-ended questions. Figure 7.5 show the mean frequency and time of the different questions.

In the pre-intervention results, the teachers' pseudo questions occupied 47.2% of all questions and 42.7% of all question time, the teachers' closed-ended questions occupied a proportion of 45.6% of all questions and 50.7% of the total question time, and open-ended questions occupied 7.2% of the total question and 6.8% of all question time. The frequency of the close-ended questions is almost twice that of open-ended questions. It is evident that pseudo questions predominated the teachers' questions, extensively ritualised by teacher OL, whose total lesson time is 34.7 minutes out, of which 12.4 minutes was spent on asking pseudo questions with a frequency of 134 counts. The ratio of the frequency of teachers' pseudo questions to closed-ended questions to open-ended questions is 14:7:1, and the ratio of the teachers' pseudo questions time to closed-ended questions time to open-ended questions time is 28:10:1. The extract from the transcript of discourse analysis in Table 7.2.2.1 showed a sample of the ritualised pseudo questions in Turns T(7, 10, 18, 21, 32, 37, 40, 43, 47), for instance, "do you understand"? "Is that so"?

The above results reveal that the frequency of pseudo questions is about twice higher as the frequency of closed-ended questions and fourteen times that of open-ended questions. The post-intervention results illustrate that the teachers spent a total of 3.2 minutes asking 44.8 counts of different types of questions. The teachers spent 13.8% of the total question time on pseudo questions, which occupied 44.0% of all the total questions. The teachers' closed-ended questions were 36.5% of all the total questions, which took 51.4% of the total question time. Finally, the teachers spent 34.4% of the total question time on open-ended questions, which occupied 18.9% of all the questions. In the transcript of the discourse analysis of the post-intervention result, the teacher's pseudo questions had reduced, as illustrated in T (10, 13,16, 20) in Table 7.2.2.2.

7.5.1 Changes in pre- and post-intervention question time and frequency allocated to different forms of questions.

This Section specifically looks into the changes observed after the post-intervention regarding the three forms of questions (pseudo questions, closed-ended questions, and open-ended questions) both in terms of frequency of usage and time spent on them. The steps involved in pulling this out covered the following: Identify the changes in the proportion (as %) of the total frequency of questions and total question time occupied by the teachers' pseudo, closed, and open-ended questions. Compare the pre-intervention data with the post-intervention data.

TABLE 7.5.1 CHANGES IN TIME AND FREQUENCY OF PSEUDO, CLOSED AND OPENED ENDED QUESTIONS.

Teacher ID	POST-PRE- change in total pseudo (% of total teachers' questions	POST-PRE change in total pseudo time (% of total question time) (min)	POST-PRE- change in closed-ended question (% of total teachers' question	POST-PRE change in closed-ended time (% of total question time) (min)	POST-PRE- change in total open- ended questions (% of total teachers' questions)	POST-PRE change in total open- ended questions (% of total question time(min)
AD	-6.5	-19.6	-10.3	-32.5	16.5	51.1
OL	-38.2	-82.6	12.6	12.6	25.5	70.7
EK	5.1	-11.7	-22.4	-13.2	15.3	24.9
IR	51.4	14.4	-37.4	5.2	-21.2	-19.9
AW	-34.6	-44.9	12.1	31.3	22.4	13.6
AVERAGE	-3.2	-28.9	-9.1	0.7	11.7	28.1

The changes in the patterns of questions in Table 7.5.1 revealed the following:

The frequency of the teachers' pseudo questions changed by -3.2% of all questions, and time spent on pseudo questions as a percentage of total time spent on questions (minutes) changed by -28.9%. However, this reduction is huge on an individual teacher OL from a frequency of pseudo questions 134 to 20. In the transcript of the discourse analysis, the pseudo questions in Table 7.2.2.1, pre-intervention in Turns T (7,10,18,21,32,37,40,43,47) in the form of "do you understand" had been reduced and could be found in Table 7.2.2.2 in Turns 10, 13, 16, 20 of the transcripts of the post-intervention discourse analysis. The frequency of the teachers' closed-ended questions changed by -9.1% of all questions, and time spent on closed-ended questions as a percentage of total time spent (minutes) on questions changed by 0.7%. The frequency of the closed-ended questions in the transcript of the pre-intervention discourse analysis had been reduced and could be found in Turns 48,51,64 of the transcript of the post-intervention discourse analysis. The frequency of the teachers' open-ended questions changed by 11.7 of all questions, and time spent on open-ended questions as a percentage of total time (minutes) spent on questions changed by 28.1%.

The transcript of discourse analysis showed that the frequency of opened ended questions increased from three towards the end of the lesson, where the teacher asked: "who can tell me how to take care of fingernails"? And how do we take care of our skin?" to Turns T (17,19,22,29 and 31,74, 86) in the transcript of post-intervention discourse analysis. The frequency of open-ended questions and time spent on open-ended questions rose by more than 10%. There is also a marginal increase in time spent on closed-ended questions at 0.7%. The greatest loser of time is time spent on pseudo questions (-28.9%), while the greatest gainer of time is time spent on open-ended questions (28.1%).

In a broadened way, the intervention appears to have created a negative shift in frequency and time teachers spent on pseudo questions in favour of frequency and time spent on open-ended questions, thus, allowing students to put their thoughts together before providing teachers' responses.

7.5.2 The relationships between the analysed comments from the five teachers' interview responses concerning the teachers' types of questions and the results of the pre-and post-intervention observation data.

Quotes from the analysed teachers' interview responses are as follows:

Teacher AD's response was "... mostly, one-word answer questions, simple questions, close-ended questions.

Teacher OL's responses were, "...so, we ask simple questions that produce a one-word answer, close-ended questions like define, state, or mention.

Teacher EK's response was, "In most cases, I ask low-ordered questions."

Teacher IR's response was, "I ask simple or low-ordered or close-ended questions.

Teacher AW's response was "...according to the topic."

The five teachers' interview responses evidenced expressions reflecting the use of (simple questions) closed-ended questions. However, one teacher expressed that the types of questions she asks in lessons depend on the topics. Of note is the fact that the above testimonies did not capture the teachers' spontaneous regular use of pseudo questions as captured in the researcher's analysed field notes.

The teachers' responses are as follows regarding the time teachers spent asking questions and the analysed comments from the five teachers' interviews in the pre-intervention.

Teacher OL's response was, "In the lesson, I think I can spend 3 minutes asking questions."

Teacher AD's response was, "I usually spend like 5 minutes."

Teacher EK's comment was, "I do not really know, but it can be up to 3 minutes."

Teacher AW's response was, "I spend 2 minutes, I think."

Teacher IR's response was, "I can spend about two minutes asking questions."

The findings from the teachers' quotes showed that the teachers spent two to five minutes asking questions. However, the findings from the results of the observations showed that while

the teachers spent a total average of 3.9 minutes, three of the five teachers spent just about 2 minutes on questions, one teacher spent less than 1 minute, and one teacher spent 13 minutes, although with a wide range (0.8, 2, 1.8, 1.9 and 13.2) minutes.

In the post-intervention analysis using Harland and Kinder's (1997) impact on teachers' classroom practice, the analysis shows that when the five teachers were asked how they have improved on the aspect of questioning, the following were the teachers' statements:

Teacher AD's response was, "Not much has been done on that aspect; I still ask closed-ended and open-ended questions."

Teacher AW's response was, "I have been able to ask thought-provoking questions in class, moving away from simple single-response questions."

Teacher EK's response was, "I am still only able to ask pupils simple questions."

Teacher OL's response was, "Today, I asked students to explain growth and development to make them think deeply."

The above supported the reductions in the number of pseudo-questions and closed-ended questions and an increase in the number of open-ended questions in the quantitative results after the intervention. The transcript of the classroom discourse analysis also supports the change in teachers' questioning patterns with increased Turns in the opened and reduced pseudo and closed-ended questions. The above showed the teachers' efforts to try and ask good questions in a bid to engage the students.

7.6 The proportion of the lessons occupied by silence (wait time) (minutes) in pre-and post-intervention.

In answering the sub-research question 7, what are teachers' and students' silence (wait time) currently used in basic science lessons? The report of the results is presented as follows:

- Identify the total lessons' time.
- Determine the proportion of the lessons' time occupied by teachers' silence or wait time.

TABLE 7.6A: THE PROPORTION OF THE LESSONS TIME OCCUPIED BY SILENCE OR WAIT TIME BEFORE THE INTERVENTION (MINUTES).

Teachers' ID code	Silence (wait time) (min)	Total lesson time(min)	Total wait time (% of total lessons' time) (min)
AD	0.2	31.6	0.6
OL	0.1	34.7	0.3
EK	0.0	40.3	0.0
IR	0.0	30.2	0.0
AW	0.5	23.4	2.1
AVERAGE	0.2	32.0	0.6

TABLE 7.6B: THE PROPORTION OF THE LESSONS' TIME OCCUPIED BY THE FIVE TEACHERS' SILENCE OR THE WAIT TIME AFTER THE INTERVENTION (MINUTES).

Teachers' ID code	Total silence, wait time(min)	Total lesson time(min)	Total wait time (% of the total lesson time) (min)
AD	0.4	40.4	1.0
OL	0.0	28.6	0.0
EK	1.5	36.8	4.1
IR	0.0	33.0	0.0
AW	0.0	36.8	0.1
AVERAGE	0.4	35.1	1.0

Wait time before intervention(minutes).

Wait time after the intervention(minutes).

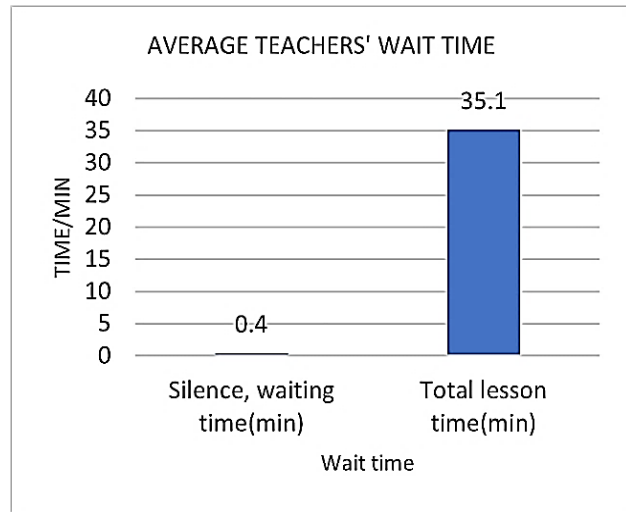
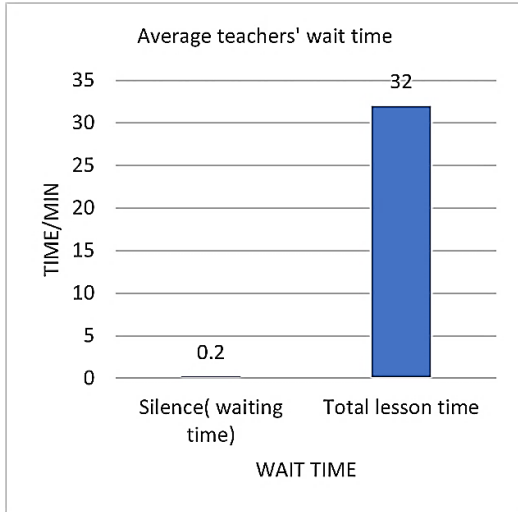


FIGURE 7.6: AVERAGE LESSON TIME OCCUPIED BY SILENCE (WAIT TIME) IN MINUTES.

Table 7.6a and Table 7.6b, and Figure 7.6 reveal the proportion of the total lesson time in minutes occupied by silence (wait time) between the teachers' questions and students' responses.

The pre-intervention result shows that two of the teachers have almost no wait time. For the other three teachers, the proportion of the lesson time occupied by the wait time is very negligible (0.2 and 0.1 minutes), which is 0.6% of the lesson time. Two of the teachers were found to have no wait time for students' responses. The complete version of an extract from the transcript of the pre-intervention discourse analysis in Figure 7.2.2.1 showed the lessons' wait time in Turns T (80). The post-intervention results show that the mean wait time occupied only 1% of the total lesson time. In fact, for four of the five teachers, the wait time can be considered negligible as one particular teacher who had a 4% wait time contributed mostly to the mean wait time. The ratio of the teachers' wait time to lesson time is 0.01 to 1. The complete version, an extract from the transcript of discourse analysis of the post-intervention, showed the lessons' wait time in Turn T (74).

7.6.1 Changes between the pre-and post-intervention wait time.

In order to find the changes in the wait time, the following steps were followed:

- Identification of changes in the proportion of the total lesson time occupied by wait time or silence.
- Comparison of the pre-intervention data with post-intervention data

TABLE 7.6.1: CHANGES IN THE PROPORTION OF LESSONS TIME OCCUPIED BY WAIT TIME(MINUTES).

Teachers ID code	POST-PRE (Change in total wait time (% of the total lesson time) (min)
AD	1.0
OL	0.0
EK	4.1
IR	0.0
AW	0.1
AVERAGE	1.0

Table 7.6.1 shows that the teachers' wait time as a percentage of the total lesson time (minutes) before intervention is 0.6%, and the teachers' total wait time as a percentage of the total lesson time after the intervention is 1%. This indicates a positive 0.4% change in teachers' wait time. This change is very insignificant and not considered a substantial increase in the pattern of teachers' wait time. The complete version of the extract of the transcript from the pre-intervention discourse analysis in Figure 7.2.2.1 that showed an instance of a turn of the lessons' wait time in Turns T (80) and the post-intervention also in one instance in Turn (74) depicts that the change in wait time is insignificant.

7.6.2 The relationships in the comments from the analysed teachers' interview responses with the findings from pre-intervention results of the lessons' wait time.

The analysed quotes from the teachers' comments are below.

Teacher AD's responses were "2 minutes" and "...sometimes it depends on the question, and it depends on the students."

Teacher AW's responses were, "some immediately and some 2 minutes."

Teacher OL's responses were, "I give a little time for the students to think before responding." and "If the student answers and not getting it right, I ask another student."

Teacher EK's responses were, "Immediately I ask the question or within 1 minute, even those that are not responding, I will point at others."

Teacher IR's responses were, "If they are thinking, I will keep on asking the question", and "I give clues if they are thinking."

There were eight analysed quotes from the teachers' interview responses. There were pieces of evidence in the analysed teachers' interviews that two of the quotes indicated that teachers confessed that they do not wait for students to think about the questions. Once the student cannot provide an answer to the question, they move on to another student. Two of the teachers' quotes testify that the teachers' wait time is between one to two minutes for students' responses, and three quotes testify to giving students little time to think while teachers provide clues. One quote said it depends on the individual student and the type of question.

Table 7.6a revealed that three teachers have a wait time of (0.5, 0.1, and 0.2) minutes each, while two teachers move on immediately to the next students without wait time. Two quotes agreed that their wait time was negligible, while five of them exaggerated their wait time.

In the post-intervention analysis using Harland and Kinder, all the teachers said they had been able to improve on the wait time pattern of interaction. Two of the responses are below, but in contrast, the results of the quantitative analysis showed a disparity with the interview responses, with the wait time insignificant and the transcripts of pre- and post-discourse analysis also showing instances of only one turn wait time in each T-80 and T-74.

Teacher IR's response was, "I have been able to wait for students to provide a correct response after a wrong one."

Teacher AD's response was, "I have been patient with students providing responses to questions."

Teacher EK's response was, "Yes, I now wait patiently because there are some that would want to think before responding."

7.7 The responses from the five students' focus group interviews.

In addition to the results obtained from the observation of the classroom interaction patterns, the responses from the five students' focus group interviews will be presented to answer research question one (RQ1: what are the different teachers' interaction patterns presently used in the teaching of basic science in junior secondary schools in Nigeria?). The students ranked the ten statements below to assess their current basic science classroom experience.

The diamond ranking has nine layers, but the researcher gave them ten statements so that they can have the opportunity to choose and discard anyone not applicable to them. Nine statements were ranked in grids of a diamond. The statements were also coded from A-J. The diamond grids were assigned 0-5 (levels of the grid the statement or statements falls into).

Coding of the diamond grids:

0 = Not relevant (Not ranked)

5= Most important (Highest rank)

4= Next important

3= Third most important

2= Second to the least important

1= Least important (Bottom of the diamond)

TABLE 7.7.1 THE STATEMENTS AND THEIR CODES.

CODES	STATEMENTS
A	I learn a lot in basic science class because the atmosphere is friendly and favourable.
B	I would like more opportunities to talk in basic science class.
C	I get to talk to other pupils in the class about the teacher's questions.
D	I feel comfortable talking to my basic science teacher in basic science class.
E	I learn best when listening to the teacher in basic science class.
F	I learn best when discussing with other pupils in the class about a topic in basic science.
G	I like to be asked questions related to life events in basic science class.
H	I get to be corrected with love when I misbehave in basic science classes.
I	I like to be recognised for answering a question correctly.
J	I think everyone participates fairly in basic science class.

TABLE 7.7.2 THE DEGREE OF PREFERENCE OF THE DIFFERENT STATEMENTS ON THE CARDS.

IDENTITY	A	B	C	D	E	F	G	H	I	J
AD	5	3	4	3	3	4	4	1	4	0
OL	1	4	2	5	3	3	3	2	4	0
EK	4	3	0	3	5	2	4	2	3	1
IR	1	4	2	5	3	3	3	2	4	0
AW	3	3	1	5	3	0	2	4	4	2
AVERAGE	2.8	3.4	1.8	4.2	3.4	2.4	3.2	2.2	3.8	0.6

Summarising Table 7.7.2, on average, the degree of preference of the statements according to the students' basic science classroom experience from the highest to lowest is D (4.2), I (3.8), B and E (3.4), G (3.2), A (2.8), F (2.4), H (2.2), C (1.8), J (0.6). Table 7.7.1 shows that the statement which scores the highest average is D (4.2) which is, "I feel comfortable talking to my basic science teacher in basic science lessons", is the students' best experience, followed by the statement "I like to be recognised for answering a question correctly" with an average score of I (3.8). The next important statements to the students are statements B and E, with an average score of 3.4, which are "I would like more opportunities to talk in basic science class, and "I learn best when listening to the teacher in basic science class". The succeeding statement that is important to the students is (G) with an average score of 3.2, which is, "I like to be asked questions related to life events in basic science class".

The students' important statement that follows the above ones is (A), with an average score of 2.8, and the statement is "I learn a lot in basic science class because the atmosphere is friendly or favourable". The next statement that was ranked popular is that (F) I learn best when discussing with other pupils in the class about a topic in basic science. The next statement that the students favour is (H) with an average score of 2.2: "I get to be corrected with love when I misbehave in basic science classes". The second to the last statement that is

popular is (C), with an average score of 1.8, which is “I get to talk to other pupils in the class about the teacher’s question”. Furthermore, the last statement the students considered least important is (J), which has an average score of 0.6, which is “I think everyone participates fairly in basic science class”.

Findings from above reveal that the first two most significant experiences the students responded that they have are that: they feel comfortable talking to their teachers and that they would like to be recognised for answering questions correctly. The students’ next two ranked experiences were expressed in their agitation for an increased chance to talk more during basic science lessons, and they also claimed to learn best while listening in basic science lessons, which they prioritised at the same level. Next, the students ranked an expression of a request that they would like their teachers to ask questions that apply to life events (application, analysis, synthesis, and evaluation) and not just simple questions. The students’ experience that stands in the middle, which I refer to as a ‘good’ experience, was the students expressing that they learn a lot in basic science lessons because the atmosphere is friendly or favourable. This is somehow different from the results showing that the teachers’ non-talk cue is 5.1% of the total lesson time. Though eleven of the teachers’ comments reflect that they believe non-verbal cues are essential, they confirmed to make only little jokes in class and feel they must be firm rather than smile. Besides, they do cane the students often. The students might have ranked this in the middle to satisfy their teachers.

The students’ next two fair experiences are that they learn best when discussing with other pupils in the class about a topic in basic science, and they get to be corrected with love when they misbehave in basic science classes. This might not be unconnected to the fact that evident from the comments from the teachers’ interviews that students seldom engage in classroom discussions during lessons. So, it is not surprising that they rank this at the lower bottom of the diamond. Besides, the results from the lessons’ observation also show that teachers’ talk took up 85% of the total lesson talk. The students also captured at this level that they preferred to be corrected with love rather than punished. In their interview comments, the teachers confessed to using punishment to correct students’ perceived misbehaviour.

The last two ranked lowest at the bottom of the diamond, which is the least experiences expressed by the student, are that they get to talk to other pupils in the class about the teacher’s question, and they think everyone participates fairly in basic science class. These imply that students seldom engage in student-student dialogue in basic science lessons. This is evident in

the results of the classroom talk, where students' talk took 14% of the total lesson talk. Describing the kind of students' talks from analysis of the researcher's field note showed that the students' 14% of talks occurred in students' chorus or individual responses to teachers' questions.

7.8 The results of teachers' post-intervention interviews.

In this Section, with thematic analysis, the researcher will investigate what was responsible for the changes in the practice regarding the teachers' and students' interaction patterns after the intervention. The teachers' interview responses will be matched with the findings obtained from the changes between the post-intervention and pre-intervention results. Harland and Kinder's (1997) model of change in the practice of in-service education and training of teachers with nine INSET outcomes underpins the presentation of the post-intervention interview findings. Six themes were adapted from nine inset outcomes. Some nodes related to the outcome of the intervention were generated (See Appendix 7). The results of the analysis are presented below in Table 7.8.

TABLE 7.8: SIX THEMES, NODES, AND RELATED OUTCOMES FROM THE ANALYSIS OF THE DATA.

THEMES AND NODES	DEFINITION
<p>Theme 1: New awareness outcomes</p> <p>Node: Overall teachers' awareness of using newly learnt knowledge</p>	<p>This is defined as a shift in perception from previous assumptions of content and method of delivery to a new experience.</p>
<p>Theme 2: Value congruence</p> <p>Nodes: Teachers' preference for a method</p> <p>Shared values</p>	<p>This is defined as an individualised code of practice, personalised content delivery, and classroom management methods, a preferred personalised approach to content delivery and classroom management. They are issues about teachers' and educators' values, beliefs, ideologies, and a sense of moral purpose.</p>
<p>Theme 3: Affective outcomes</p> <p>Nodes: Negative affective outcomes</p> <p>Positive affective outcomes</p>	<p>Affective outcome is defined as a feeling of excitement, confidence, and competency about a new practice.</p>
<p>Theme 4: Motivational and attitudinal approach</p>	<p>This theme is defined as a keen interest in implementing newly learnt ideas from INSET. This involves changes in teachers' attitudes towards their self-concepts and their professional development.</p>

<p>Nodes: Inspiration for change</p>	
<p>Theme 5: Impact on practice</p> <p>Node (a): General impact of the intervention on teachers' classroom interaction patterns.</p> <p>(b) Questioning.</p> <p>(c) Students' classroom discussion. (d) Wait-time (e) Misbehaviour correction (f) Non-verbal. (g) Provision of clues to questions.</p>	<p>This theme is defined as direct or indirect methods of intentionally transferring skills to teachers to bring about change in practice.</p>
<p>Theme 6: Knowledge and skills</p>	<p>Development of a more in-depth level of knowledge. Development in teachers' self-knowledge and awareness</p>

7.8.1 Theme 1: New awareness outcomes.

This is defined as a shift in perception from previous assumptions of content and delivery method to a new experience. This will be examined in the context of teachers' awareness using newly learnt classroom interaction patterns. When the teachers were asked about their overall awareness regards using the newly learnt patterns of classroom interactions, the following statements were obtained from the teachers' responses:

Teacher ADs comments were, "Lessons learnt from the pre-training showed that I do most of the work in class, looks like a one-way traffic class and not given the students room to contribute, so I now allow students to talk" and "I watched one of the recorded lessons and saw some mistakes in my teachings, so I prefer the use of the interaction patterns learnt from the training."

Teacher AW's comment was, "...I had not been able to tolerate students discussing among themselves in my lesson before, but I now allow student-student discussion."

Teacher IR's comment was, "... before if I ask them any question, I do not normally give them time to answer before I divert to another student, but now I do, but now I am aware that it encourages students' deep thinking."

Teacher OL's response was, "I know now that students find participation interesting."

Teacher EK's response was, "I now know that allowing students to talk in class makes them happy."

A brief explanation of the evidence from the above statements is that, as a result of the researcher providing the intervention on how to use the different classroom interaction patterns, they are now aware of the differences between the old traditional method of classroom interaction and the new one. This is supported by the transcripts of the discourse analysis of the post-intervention, where the students discussed in groups and findings that students' talk increased by 13.9% of the total talk and 10.1% of total lesson time in the post-intervention data. Harland and Kinder (1997) reported in their study that a change in previous assumptions about a concept or perception can lead to a change in practice with the presence of other outcomes.

7.7.2. Theme 2: Value congruent outcomes.

Value congruence refers to the degree to which an individual's value matches the values found in the classroom or place of work. Value congruence is how an individual behaves at work that is consistent with their self-image. It may also be understood how much the values we espouse to ourselves, and others are consistent with the way we behave at work. The evidence from Harland and Kinder (1997) suggested that for outcomes of change to be achieved, the teachers have to embrace the positive value of the change. The nodes, teachers' preference of method, and shared values fit into this theme, and Fullan (2002) supports this.

When the teachers were asked if they preferred their old method of interaction to the newly learnt classroom interaction patterns, the following statements were coded from their responses:

Teacher AD's comment was, "I am committed to the change in practice and prefer the new method."

Teacher EK responded with, "I prefer the use of the interaction patterns learnt from the training."

Teacher AW's response was, "I prefer the use of the newly learnt method of interaction."

Teacher IR's response was, "I prefer the new method of interacting with the students."

Teacher OL's response was, "I prefer the newly learnt method of classroom interaction patterns."

Here is a brief discussion of the above teachers' statements: Evidently, the teachers like to use the new classroom interaction patterns practice and consider it "a good practice." However, Fullan (1994) opined that standards and norms of teachers' actions or outcomes are much more challenging to change than structural ones and further stressed that for an overall outcome of a change to be achieved, the participants have to espouse a positive value of the changes advocated. It is about what the teachers deem good. From the statements, the teachers expressed that there is a shared similar value among them, which could have a significant effect on the outcomes of change. The work of Harland and Kinder (1992) shows that there was an improved impact on classroom practice, where there are common shared values and beliefs between coordinators and teachers.

The second node generated, shared value, is defined as the compatibility of values between the teachers, school leaders, and educators. When teachers were asked what the school leaders felt about implementing the newly learnt classroom interaction patterns, the following were the statements analysed from the teachers' responses.

Teacher IR's response was, "When my course coordinator witnesses it, his view is that I am wasting time."

Teacher AD's response was, "Our school management just gives rules and regulations, for example, no speaking vernacular in class, but we teachers know that some of these students do not understand some things in English except spoken in the mother tongue and then translated in English. The principal said it is good so far as I can convince the state supervisors and cover the syllabus."

Teacher OL's response was, "My vice-principal academics said just cover the syllabus."

Teacher AW's response was, "My principal liked it when he saw me."

Teacher EK's comments were, "The principal said it is a good method, but if supervisors come, he hopes they will not complain," and "Some other teachers were not encouraging us."

The above teacher's statements briefly suggest that their values could be different. Some leaders liked the idea, some showed concern about state educational supervisors, and some were not supportive and in doubt about the sustainability. Some of the principals showed main concern for syllabus coverage and seemed to be neutral about the project.

7.8.3 Theme 3: *Affective outcomes.*

This theme is about the emotional part of the human being experienced in a learning situation, which can be a positive or negative outcome of a learning process, in the form of a feeling of eagerness, concern, or indifference towards a new knowledge or skill. The nodes fitted into this theme are positive affective outcomes and negative affective outcomes. The statements from the teachers' interview responses were matched together with this theme as follows.

Teacher AD's comment was, "Yes, I feel excited and encouraged, moreover, with additional knowledge from other extra workshops."

Teacher OL's comment was, "I feel like I am a trainee teacher under supervision."

Teacher AW's response was, "Yes, I feel excited about trying it out."

Teacher IR's comment was, "I feel happy using newly learnt interaction patterns."

Teacher EK's response was, "I do not feel discouraged using the newly learnt patterns of interaction."

A brief discussion of the above statements is that four of the teachers are interested in and keen to use the newly learnt patterns of interaction in basic science lessons. One of the teachers' statements infers that the researcher's presence made a teacher feel like a trainee teacher.

7.8.4 Theme 4: Motivational attitude.

This theme is defined as inspiration to implement the ideas learnt during the intervention, which involves teachers' change in attitudes regards their professional development. The node, inspiration for change, was coded under this theme, and when the teachers were asked, "what motivated you to implement the newly learnt patterns of interaction from the intervention provided by the researcher"? The following statements were obtained.

Teacher AD's comment was, "I am really committed to the change in practice when I watched the recorded video of my lesson before your training, and then I decided to use it."

Teacher AW commented, "My inspiration is from the awareness created by you that the class actually belongs to the students, but before, I do almost all the talking."

Teacher EK commented, "I personally see the need to use the new method."

Teacher IR commented, "I watched one of the videos in the training and some mistakes in my teachings, and I like to improve on them."

Teacher OL commented, "Another science teacher in the school and we discuss it together regularly about it, and we encourage each other to improve."

A brief explanation of the above teachers' interview responses is that four teachers said that the inspiration comes from internal; that is, they are intrinsically motivated, and one teacher was extrinsically motivated by a colleague.

7.8.5 Theme 5: Impact on Practice.

This theme is about the various impact on teachers' classroom practices associated with the educative intervention provided by the researcher. The nodes fitted into this theme are seven, and they are the overall impact of the intervention on teachers' classroom interaction patterns, aspect of questioning, students' classroom discussion, wait-time, misbehaviour correction, non-verbal, and provision of clues to questions. When the five teachers were asked how well the intervention has generally impacted their classroom interaction patterns, the following were the statements coded from their responses.

Teacher AD's comments were, "I now give students the opportunity to talk", "I am really committed to the change in practice", "I divide them into groups, and give them different roles relating to the topic", "I try now to find out why some students exhibit some misbehaviour before now, for example, coming late to class", "I listen more and more now and am friendlier to students in the classroom", "... and I now give the students more time to ask questions and try to find out what they do not know."

Teacher AW's responses were, "I now allow student-student discussion" and "I have been allowing the students to talk more in class now."

Teacher EK's responses were, "I give pupils some minutes to think over the questions" and "I was able to correct and not look down on pupils."

Teacher OL's responses were, "I allow them to talk about their ideas", "I now motivate students", and "I allow the students to participate in my teaching."

Teacher IR's responses were, "I have been allowing students to participate", "I ask students to give me their own opinion", "I have been awarding gifts to the individual student. I have also been given clues to questions that seem not to be understood" and "am I am not condemning students for wrong responses anymore."

Broadly, it can be briefly interpreted that all five teachers' statements testified to the different aspects of change they have made to their classroom practices using the new approach to classroom interaction practice. Evidence from the transcripts of the post-intervention discourse patterns where most of the teachers employed student group discussion after the intervention supports the above teachers' statements, and the findings

from the changes made to the lessons' talk showed students' talk increased by 10.1% of all talk time and increased by 8.8% of total lesson time. When the five teachers were asked how they have improved on the aspect of questioning, the following were the teachers' statements.

Teacher AD's comment was, "Not much has been done on that aspect; I still ask closed-ended and open-ended questions."

Teacher AW's comment was, "I have been able to ask thought-provoking questions in class, moving away from simple and single-response questions."

Teacher EK's comment was, "I am still only able to ask pupils simple questions."

Teacher IR's comment was, "I ask simple questions because of the rural location."

Teacher OL's comment was, "Today, I asked students to explain growth and development to make them think deeply."

The interpretation of the above is that two of the teachers claimed they were able to ask closed-ended questions. One of the teachers claimed to have been able to ask an open-ended question, and one teacher asserted that she did ask an open-ended question in an instance of "today." One of the teachers claimed to ask both open-ended and closed-ended questions. One teacher claimed to continue to ask simple questions because of the rural location, probably in support of her claim somewhere in this work that most of the students do not know what a water system of toilets is due to the high level of ignorance and lack of social amenities in the location. This could explain why there were reductions in the number of pseudo-questions and closed-ended questions and an increase in the number of open-ended questions after the intervention.

In relation to the lessons' talk, the researcher tried to find out if the post-interview data supported the findings from the post-observation data of the classroom talk. Statements from the five teachers' interview, when asked whether they now allow students to talk in their lessons, are as below:

Teacher AD's response was, "Yes, the student-student talk took most of the lesson time now."

Teacher IR's response was, "Yes, I divide the students into groups and allow them to discuss within themselves, but this takes much of the time."

Teacher AW responded that "Yes, I give students time to discuss most of the time now."

Teacher OL's response was, "Students now talk in groups in my class."

Teacher EK's response was, "Yes, students' discussion took most of the time".

Reports of an increase in students' total talk and a decrease in teachers' total lesson talks were supported by the evidence from the statements of the five teachers' interviews encouraging students to talk. The researcher tried to find out if the increase in the time teachers actively wait for students to respond to questions after the intervention is supported by the interview data. The teachers' responses to the question, "how have you improved on your wait time" were coded under a node (wait time). The following statements matched with the node:

Teacher AD's response was, "I have been patient with students during their responses to my questions, and I have been allowing students to think, as against former rushing over, trying to cover the topic and not being patient."

Teacher AW's response was, "I have been able to wait for students to provide a correct response after a wrong one."

Teacher EK's response was, "Yes, I now wait patiently, because there are some that would want to think before responding."

Teacher IR's response was, "I wait to provide enough time for students to provide answers to my questions."

Teacher OL's responses were, "Yes, I do. Unlike before that, if a student does not get an answer, I move to the next person", and "... now, I exercise patient."

The responses above correspond with the results of the post-intervention results about the increase in the teachers' current wait time for students' responses to their questions. To further corroborate the findings on the teachers' change in classroom practices, the teachers were asked to tell the researcher how they have been able to provide clues to the questions they ask students. The following responses were analysed under the node.

Teacher AD's response was, "I do that in class now. I give clues to students' questions in classrooms", and "I now pay attention to individual students' needs."

Teacher AW's response was, "I have been able to wait for students to think about the question following her provision of clues when students seem not to understand my question."

Teacher EK's response was, "Yes, I provide clues so that they will be able to grab what I am asking."

Teacher IR's response was, "Yes, I give students clues to my questions when they seem not to understand."

Teacher OL's response was, "... yes, sometimes, reframing my question to give clues."

The five teachers all asserted that they have been providing clues to students' questions when students seem not to be able to understand the teachers' questions. The researcher also probed the claims that teachers have changed their practice of correcting students' misbehaviour from caning to sending out students from classrooms, as earlier reported in the pre-intervention results. The following are the statements coded from their responses:

Teacher AD's comment was, "I have to take the pain not to be harsh to students and now discover that this wastes my time."

Teacher AW's response was, "Please do not make a noise", and, "I tell them to be out of the class."

Teacher EK's responses were, "Yes, I was able to refrain from caning" and "I just tell them, do not do that again."

Teacher IR's responses were, "I like talking to students rather than beating them", and "Since the training, you asked us not to send them out, and I do not send students out anymore."

Teacher OL's responses were, "By using soft words" and "I do not cane students anymore."

A short interpretation of the above statements is that four of the teachers claim that they have been able to refrain from caning or sending students out of the classrooms because of teachers' perceived students' misbehaviour.

The teachers' and students' non-verbal interaction patterns were also looked into to check if the interview data supported the post-intervention findings. These generated the following responses from teachers, which indicated that four of the five teachers claimed that their non-verbal cues were minimal.

Teacher OL's response was, "I just move around groups to explain to students."

Teacher AW's response was, "I make eye contact with students now."

Teacher EK's response was, "I have not done a lot in that aspect."

Teacher IR's response was, "I have not been noticing myself doing that, really."

Teacher AD's response was, "I have not been able to be laughing with students."

Only one teacher asserted that she maintains eye contact with students in basic science lessons. This negligible number of non-verbal cues is supported by the decrease in the percentage of lesson time and total lesson non-talk cue time occupied by teachers' non-verbal cues in the post-intervention data.

7.8.6 Theme 6: Knowledge and skills.

The above theme represents an advancement in teachers' self-awareness or knowledge of any professional development process, a deeper understanding of concepts, and pedagogy. The teachers were asked if they had access to additional knowledge and skills. This is in a bid to find out any claim by the teachers to have access to other forms of teachers' development programmes that could provide an extension to self-knowledge and understanding of science concepts and pedagogy. The following statements were coded and analysed from their responses.

Teacher AW's comment was, "I have been able to shift from the lecture method to student-to-student group discussion." I have also refrained from flogging students."

Teacher OL's responded, "One major thing I have achieved is that I am now able to refrain from my habitual use of "do you understand" as a question."

Teacher IR's comment was, "I am now able to engage the students more in class. I can start by lecturing, then group the students, and if I ask them questions, I give clues."

Teacher EK's response was, "I have learnt to use students' ideas and build on them and ask questions based on their responses to drill the students further."

Teacher AD's comment was, "After the intervention, I attended a training on classroom interaction facilitated by a lecturer from Ekiti State University. I am more aware now that the lesson is not about covering the syllabus but about the students learning what they are supposed to learn."

The statements above reveal the skills and new knowledge experiences that individual teachers claimed they acquired from the post-intervention. However, only one teacher claimed to have added additional training to the training intervention.

7.9 The statistical analysis of the results.

This Section details the statistical analysis methods employed in determining the associations between the phase of the study and the types of teachers' and students' classroom interaction patterns for each of the five teachers and as a whole.

It is important to note that this study's statistical analysis can only provide little evidence for generalisation based on the small five cases studied, considering the exploratory nature of the study and the importance of the individual properties of each case explored. The five cases provided a clear picture of the issues for logical and analytical generalisation in that the results of the cases studied can be compared to previously developed theories and make projections about the transferability of the findings. Future selection of diverse cases may provide an expansion that will facilitate the replication of results and provide more insights into the relationships. The case study enhanced the understanding of how and why the issues surrounding teachers' classroom practices in Nigeria. The analytic components of the current study detailed the underlying situations, while the statistical analysis supports understanding the situations.

7.9.1 Wilcoxon signed ranked test.

The Wilcoxon signed-rank test is a non-parametric paired test to compare the relationship between samples from the same participants. It is used to find out if two samples are chosen from a population having the same distribution, and it is used when the distribution of the contrast between two samples' means cannot be assumed to be normally distributed.

Wilcoxon’s signed-rank test with STATA 16 software statistically answers the sub-research questions about the effects of the intervention on the teachers’ and students’ verbal, non-verbal and wait-time patterns of interactions.

TABLE 7.9.1 WILCOXON SIGNED RANKED TEST.

WILCOXON HYPOTHESES TEST SUMMARY					
	Null Hypothesis	Test	Sig. (P-Value)	Decision	Conclusion
1	The median of the differences between teachers’ talk time (as a percentage of the total talk time) before the intervention and after intervention equals zero. The Median between TTPTTB and TTPTTA is zero.	Related-Samples Wilcoxon Signed Ranked Test	0.0431	Reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on teacher’s talk time as a percentage of the total talk time.
2	The median of the differences between students’ talk time (as a percentage of the total talk time) before the intervention and after the intervention equals zero. The Median between STPTTB and STPTTA is zero.	Related-Samples Wilcoxon Signed Ranked Test	0.0431	Reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on student’s talk time as a percentage of the total talk time.

3	The median of the differences between teachers' talk time (as a percentage of the total lesson time) before the intervention and after the intervention equals zero. The Median between TTPTLB and TTPTLA is zero.	Related-Samples Wilcoxon Signed Ranked Test	0.0431	Reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on teacher's talk time as a percentage of the total lesson time.
4	The median of the differences between students' talk time (as a percentage of the total lesson time) before the intervention and after the intervention equals zero. Median between STPTLB and STPTLA is zero	Related-Samples Wilcoxon Signed Ranked Test	0.0431	Reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on student's talk time as a percentage of the total lesson time.
5	The median of the differences between teachers' direct talk time before the intervention	Related-Samples Wilcoxon Signed	0.0431	Reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on

	and after the intervention equals zero. Median between TPDTB and TPDTA is zero	Ranked Test			teacher's direct talk time.
6	The median of the differences between teachers' indirect talk time before the intervention and after the intervention equals zero. The Median between TPITB and TPITA is zero.	Related-Samples Wilcoxon Signed Ranked Test	0.0431	Reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on teachers' indirect talk time.
7.	The median of the differences between wait time before the intervention and after intervention equals zero. Median between WTPB and WTPA is zero	Related-Samples Wilcoxon Signed Ranked Test	0.7855	We cannot reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention did not elicit a statistically significant change in the wait time.
8	The median of the differences between	Related-Samples	0.1380	We cannot reject the	A Wilcoxon signed-rank test showed that

	students' pre-intervention non-verbal cue time and post-intervention non-verbal cue time equals zero. The Median between SPCB and SPCA is zero.	Wilcoxon Signed Ranked Test		null hypothesis.	the intervention did not elicit a statistically significant change in students' non-verbal cue time.
9	The median of the differences between teachers' pre-intervention non-verbal cue time and post-intervention non-verbal cue time equal zero. The Median between TPCB and TPCA is zero.	Related-Samples Wilcoxon Signed Ranked Test	0.0796	We cannot reject the null hypothesis.	A Wilcoxon signed-rank test showed that the intervention did not elicit a statistically significant change in teachers' non-verbal cue time.

Table 7.9.1 above shows that the Wilcoxon signed-rank test results showed that the intervention had statistically significant effects on the teachers' and students' classroom talk concerning the total time and total lesson time. Seemingly, the teachers' talk was reduced, and the students' talk increased after the intervention. The Wilcoxon signed-rank test showed that the intervention had statistically significant effects on teachers' direct talk and the teachers' indirect talk time. The teachers' direct talk time seems reduced, while the teachers' indirect talk time seems to increase. The Wilcoxon signed-rank test showed that the intervention did not elicit a statistically significant change in teachers' non-verbal and wait-time interaction patterns.

7.9.2 The chi-square and Fisher exact test analysis.

The chi-square was used to investigate what was actually found in the study and what is expected to find. This is used as the data were in categories and displayed as frequencies and

not percentages as above and with a sample up to 5. Where the frequency displayed was less than 5, the Fisher exact probability test of 2x3 was employed.

This section statistically answers the sub-questions of RQ3; what are the effects of the intervention on the teachers' frequency of different types of questions in basic science lessons? This is answered statistically below by highlighting the results obtained from the chi-square test of independence, measuring how expected data is compared to the observed data with the null hypothesis: the teacher's types of questions are pre-and post-intervention independent or not related. This is to estimate the probability that the two samples (the pre and the post) are drawn from the same distribution. The experimental hypothesis is that the observed did not occur by chance (goodness of fit). This is done separately for each teacher and for all five teachers together.

For teacher AD.

TABLE 7.9.2.1 CONTINGENCY TABLE FOR TEACHER AD SHOWING THE OBSERVED VALUES, THE EXPECTED VALUES, AND THE CHI-SQUARE STATISTICS

	PSEUDO	CLOSED	OPEN	Row Totals
PRE	30 (28.22) [0.11]	24 (21.04) [0.42]	1 (5.74) [3.91]	55
POST	29 (30.78) [0.10]	20 (22.96) [0.38]	11 (6.26) [3.59]	60

The Chi-Square statistic is 8.51. The p-value is .01. The result is significant at $p < .05$. $[df = (r-1)(c-1) = (2-1)(3-1) = 2]$. $X^2 = \sum \frac{f_o - f_e}{f_e}$. P-value = CHISQ.TEST(actual range, expected range) = .01). $X^2(2, N = 115) = 8.51, p = .01$. We reject the null hypothesis. There is a significant association between the teacher's questioning pattern and the phase of the study (i.e., before or after the intervention).

The researcher's interpretation of the above is that the observed values did not happen by chance. The most probable explanation for the decline in the teachers' frequency of pseudo questions could be that the teacher engaged in more meaningful classroom activities like dialogue, facilitating student group discussion or, as can be seen above,

spent more time asking open-ended questions as intended by the intervention. The intervention presumably may have changed the teacher's pattern of questions: the teacher's use of pseudo questions declined maybe because the teacher engaged in more meaningful classroom activities like dialogue, facilitating students group discussion or, as can be seen above, spent more time on asking open-ended questions as intended by the intervention. This teacher's frequency of questions generally increased after the intervention.

Teacher OL.

TABLE 7.9.2.2 CONTINGENCY TABLE FOR TEACHER OL SHOWING THE OBSERVED CELL VALUES AND EXPECTED CELL VALUES AND THE CHI-SQUARE STATISTIC FOR EACH CELL.

	PSEUDO	CLOSED	OPEN	Row Totals
PRE	134 (121.92) [1.20]	15 (19.00) [0.84]	3 (11.08) [5.90]	152
POST	20 (32.08) [4.55]	9 (5.00) [3.20]	11 (2.92) [22.40]	40

The Chi-Square statistic is 38.09. The p-value is .00. The result is significant at $p < .05$. $X^2(2, N=192) = 38.09, p = .00$. The null hypothesis is rejected. There is a significant association between the teachers' questioning patterns and the pre-and post-intervention phases. The seeming change or the drastic reduction in the numbers of pseudo might be due to the intervention.

This significant association might probably be due to the teacher's increase in the number of open-ended questions from three to eleven. The teacher might also be busy facilitating students' active engagement in other learning tasks. The teacher's frequency of questions seems to reduce drastically after the intervention, possibly due to a drastic reduction in the frequency of pseudo questions.

Teacher IR.

Table 7.9.2.3 Contingency table for teacher IR showing the observed cell values and expected cell values and the chi-square statistic for each cell.

	PSEUDO	CLOSED	OPEN	Row Totals
PRE	3 (10.89) [5.72]	18 (12.96) [1.96]	7 (4.15) [1.96]	28
POST	18 (10.11) [6.16]	7 (12.04) [2.11]	1 (3.85) [2.11]	26

The Chi-Square statistics is 20.00. The p-value is .00. The result is significant at $p < .05$. $X^2 (2, N = 54) = 20.01, p = .00$. The null hypothesis is rejected. There is a significant association between the teachers' pattern of questions and the phase of the study, the pre-intervention and post-intervention. This teacher's pattern of changes shows a different form from those observed from others, almost in reverse of others, as there was an increase in the frequency of pseudo questions while the frequency of opened and closed questions decreased.

This might be that the intervention impacted differently on the teacher or the teaching situation is different from the others. The teacher reduced the frequency of questions asked after the intervention.

Teacher AW.

TABLE 7.9.2.4 CONTINGENCY TABLE FOR TEACHER AW SHOWING FISHER'S EXACT PROBABILITY TEST:2x3

	PSEUDO	CLOSED	OPEN	TOTAL
PRE	22	14	0	36
POST	13	25	11	49
TOTAL	35	39	11	85

Chi-Square=14.77. $p = .00$. The result is at $p < .05$. The Fisher Exact probability test (2x3) gives $P_A = 0.00$ and $P_B = 0.00$ (P_A and P_B are non-directional (two-tailed)). Chi-Square Test ($df=2$). P_A =The P of the observed plus sum of P of all other cell frequencies (consistent with observed marginal total \geq P of the observed). P_B = The P of the observed plus sum of P of all other cell frequencies consistent with the observed marginal total $>$ P of the observed. $X^2 (2, N = 85) = 14.77, p = .00$. The null hypothesis is rejected. There is a significant association between the teachers' pattern of questions and the phase of the study in two directions; there is a significant association as well as to measure the effectiveness of the association. The hypothesis in both directions is significant and bears the same weight. The closer the value, the more the association.

It can be inferred that in the phase of the study, the teachers' patterns of questions improved both in quality and quantity, as explained below:

The teacher's number of pseudo questions was reduced by nine, the frequency of the open-ended question increased from zero to eleven, and the frequency of closed-ended questions increased by 11. This may presumably mean that the teacher changed the interaction pattern to asking more questions requiring students' critical thinking or high cognitive questions and increased questions for simple recall of facts or rote learning. The teacher also seemed to reduce the time wasted on pseudo questions and probably diverted spending some time facilitating students' activities. The teacher's frequency of questions increased after the intervention.

Teacher EK.

TABLE 7.9.2.5 CONTINGENCY TABLE FOR TEACHER EK SHOWS THE OBSERVED AND EXPECTED CELL VALUES AND THE CHI-SQUARE STATISTIC FOR EACH CELL.

Result	PSEUDO	CLOSE	OPEN			Row Totals
PRE	9 (10.15) [0.13]	30 (25.38) [0.84]	3 (6.46) [1.85]			42
POST	13 (11.85) [0.11]	25 (29.62) [0.72]	11 (7.54) [1.59]			49

The chi-square statistic is 5.25. The p-value is .07. The result is not significant at $p < .05$. $X^2(2, N = 91) = 5.25, p = .07$. There is not enough evidence to conclude that there was an association between the teacher's change in the patterns of questions and the intervention hence "fail to reject the hypothesis." The teacher's frequency of questions increased after the intervention.

The Five teachers.

TABLE 7.9.2.6 CONTINGENCY TABLE FOR THE FIVE TEACHERS SHOWING THE OBSERVED CELL VALUES AND EXPECTED CELL VALUES AND THE CHI-SQUARE STATISTIC FOR EACH CELL.

	PSEUDO	CLOSED	OPEN	Row Totals
PRE	198 (169.61) [4.75]	101 (109.00) [0.59]	14 (34.39) [12.09]	313
POST	93 (121.39) [6.64]	86 (78.00) [0.82]	45 (24.61) [16.89]	224

The chi-square statistic is 41.775. The p-value is .00. The result is significant at $p < .05$. $X^2(2, N = 537) = 41.775, p = .00$. The result is significant for the five teachers; the relationship between these variables was significant.

The changes intended by the intervention appear to have manifested in improvement in the patterns of the five teachers' types of questions: the five teachers' use of pseudo questions was reduced by more than half. This may be due to the teachers' efforts to ask meaningful questions or to spend quality time facilitating students' active participation through dialogue, discussion, and demonstration. Meanwhile, the five teachers enhanced their pattern of open-ended questions by more than a three-fold increase. The teachers, on the whole, reduced the number of pseudo-questions and closed-ended questions they asked and increased the frequency of open-ended questions they asked.

7.9.3 Percentages of the frequency of types of questions.

Making comparisons of the patterns of questions is difficult on the basis of the chi-square frequencies test alone because the total lesson time varies for each lesson. The following tables

for each teacher display percentages of each type of question before and after the intervention. The percentages in each row add up to 100% because all the questions were categorised as either pseudo, closed, or open, none were classed in two or more categories, and there is no uncategorised question. For comparison, percentages are shown for the total sample in the final table.

For teacher AD.

TABLE 7.9.3.1 THE PERCENTAGE OF TEACHER AD TYPES OF QUESTIONS.

	PSEUDO	CLOSED	OPEN
PRE	54.6%	43.6%	1.8%
POST	48.3%	33.3%	18.3%

Teacher AD from the above percentages shows results in line with the chi-square analysis. This teacher’s pattern of questions improved as intended by the intervention. The percentages of pseudo-questions and closed-ended questions were reduced, while the percentage of open-ended questions increased by 17%.

For teacher OL.

TABLE 7.9.3.2 THE PERCENTAGE OF TEACHER OL TYPES OF QUESTIONS.

	PSEUDO	CLOSED	OPEN
PRE	88.2%	9.9%	2%
POST	50%	22.5%	27.5%

The rate at which the teacher engaged in asking pseudo questions improved by a reduction of more than 38%. And there was a boost in the number of open-ended questions, with a percentage increase of 26%.

A brief interpretation of the above is that teacher OL's pattern of questions also changed in the direction of the intervention. The key thing about this teacher is the huge drop in pseudo questions and a big increase in the percentages of open-ended questions and closed-ended questions.

Note that the percentage representation can be revealing but not as revealing as the absolute numbers, which are shown in Figures 7.5a and Table 7.5b.

For teacher IR.

TABLE 7.9.3.3 THE PERCENTAGE OF TEACHER IR TYPES OF QUESTIONS.

	PSEUDO	CLOSED	OPEN
PRE	10.7%	64.3%	25%
POST	69.2%	26.9%	3.9%

For teacher IR, the teacher's pattern of questions changed. Although the percentage of the pseudo questions increased, the percentage of the closed-ended question reduced. The teacher asked a lot more pseudo questions and fewer open and closed-ended questions. These are more revealed in Tables 7.5a and 7.5b.

For teacher AW.

TABLE 7.9.3.4 THE PERCENTAGE OF TEACHER AW TYPES OF QUESTIONS.

	PSEUDO	CLOSED	OPEN
PRE	61.1%	38.0%	0%
POST	26.5%	51%	22.5%

The percentage of the pseudo questions was reduced by 34%.

This may infer that the teacher improved the pattern of pseudo-questions as intended by the intervention. The intervention’s influence is more shown with a zero percentage in open-ended questions before the intervention to a 23% boost after the intervention. **For teacher EK.**

TABLE 7.9.3.5 THE PERCENTAGE OF TEACHER EK TYPES OF QUESTIONS.

	PSEUDO	CLOSED	OPEN
PRE	21.4%	71.4%	7.1%
POST	26.5%	51.0%	22.5%

Teacher EK ‘s pattern of the pseudo questions seemed not to improve because there was an increase in percentage after the intervention. But the pattern of the open-ended questions seemed to have highly improved by an increase of 15% and a reduction in the number of closed-ended questions asked.

All the teachers.

TABLE 7.9.3.6 THE PERCENTAGE OF ALL THE TEACHERS’ TYPES OF QUESTIONS.

	PSEUDO	CLOSED	OPEN
PRE	63.3%	32.3%	4.5%
POST	41.5%	38.4%	20.1%

The result of the percentages for all the teacher’s types of questions seems to be in line with the chi-square analysis result. The above shows a change in the teachers’ patterns of questions. There is also an advancement towards the intervention with a shift in open-ended questions from 5% to 20%. The teachers’ pattern of asking pseudo questions seemed to improve by a decrease of 21%, as intended by the intervention. The pattern of open-ended questions is enhanced by 15%.

A brief explanation is that this may mean the teachers were busy with meaningful classroom activities like engaging the students in quality questions that initiate classroom talk and facilitating students' group discussions.

7.9.3.6 Summarising the statistical results.

Using STATA 16, the Wilcoxon signed-rank test showed that the intervention had a statistically significant effect on teachers' talk and students' talk as a percentage of both the total lesson time and total talk time. These had also been shown in Table 7.2.1, which revealed a decrease of 10.2% in teachers' talk in the total lesson time and a decrease of 9% in teachers' talk in the total classroom talk. The students' talk increased by 8.8% in total lesson time and 10.1% in total classroom talk. This result also supports the statements analysed where all the teachers claimed that they allowed the students to talk more after the intervention. The video lessons where the students engaged in group work and student-student discussion were also revealing. The Wilcoxon signed-rank test showed that the intervention is statistically significant on the teacher's direct and indirect talk, as shown in Table 7.3.1, where the teachers' direct talk reduced by 22.6% and the teachers' indirect talk increased by 22.2%. This is equally supported by the qualitative findings where teachers said they now build more on students' responses, and the video also showed teachers asking more questions, building more on students' ideas, and encouraging them more.

The Wilcoxon signed-rank test showed that the intervention had no statistically significant effect on teachers' and students' non-verbal cues, as revealed in Table 7.4.1 revealed that the teachers' non-talk cues reduced by 32.4% of the total non-talk cues and students increased by 32.4%. The teachers' non-talk cues were reduced by 2.2% in the whole lesson time, and the students' non-talk cues increased by 3.9% of the total lesson time. The Wilcoxon signed-rank test showed that the intervention had no statistically significant effect on teachers' wait time. The teachers' wait time seemed to have not changed due to the intervention. This can be seen in Figure 7.5.1, where there was just a non-significant increase of 0.4% in the teachers' wait time.

The chi-square contingency tables show significant results for four of the teachers' types of questions and a non-significant result for one. Collectively, the chi-square contingency table for all five teachers' types of questions shows a significant association. This presumed that the intervention has effects on the teachers' interaction patterns of questioning, which is

also justified by the percentage tables. However, as revealing as the tables might be, the absolute values shown in Tables 7.5a and 7.5b are more revealing than those above.

7.10 Summary of the Chapter.

This chapter has presented the baseline findings of the classroom interaction patterns in basic science classrooms in junior secondary schools in Ekiti State, Nigeria, which consists of teacher-dominated talk characterised by recitation, initiation and re-initiation of responses, use of ritualised pseudo questions and few closed-ended questions, and insignificant teachers wait time. The students' responses were chorus responses initiated by the teachers. The chapter also presented the pre-intervention interview responses from the teachers and students. This chapter has also presented the post-intervention findings and compared the pre-intervention and post-intervention data. The chapter finally described the changes found in the qualitative and quantitative data from analysed transcripts of the discourse patterns, interview responses and charts. The findings showed that there were changes to the classroom seating arrangements. The teachers modified the teaching style by incorporating group discussion and increased the use of opened-ended questions, which helped to reduce the teachers' talk and increased students' talk and active participation.

Chapter Eight: Reports of Teachers' Interviews about Issues Affecting Classroom Interaction Patterns.

8.0 Introduction.

This chapter reports the results of research question three (RQ3): What issues do teachers say affect classroom interaction patterns in basic science lessons in Ekiti State, Nigeria? The researcher asked the teachers, "What issues do teachers think affect their classroom interaction patterns?" The five teachers' interview responses were analysed by creating eight nodes or themes. These include language, lack of instructional materials, teachers' unpaid wages, cultural values, poverty, habits, time pressure in lessons, lack of basic classroom amenities, and overcrowding. The five teachers' statements concerning each issue are coded under related themes, and the findings obtained will be presented in order of importance. The first four issues were coded for all the teachers and will be discussed accordingly.

8.1 Language.

The statements from the teachers revealed that the compulsory use of the official English Language in basic science lessons poses a problem in interpreting most of the science words in English. More so, in some schools, Management imposes sanctions on students and teachers who speak Yoruba language; their mother tongue, in the school and classrooms. The teachers alluded to spending time to replace/explain many science words that they could have simply provided quick and accurate translations in students' mother tongue. According to the teachers, despite the efforts and time spent, they still felt that what they were trying to say was not understood. An example of a word mentioned here is mistletoe. This word could easily have related to students by using the mother tongue word (Afomo-Onisano in the Yoruba language). Still, teachers claimed they struggled to explain such words in English. The following testimonies capture the issue of language.

Teacher AD: "The compulsory use of English as a language to teach in school, especially science, creates a language barrier, as the students understand much science in their local languages" and "The students understand many science words in mother tongue languages. The school even made speaking English language a rule that if broken, there are penalties also involved."

Teacher AW: “Some students do not understand English language, so I try to interpret in the mother tongue language and later explain in English language” and “Sometimes, students do not know how to express themselves in English, and do not have the confidence to ask or respond to questions.”

Teacher EK: “Hmmm, Language has been a barrier; when I tell them to do something in English, I have to interpret it in the local language again so that they can understand.”

Teacher IR: “The school Management insisted on the use of the borrowed official English language in teaching in the school, including basic science, which creates a language barrier.”

Teacher OL: “English language is a barrier, as students do not understand everything you teach in English language.

All the teachers expressed in their claims above that the use of English language as the only official means of communication in schools is a barrier to classroom interaction between teachers and students. Because of this barrier, the content of classroom interaction patterns is less rich in quality.

8.2 Lack of instructional materials.

All the teachers express concern about the lack of teaching aids in their basic science lessons. This hinders patterns of classroom interactions by failure to arouse and sustain students’ interests and also hampers student-student, group, and whole-class classroom interaction. The students’ opportunity to verbally share experiences that are imperative for new ideas and make learning more lasting is also impeded. The teachers’ claims of providing alternatives to teaching aids by taking the students out to see real objects were feasible. However, the researcher’s lesson observations reveal that none of the teachers took the students out for viewing. Comments provided by the teachers are as follows:

Teacher EK: “Ekiti state government said they have no money and do not supply teaching aids which would have enhanced teaching and learning if we had had teaching aids. Teaching aids would help to teach difficult subjects and different topics; if time permits, students can go out to see real objects.”

Teacher AD: “There are no teaching aids and no time to take the students out to see real objects.”

Teacher OL: “There are no teaching aids, so I try to improvise teaching aids for any topic I want to teach, and sometimes, I will take students out to see the physical objects.”

Teacher AW: “No, not in JSS1. I take students to the laboratory to touch or see the equipment” and “Sometimes, the government gives science equipment to higher classes but not junior classes in this class.”

Teacher IR: “The school lacks teaching aids and some materials required for teaching, and sometimes, we do not have chalk to write on the chalkboard.”

Teacher AD: “There were no newly provided instructional materials. Those available are stored in the principal’s office.”

Instructional materials promote students’ active classroom participation and could make classroom engagement passive and less productive if not available. Without instructional materials, there will be no student-material interaction patterns.

8.3. Teachers’ unpaid wages.

Nigeria was in an unforeseen recession at the time of data collection. The government had not paid the teachers wages for six months, so there was reduced motivation and dedication, with an attendant impact on effectiveness. Teachers were pursuing secondary jobs; a practice which hindered their professional development. These are evident from the teachers’ lack of emotional and financial stability and could affect their classroom behaviours, mostly the teachers’ indirect teaching. This could be perceived in the way and the number of times they smile, frown or even pick on the students by misinterpreting students’ behaviours. The teachers’ irregularity at work also resulted in the researcher chasing and rescheduling lesson observations. All the teachers expressed grievances about the non-regular payment of their salaries. Below are their comments:

Teacher EK: “I have not been paid six months of salary, and I am economically unstable.”

Teacher AW: “It is difficult to get even transport fare to work when workers have not been paid for six months now.”

Teacher OL: “We source financial support from other means just to feed.”

Teacher IR: “It is not easy to be effective when our earnings are not regular.”

Teacher AD: “The state government owes us a lot, and we do not have another job, and we have families, so being dedicated is challenging.”

Irregular payment of teachers’ wages is a common issue in Nigeria, and this causes demoralisation and poor motivation. This could affect teachers’ classroom behaviour, and effectiveness in classroom interaction patterns may not be encouraged towards improving their classroom behaviour or performance. Pursuing further professional development to improve their skills in classroom interaction patterns may be very difficult as teachers wriggle with financial difficulty.

8.4. Cultural values.

The teachers claimed that the feeling of losing classroom control is also of concern to them. It is a local culture in Nigeria that while an adult is talking, it is inappropriate for younger persons to contribute or interrupt except when called upon to do so. Even when called upon, the adult verbally or non-verbally subtly moderates what the younger person says. This culture has made its way into the classroom and significantly affects student-teacher interaction. The analysis of all five teachers’ comments revealed their concerns about losing classroom control if the students were allowed to talk in lessons. The following statements capture this deep-seated cultural belief.

Teacher AD: “Students are ordinarily fond of talking in the classroom in order to divide the class. It is when the teacher is talking that they, too, will be discussing, and I do not allow this so that I can maintain class control. I do not allow students to talk for this reason.”

Teacher OL: “When I am teaching, and students are talking and disrupting my class. I try not to allow this while I am teaching because students will disrupt my class.”

Teacher AD: “Students’ talk makes the class rowdy and uncontrollable.”

Teacher EK: “When students are permitted to talk and take over the class.”

Teacher IR: “Students’ talk disturbs the flow of teaching.”

The out-of-respect, authoritarian nature of adult and children conversation in Africa, including Nigeria, found its way into the classroom with few interactions between the teacher and the students. The teachers talk mostly in the classroom, and students talk mostly in chorus

and only when initiated by teachers. This makes the students quiet, and it is not easy to ascertain their comprehension of the topic.

8.5. Poverty.

Four of the five teachers expressed that poverty influences basic science classroom interaction patterns, and this is evident in their comments below:

Teacher AW: “Sometimes, some of the students would come to class in the morning without eating food. Poverty might make it difficult for them to assimilate; some might not have money to buy exercise books, pens, and other writing materials to copy notes.”

Teacher IR: “At times, some students might not have eaten morning food, and they come to school.”

Teacher EK: “Most of the students do not have textbooks, pens, and worksheets.”

Teacher AD: “Most students lack textbooks, workbooks due to poverty, lack of money to buy textbooks, workbooks.”

Teacher OL: “Some students lack workbooks because parents cannot afford the money to buy them.”

Poverty and lack of money for textbooks and workbooks means the teachers have to expend extra time writing homework and classwork on the chalkboard, resulting in less/little time to spare for students’ active talk. Evidence from the video showed that some students come to school without breakfast due to poverty. This could hinder students’ active participation and make classroom interaction less robust. More so, hunger can impede students’ concentration in class, leading to unnecessary repetition by the teacher and increasing the teacher’s talk time.

8.6. Old Habits.

The teachers revealed that being trained by teachers who used the traditional teaching methods and using those styles too for a long time had made them accustomed to that old method. The teachers also expressed that they are not encouraged to change by those in charge of teacher education and school management. The classroom interaction patterns are resistant to change due to a lack of encouragement from conservative senior staff who serve as role models for

teachers. The following submissions confirm four of the teachers' predispositions to the traditional style:

Teacher AD: "I have lectured for ten years with the old traditional method. The education officers, during inspections, look out for my ability to present my lesson notes/plan and my capacity to complete the scheme of work. There has not been any mandate for a change in engagement."

Teacher AW: "My teachers taught me using the old traditional method, and I did repeat this in teaching practice. I have not been really challenged to change my mode of interaction."

Teacher EK: "I have been teaching like this since I became a teacher, and I have not any need to personally assess my teaching method."

Teacher OL: "I have not been criticised, and the Management mainly encourages us to cover the syllabus."

The teachers' interaction patterns are linked to the way they were taught and therefore tailor their teaching patterns and strategy to the quality of pre-service training. The teachers performed their roles based on the experience they received in schools and colleges. Teachers are not aware of or introduced to other kinds of discourse patterns due to a lack of, for instance, dialogic role models, so they stick to the old traditional style in which the teacher's classroom talk dominates, leading to passive students and poor interaction patterns.

8.7. Time pressure in lessons.

The teachers revealed that the time allotted for lessons affected students' interaction in science lessons. The comments made by three of the five teachers revealed that they had to complete and cover a large amount of work in the curriculum within the duration of the term. The comments received are as follows:

Teacher AD: "Time has been a constraint. As much as possible, and I try to make use of the available time to do something. Management of the 40-minute lesson between student-student talk, writing notes on chalkboard, teacher explanation, questioning, moving away from the former, teacher explanation, then note writing by students take much time."

Teacher IR: “Time factor, the time allocated for the students to think over responses to questions or prompt students for responses, is a challenge.”

Teacher OL: “The scheme of work contains a lot to be covered by teachers and teacher-students dialogue, and student-student dialogue is time-consuming.”

The above statements are supported by the high prevalence of rote and teacher-led recitation, as evident in the findings from the observation data and teachers’ interview responses, coupled with the fact that teachers spend time writing notes and assignments on the chalkboard as evident in the videotape. This means more time to accomplish the task and less time for students’ classroom dialogue with fewer opportunities lasting for short durations resulting in hampered quality and quantity of interaction patterns.

8.8 Lack of basic classroom amenities.

Three of the five teachers expressed concern about the lack of some classroom infrastructure. This concern is evident in their statements below.

Teacher AW: “The classroom lacks electricity, and sometimes it becomes very dark.”

Teacher IR: “Most classrooms lack cross ventilation and sometimes become non-conductive and very warm.”

Teacher AD: “The students sitting positions are mostly overcrowded; there are not enough chairs and benches, so sometimes, students sit in four or three on a seat.”

Teacher OL: “The physical condition of the classroom is not encouraging, and the floors are deteriorating with dust everywhere, no louvres for windows, no fan, and it can be very warm because of congestion too.”

Large classes and small classroom spaces cause overcrowding; most of the desks facing the chalkboards lead to teachers not being able to move around and talk more to some sections of the classroom. Some sections responded more to teachers’ questions, especially those sitting in the front. None of the classrooms had electricity to illuminate them; there was no fan in any of the classrooms; the classes were stuffy and uncondusive, and almost everyone was sweating. Lack of electricity means not being able to use ICT equipment like computers, games, televisions, videos, and tape recorders that could enhance student-student talk or teacher-

student talk. Such materials were not even available, and the teachers were not encouraged to improvise as there would be no electricity to power them.

8.9 Overcrowding.

Three of the teachers made statements expressing evidence of overcrowding hindering classroom interaction patterns in their lessons. The following statements capture this issue/challenge.

Teacher AD: “In a situation where students are over 50, it might be a little difficult for the teacher to control them.”

Teacher OL: “Too large numbers of students in a class, a maximum of 50 students, which leads to poor class control.”

Teacher IR: “I think the number of students in the class is too large, with above fifty, for an effective interaction to occur.”

Overcrowding makes active classroom interaction patterns difficult, as teachers struggle to move between desks, resulting in often standing in front of the classroom. All the desks overlook the chalkboard, and a minimum of three students sit on a bench. Overcrowding increases distraction, conflicts, and disruptions, which affects students’ focus. A large class makes it difficult to provide an equal chance for students to participate, so there is a distinctive active zone and several inactive zones. Meeting students’ individual needs in consideration of varying interests, abilities, and personalities are equally challenging. Group work could also be disastrous with such limited spaces.

8.10 Lack of exposure to innovations.

The teachers discussed a common issue with schools located in rural areas, opining that the students at such schools have limited access to new developments and new technologies, thus, creating barriers in classroom interaction patterns in basic science lessons. Thus, it is difficult for students to connect with things they have never seen or heard before. The following statements support this allusion:

Teacher IR: “I teach in a rural area where most students are not familiar with innovations like the water system of a toilet. Out of 35 students sampled in my class, only one has seen a water closet. All they know is the old pit toilet system.”

Teacher AW: “This is a rural area, and the students have a boundary of knowledge.”

The people in rural areas do not have access to new technology, resulting in students’ minimal background knowledge of the topic; thus, to aid comprehension, teachers would need to expend more time and effort and utilize different styles of classroom interaction. For teachers in these rural areas to effectively connect their students’ background knowledge with new experiences, they had to be adequately skilled in different classroom interaction patterns. If these teachers originate and live in rural areas, then classroom interaction patterns might be less abundant in content when teachers relate real events or objects.

8.11 Summary of the Chapter.

This chapter discussed the teachers’ responses concerning factors mitigating effective classroom interaction patterns and highlights each of the teachers’ interview discourse. The problems are discussed according to the level at which the teachers perceive affect their practices, starting with the highest. Considering the results of the current study and combining them with the findings of the previous studies, it can be concluded that the use of English (second language) in teaching and learning is a barrier to easy access of students to teacher explanations and that the use of English did not facilitate effective interaction between students. The second barrier is teachers’ responses that the lack of TLMs affects effective interaction, which impedes students’ effective learning. The others are teachers’ irregular or unpaid wages, cultural beliefs, for instance, that students’ talk can disrupt the class and make teachers lose class control, poverty, old habits, time pressure in lessons, overcrowding, and lack of basic classroom amenities.

Chapter Nine: Discussion of Findings.

9.0 Introduction.

This chapter discusses the findings of the three main research questions: RQ1: What are the different teachers' interaction patterns presently used in teaching basic science in junior secondary schools in Nigeria? RQ2: What are the effects of awareness intervention on teachers' interaction patterns in basic science classrooms? and RQ3: what are the issues that teachers say affect classroom interaction patterns in basic science lessons in Ekiti State, Nigeria? Each research question is discussed in sections following the sub-research questions under them.

These involve the patterns of teachers' and students' classroom interaction before the intervention and the identified changes that the intervention had on the teachers' classroom interaction patterns in basic science after the intervention. Also, the teachers' opinions on the challenges they encounter in their classroom interaction practices are discussed. The findings are discussed by reflecting on the results of this research and other previous studies. The intervention aspect is examined to see how basic science teachers can embrace effective classroom interaction patterns into their views and practices by providing accessible and affordable pre-qualification training and continuous professional training and development programmes.

9.1 Discussion of the findings of research question one (RQ1): What are the different teachers' interaction patterns presently used in teaching basic science in junior secondary schools in Nigeria?

The discussion of the findings is done in sections following the sub-research questions.

9.1.1 The pre-intervention teachers' talk.

The discussion in the following section is steered by the sub-research question one (a)(sub-RQ1a): what are verbal interaction patterns used by teachers in basic science lessons?

The pre-intervention data shown in Table 7.2a in Chapter 7 reveal that the teachers' talk took an average of 79% of the total lesson time, and the students' talk took an average of 12.8%. Also, the teachers' talk took an average of 85% of the total talk time, while the students' talk took an average of 13.9%. Hence, 91.6% of the total lesson time is dominated

by talk. Furthermore, analysis shows that the ratio of teacher to student talk is approximately 8:1. The excerpt from Table 7.2.2.1 in chapter 7 of the pre-intervention classroom discourse transcript reveals the teachers' conversational sequences in Turns (9, 12, 14, 15, 17, 20, 23, 25, 27, 29, 31, 34, 36, 39, 42, 45, 49) that consists of teachers explanation in Turns (1, 4, 5, 9, 12, 14, 17, 20), for instance in T20 ("We want to look at the meaning of personal sanitation.....") and re-initiation in Turns (12, 15, 23, 25, 27) like Turn 12- What do I call it?, and Turns (25 and 27) - Meaning of what? Where the teacher stretches the last word or sentence to also serve as a form of re-initiation, Turns (15, 23, 25, 27, 29, 34, 45, 49, 53). The students' responses are either in the form of chorus responses to the teacher's pseudo questions, as shown in Turns (11, 19, 22, 33, 38, 41, 44, 48) with majorly a "Yes", or responses to the teacher's re-initiation of sentence or word(s), as shown in Turns (8, 13, 16, 24, 26, 28, 35, 45), example, Turn 13 ("family health") and ("health") in Turn 16.

The interpretation of the above findings is that most of the teachers' talk dominates the lesson while teachers leave students with very little time to talk, thereby not actively participating in the lessons. The teaching pattern was found to be whole-class, involving consistent teachers' explanations and pseudo questions and teacher-initiated or re-initiation of responses and feedback. The teacher mainly initiates conversations by explaining and re-initiate or reinforcing through repetition or stretching, or omitting the last word to elicit responses from the students. The students already know from the teacher's tone whether a chorus or individual response is required. There is hardly a follow-up of students' responses because it is a routine pattern of initiation, re-initiation, and responses. The repetitive re-initiation for completing words by omission and highly routine pseudo questions for affirmation deterred the student from active engagement or participation to develop a high cognitive function.

This might be because the teachers do not see anything wrong with the amount of time and kind of talk they engage in, and maybe the teachers are unaware that they talk this long. After watching videotapes of their lessons, most of the teachers in the follow-up interview said that they did not know they had talked that much and wished they had talked less. Jallifar and Nattaq (2013) and Elabbar (2017) supported these findings that much of classroom events happen intuitively and very fast and unknown to teachers and also quoted a comment from a teacher after viewing a videotape of her own lesson and claimed not to have an idea of talking so much, therefore, not let the students' practice.

Most of the teachers in the present study admitted that they talk for about 30-40 minutes in a single science lesson; teacher AD's response was, "... then for the next 15 minutes, I will do the talking, then ask them questions on the previous topic been taught....so usually, I do the talking for about hmmm, 15-18 good minutes." And teacher OL's response was, "The regular period schedule for a lesson is 40 minutes; if it is a new topic, I can use the whole 40 minutes to explain the topic; at times, I may exceed the 40 mins for that lesson; I normally exhaust the 40 minutes." This shows that the teacher can talk the whole lesson. These verbal testimonies confirm the results obtained from the observation data that the teachers' talk dominated the lessons.

These results corroborate the findings of many previous works, which revealed a dominance of teachers' talk in classrooms (Mpho, 2018; Muganga and Ssenkusu, 2019; Inamullah, 2008; Pontefract and Hardman, 2005; Abuh, 2021; Kalu-Uche, Alamina and Ovute, 2015; Osokoya, 2013; Ackers and Hardman, 2001; Domike and Odey, 2011; Akkus, Gunel, and Hand, 2007; Alexander, 2001; Barnes, 1992; Hardman et al., 2001; Hardman et al., 2008; Hattie, 2012). These studies found, in addition to the dominance of teachers' talk, a high prevalence of teacher-led recitation and that the length of teachers' talk is inversely correlated to the length of students' talk, which deprives students of the opportunity to express their opinion about the topic they are learning. Hence, students are restricted to teacher-led and traditional authoritative lecture methods, thus inhibiting students' role in engaging in meaningful learning. When students are limited to short responses, then they cannot reason. Instead, students are tailored toward a certain participation strategy by providing specific responses that limit or prevent creative thinking together. These studies suggest that teachers should reduce their talk time and use more open-ended questions to elicit high-ordered thinking responses from students.

The dominance of teachers' talk in the lesson time and lesson talk above agrees with these studies (Akter, 2010; Asyah, 2016; Hardman, 2008; Inamullah, 2008; Zare-Behtash and Azarnia, 2015; Flanders, 1970). These confirm that teachers verbally dominate classrooms. Several reports have shown that teachers' constant talk during lessons did not significantly improve learning (Hattie, 2012; Hetzelein, 2016; 2011; Nystrand et al., 1997; Nunan and Bailey, 2009). Excessive teachers' talk has faced many critiques, and some researchers do not recommend reducing teachers' talk. Van Lier (2014) emphasised the promotion of improved quality and effectiveness of teacher's talk rather than its quantity.

At the centre of the social constructivism approach is the position that knowledge can be constructed through language in classrooms. This provides the notion that scientific conceptual knowledge first appears between people on an inter-psychological level and then within the learner on an intra-psychological level (Vygotsky, 1978). The idea of taking the teacher-led authoritative or traditional approach through the zone of proximal development to generate features of a dialogic and interactive approach to promote students' higher-order thinking was popular among scholars such as (Alexander, 2008;2017b;2018; Lemke, 1990; Dawes, Mercer and Wegerif, 2004; 2000; Mortimer and Scott, 2003). They stated that the traditional-led approach, when combined with the dialogical and interactive approach, will link scientific concepts to social concepts that can be applied to diverse situations and promote complex cognitive components. Alexander (2018; 2006), Lemke (1990), Littleton and Howe (2009), Mercer (1995; 2000), and Mortimer and Scott (2003) argued that through social constructivism, essential achievements were made in educational reforms, research, and evaluation of science teaching.

In Nigeria, the notion of Vygotsky's transformation approach from the teacher's passive dominant teaching to the student's active zone of proximal development where the students engage in cognitive learning transmissive from the teacher is hindered by factors that exert a powerful influence on the patterns of the lessons observed. In Chapter 8, the teachers stated these factors to include overcrowding, where Teacher AD comments, "In a situation whereby students are over 50, it might be a little difficult for the teacher to control them," and Teacher OL said, "Too large numbers of students in a class, a maximum of 50 students, which leads to poor class control." All the teachers testified to the absence of teaching and learning material (TLMs). For instance, Teacher AW responded, "No materials provided, not in JSS1. I take students to the laboratory to touch or see the equipment", and "Sometimes, the government gives science equipment to higher classes but not junior classes in this class", and Teacher IR's response was, "The school lacks teaching aids and some materials required for teaching, and sometimes, we do not have chalk to write on the chalkboard."

The above style of teacher-dominated classroom discourse cannot be disengaged from issues and problems of teacher education in Nigeria, which include unpaid salary, poverty, old habits, overcrowding, corruption, non-implementation of educational policies, and lack of specific and effective teachers' continuing professional development programmes to address and update pre-service gaps in the short six months of teaching practice and the cumbersome

teacher training curriculum (Hamilton-Ekeke, 2016). These challenges have been discussed in detail in Chapter 2 of this thesis.

In summary, the teachers' talk dominates basic science lessons and leaves the students little time to participate. The type of the teachers' talk is the authoritative and traditional old method or teacher-recitation, followed by the teacher's initiation of responses in the form of repetition or completion of phrase or word. Feedback is done by clapping, and this is usually absent. The basic science classroom is teacher-centred and not student-centred despite the fact that students' active participation has significant roles in the teaching and learning of basic science.

9.1.2 Students' pre-intervention talk.

The discussion in the following section is steered by the sub-research question two (sub-RQ2): what are verbal interaction patterns used by students in basic science lessons?

The pre-intervention observation data in Table 6.2 in Chapter 6 reveals that the students' talk took an average of 12.8% of the total lesson time and 13.9% of the total talk time. Student-student discussions did not take place, and students barely talked in the lessons. Most of the students' talks were chorus responses to the teacher's pseudo questions that serve as checks or reinforcement and chorus responses to the teacher's repetitive stretches, or omission of the last word or words or phrase or mid-sentence rise in tone for students to complete that serves as re-initiation to elicit students' responses during recitation. The excerpt from chapter 7, Table 7.2.2.2 also shows students' chorus responses in Turns (11, 19, 22, 33, 38, 41, 44, 48) that serve as responses to the pseudo questions, for instance, the chorus "Yes" in Turns 11, 19 and so on. Turns (8, 13, 16, 24, 26, 28, 35, 45), where students give chorus responses by completing the teacher's word, words or phrases or filling the gap in the sentence omitted by the teacher, for instance, words like "sanitation" in Turn 24 and filling the gap of omission with the word clean in Turn 35, and "germ" in turn 45.

As addressed in the results, negative attitudes that reduce students' talk were identified in the teachers' interview findings to support the results from the lesson observations further. The student-student discussion was viewed by four of the teachers as an intolerable classroom activity, as shown in one quote from one of the teachers' comments: Teacher EK said, "Not acceptable", Teacher AD said, "Not allowed in my class", and teacher AW said, "...during teaching, they do not discuss" and in Teacher OL's comment, "This does

not normally happen during my teaching in class.” Only Teacher IR seems to have a positive attitude towards student-to-student classroom discussions by saying, “... It is very good, but it’s not common in my class”.

Here is a discussion of the above: most of the teachers viewed this as an offensive activity that could lead to class rowdiness and noise; some of the teachers found it an act that could challenge their ability to control the class. These might not be unconnected with issues of discipline and culture that value respect and authority for elders. In most African cultures, when adults talk, children do not speak except when called upon to do so (Osokoya, 2013; Adegboye, 2013). The results from the present study show that the students talk mainly when the teacher initiates or indirectly or strategically re-initiates students’ talk. This is supported by (Osokoya, 2013; Adegboye, 2013), which stated that in most African cultures when adults talk, children do not speak except when called upon.

The students’ talk appears to be restricted by the society that traditional command and demands that students respect their teachers by keeping quiet while their teacher or adults talk and, and this may be because the people of Ekiti state are regarded as highly educated and disciplined with the highest number of professors in Nigeria (Akindutire and Olanipekun, 2012; Oyebanji, 2012). Guthrie (2011) and Tabulawa (2006) traced the culture of strict discipline within West African primary schools back to the old African traditional practices before British colonial days and the adoption of the nineteenth-century British missionaries’ tradition of school discipline in West African schools.

Adegboye further explained that school management in Nigeria today is still largely Westernised, and the strong cultural influences are evident and have sometimes made practices challenging and ineffective. This high prevalence of the traditional and culturally dominated method of teaching replicates the situations found in other Sub-Sahara African countries (Mpho, 2018; Muganga and Ssenkusu, 2019; Guthrie, 2011; Fuller and Synder, 1991; Acker and Hardman, 2001; Pontefract and Hardman, 2005; Hardman et al., 2011). Ocheni and Nwankwo (2012) corroborated Adegboye’s statement about the influence of Westernisation and stated that even though Nigeria’s culture before colonisation had pre-existing forms of management in their ancient empires, the onset of British colonisation altered citizen’s thought processes, experiences, and environment up till today. Africans should move away from their colonial master and engage in what works for the African

society, considering our culture and what had worked for us before based on our existing situations, and be able to differentiate between modernisation and westernisation.

Evidence in the videos shows that teachers were not really struggling to control or discipline the students: the few students whom teachers perceived to misbehave were punished instantly. The students were passive but possessed lots of respect for their teachers. As can be seen in the videos, a student-to-student discussion was non-existent throughout the pre-intervention observations. Findings from all the teachers' statements confirmed that students only talk when teachers call upon them to do so, to answer questions, or respond to teachers' commands. Respect for adults is valued in Africa; younger ones can also be structured towards quality classroom talk when adults recognise them to do so to promote high cognitive development. The various challenges facing children in Nigeria could contribute to the way they respond in classrooms, for instance, lack of food, poverty in general, poor learning environments, lack of exposure to modern innovations and overcrowding classrooms.

Evidence from the student interview in Chapter 7 also shows in section 7.7, Table 7.7.1 that "I would like more opportunities to talk in basic science class, and I learn best when listening to the teacher in basic science class". The statement ranked 2nd out of the other 10 statements, which shows that the students feel that they need to talk more in their basic science lesson, so why not? When trying to find out the level of students' classroom participation, the students equally ranked at the lowest level of the diamond ranking, "I get to talk to other pupils in the class about the teacher's question", and I think everyone participates fairly in basic science class at the bottom(lowest). This further confirms that students experience rare peer interaction and participation in their basic science experiences. There was virtually no pupil-to-pupil interaction or evidence of pupils' self-reliance or of pupils being encouraged to generate their own questions or form and articulate some ideas (new or old). These results broadly support and corroborate the findings of previous works of (Ackers and Hardman, 2001; Alexander, 2000; Hardman et al., 2008; Hardman et al., 2011; Juma and Ngome,1998; Pontefract and Hardman, 2005; Zare-behtash and Azarnia, 2015).

Generally, these types of talk in the lessons can be teacher explanation, which was predominantly lecture driven or teachers' recitation, followed by the teacher's initiation of student's responses in the form of repetition or completion of a word or phrase. Students usually know whether to provide a chorus answer or individual responses

from the teachers' tone. Chorus responses dominate the students' verbal talk, and students respond when asked to answer questions.

Student-initiated talk nearly never existed despite the fact that Yuill (2011) asserts that children are born naturally to explore and are inquisitive and crafty, so teachers should be motivated to create peer-to-peer (s) interactive opportunities for students to share ideas and employ various methods that can spark up their inquiry mind, this was supported by (Westbrook et al., 2013; Hattie, 2012). Omiko (2017) identified various factors inhibiting the teaching and learning of basic science in secondary schools in Nigeria and suggested some modern methods of teaching and learning science. The methods suggested are the activity-oriented methods, laboratory method, concept-mapping, enquiry method, and guided discovery method of instruction.

In modern-day science education, attention is on the emphasis on changing students from passive receivers to manipulators and users of concrete materials and information. Classroom talk is a powerful tool that the teacher can explore to get the students engaged, expand to explore students' cognitive thinking extent, expand and build upon ideas, and explore and expand students' critical and cognitive thinking. The basic science curriculum was revised to meet the Millennium Development Goals of enabling learners to develop and apply scientific and technological knowledge and skills and enable students to utilise a wide range of options made available through science and technology. This competency-based basic science and technology curriculum in chapter 2, section 2.4, was developed alongside a teacher's guide with specific activities and competencies to be developed by students. Ogunleye and Showunmi (2020) agreed that the rote learning method found in this study could not achieve the above aims of the competency-based basic science and technology curriculum.

Ukor and Agbidye (2015) further found that some teachers were still writing integrated science in the year 2015 as the nomenclature for the subject following the 1988 6-5-4 system and were not aware that the curriculum had been through two successive changes. Odili and Ajuar (2011), in their studies, found that very few teachers have knowledge of the new BST curriculum as the new curricula were not available in most schools, so the teachers have not been involved in the implementation. How do you teach what you do not know to exist? In support of the above assertions, the teachers in this study revealed in chapter 8 in their interview responses some specific and major challenges facing their classroom

interaction such as old habits- Teacher AW- “My teachers taught me using the old traditional method, and I did repeat this in teaching practice. I have not really been challenged to change my mode of interaction” and Teacher EK- “I have been teaching like this since I became a teacher, and I have not any need to personally assess my teaching method.”

Other challenges the teachers stated include overcrowding discussed above and lack of teaching materials- Teacher IR’s response was, “The school lacks teaching aids and some materials required for teaching, and sometimes, we do not have chalk to write on the chalkboard.” Lack of basic classroom amenities was also among the challenges- Teacher OL- “The physical condition of the classroom is not encouraging, and the floors are deteriorating with dust everywhere, no louvres for windows, no fan, and it can be very warm because of congestion too.” Chapter 7, Table 7.0, shows that in all the 10 lessons transcribed in this study, other than the teachers’ lesson notes and chalkboards, there were no lessons where the teacher employed the use of teaching and learning materials that could stimulate active participation and discussion and improve the quality of responses from students to improve the quality of the classroom interactions patterns.

The teachers ended up talking longer by lecturing to cover times that could have been used to interact with materials that could aid quality questions and stimulate students’ discussion to improve high cognitive learning, and effective classroom interaction will be impeded, with an average of 46 students in each lesson with almost no space to move between the desks in the classrooms (Westbrook et al., 2013). Well, it could be argued that the teachers could actually improvise with local material, but other major issues mitigate against this attitude, such as lack of payment of teacher’s salaries, imagine having no income for six months. The fact that some students come to school without breakfast is another issue that could affect the level of classroom interaction and, in some cases, where students sleep off in the classroom. This definitely affects the teaching and learning process and, invariably, teachers’ effective performance and dedication. Teachers should be encouraged and provided with information, training and updates about classroom pedagogy and the provision of enabling work environment where wages are paid as at when due, and the provision of learning materials are important to the quality of teachers’ interaction patterns in science classrooms.

In summary, students’ engagement in meaningful basic science teaching and learning process is inhibited by the teacher’s dominated classroom talk through the traditional

authoritative lecture method. The students were not actively engaged in the teaching and learning process.

9.1.3 The teachers' direct and indirect talk.

The discussion in this section will be guided by the sub-research question, one (b), (RQ1b): What are the direct and indirect verbal interaction patterns used by teachers in basic science lessons?

On the teachers' indirect talk, which is accepting student's feelings, praise, or encouragement, asking questions, and accepting or using student's ideas and direct talk, which is lecturing and giving directions, Table 7.3a shows that the teachers' direct talk dominates the teachers' total talk by constituting 87% while the indirect talk constitutes 13%. The result also shows that more than three-quarters of the teachers' total talk is dominated by lecturing and giving directions. Only 13% of the teacher's total talk was spent on accepting students' feelings, accepting, or using students' ideas, asking questions, and praising or encouraging students' actions. The videotaped lessons show that, in most cases, the teachers often move on to the next activity rather than building or accepting students' responses. The few acceptances of students' ideas done by teachers were by repeating students' responses.

The teachers' direct talk in Turns (1, 5, 9, 12, 14, 15, 17, 20, 23, 25, 31, 34, 39, 42, 45, 42) where the teacher said, "I am going to give you a little definition that you are going to read, then you can understand" and indirect talk in Turns (2, 4, 7, 10, 18, 21, 27, 32, 37, 40, 43, 47). The indirect teacher's talk consists of highly routine pseudo questions like, "do you understand me now" in Turns (10, 19, 21, 32, 38, 40, 43) and a few questions that serve as evaluation questions, greeting, and very few closed-ended questions on page 36 of the original transcript, sharp objects like what? The teacher's opened-ended questions, like "how do we take care of our skin?" was asked on page 39 of the original transcript towards the end of the lesson.

The teacher gives students directives with authoritative tones in different ways by giving orders and commands in a "do this, do that" like "talk louder" and "touch your skin" in the later part of the lesson. The transcript of the pre-intervention discourse analysis shows a routine that usually lacks follow-up and build-up of students' ideas. The discourse patterns showed the teacher's two instances of acceptance of student ideas and genuine praise, like "good of you". The affirmation of responses occurred through the repetition of students'

answers. The analysis of the teachers' direct talk in the interview reported that the teacher's explanation is the presentation of facts, like the definition of terms, instead of the process of how to know, giving students directives with authority with tones that command. This authoritative power could also be by giving information firmly. The fact that commands are essential tools to be used in classroom management cannot be overlooked, but the danger is that students may feel coerced when commanded in an angry or sarcastic tone of voice and may resist teachers' directives. Hence, teachers are encouraged to give commands in positive and neutral statements (George, George and Fogt, 2013).

Evidence from the analysis of the lesson's videotape and most of the teachers' interview reports show that teachers used flogging as a disciplinary method. When they were asked what forms of disciplinary methods they employ, they also stated flogging, caning, sending students out of the class, and standing up, which are forms of punishment as disciplinary methods. Busari et al. (2017) found out that punishments like flogging and beating are acceptable methods of discipline in southwestern Nigeria. The idea of punishment and discipline are not seen as forms of abuse like in the developed world. Yoruba has a notion that children would turn out badly if left alone on their own (Ndofirepi and Shunba, 2014). No laws differentiate discipline and punishment methods for children in Nigeria (Busari et al., 2017).

The 13% of the teachers' talk that was indirect talk consisted mainly of teachers' acceptance of students' ideas by the repetition of those responses; acceptance of students' feelings was rare, and praises or encouragement took place by teachers' commanding chorus clapping for students when responses are correct. Myers, Simonsen and Sugai (2011), Floress and Jenkin (2015), Benson-Goldberg and Erickson (2021), and Good and Brophy (1994) found these teachers' methods of praising and encouraging students' responses not to be genuine. In their studies on effective teaching, they suggested that teachers should use words such as excellent, good, fantastic, good thinking, warm smiling or nodding in exciting manners to praise or encourage students as they have positive effects on self-esteem.

The study results show that affirming students' responses occurred mainly by teachers repeating students' responses when they were correct, and generally, building on the responses or probing was rare. Teachers immediately move to the next student when a student gives a wrong response or when a student seems to be putting thoughts together about the teachers' questions, and the teachers assume that the student does not know the answer to

the question. Tofade, Elsner, and Haines (2013) agreed with this report and explained that apart from the teacher not waiting enough for students to think through a response, there are some instances where teachers respond to their own questions.

The teachers' interview responses, however, showed that they spend a minimum of 15 minutes and a maximum of 30 minutes on the presentation of facts; for example, Teacher OL's response was "A minimum of 30 minutes for the presentation of facts and concepts", and Teacher EK responded that "at least 20 minutes will be used on that subject to explain the concept." The above confirms that a lot of the teachers' talk is direct talk, which supports the result that the teachers' direct talk was 87% of all the teachers' talk. When the researcher asked about teachers' indirect talk, four of the responses showed that the teachers will accept or affirm students' responses positively; for example, Teacher AW's response was, "I will encourage her by smiling", and teacher AD response was, "I am very friendly and do not frown at students", and when asked how the teachers praise or encourage students in the class, four of the teachers said they would ask other students to clap.

Alexander (2018) asserts that teacher's talk is essential in classroom organisation and in the process of students' acquisition of knowledge. If teachers provide the right kind of talk, learners will learn. For the teachers to do this, they need the necessary training, which could be incorporated into a pre-teacher training curriculum and continuing teacher education programmes. According to Darling-Harmond (2008), teacher activities that include reflecting and collaborating with other teachers, observing students closely, and encouraging sharing of ideas should be incorporated into teacher training. The ability of the teacher to carefully use questions to stimulate and encourage the learners to reflect on their answers and the ability to use praises to encourage the expected and specific efforts that students put into their work and behaviours exhibit are important skills that teachers need to develop (Myers, Simonsen and Sugai, 2011). Alexander (2008) and Mercer and Hodgkinson's (2008) view is that teachers should use talk effectively to instruct and explore children's ideas so that they gain a deep understanding of the teacher's presentation.

In summary, the teachers' direct talk dominated the teachers' total talk, which was done through the lecture method, and the teachers' few indirect talks were dominated by pseudo questions, by giving directions and use of claps to praise teacher-initiated and re-initiated students' responses.

9.1.4 Discussion of the teacher's types of questions.

This section's discussion is steered by the sub-research question five: (Sub-RQ5): What are the teachers' different types and time spent on questions in basic science lessons?

Table 7.5a shows that the teachers' pseudo questions occupied 47.2% of all questions and 42.7% of all question time, the teachers' closed-ended questions occupied a proportion of 45.6% of all questions and 50.7% of the total question time, and open-ended questions occupied 7.2% of the total question and 6.8% of all question time. The discourse analysis of the classroom conversation in Table 7.22.1 shows the types of the teacher's questions. The pseudo questions were used in Turns 7(Is that not so?), 12 (What do I call it?), Turns 25, 27 (Meaning of what?) and Turns 10, 21, 18, 32, 37, 40, 43,47,51 (Do you understand). The closed-ended (for example, define cooking utensils?) and opened ended questions (for example, "How do we take care of the home we live?) are in the original transcripts. The closed-ended questions appeared on the transcript of the discourse analysis in 15 instances, while the pseudo questions used as evaluation questions to check students' understanding of concepts appeared in 134 instances and opened ended questions appeared in 3 instances.

In this study, the extensive ritualised use of huge numbers of pseudo-questions, which Hardman et al. (2008) referred to as tag questions, is prominent. The teachers' rare use of thought-provoking open-ended and close-ended questions is prevalent. So, these simple questions failed to elicit students' range of responses as they were teacher-designed to produce students' affirmative responses. These findings provide support to studies by (Ackers, 2001; Smith et al., 2003 and 2008; Smith and Higgins, 2006; Tofade et al., 2013). The teacher interview responses indicated that the teacher's form of questions were mainly closed-ended questions. For instance, Teacher OL's responses were, "...so, we ask simple questions that produce a one-word answer, close-ended questions like define, state, or mention and Teacher EK's response was, "In most cases, I ask low-ordered questions", and Teacher IR's response was, "I ask simple or low-ordered or close-ended questions. The teachers showed that they spent between 3-5 minutes in a whole lesson asking questions. This is shown in the responses of Teacher AD, "I usually spend like 5 minutes", and Teacher EK, "I do not really know, but it can be up to 3 minutes", and Teacher AW, "I spend 2 minutes, I think."

However, the findings from the results of the observations showed that while the teachers spent a total average of 3.9 minutes, three of the five teachers spent just about 2 minutes on questions, one teacher spent less than 1 minute, and one teacher spent 13 minutes, although with a wide range (0.8, 2, 1.8, 1.9 and 13.2) minutes. The longest time was spent asking pseudo questions (13.2 minutes). Tofade et al. (2013), Osborne and Chin (2008), Alexander (2018), Swain (2000) and Mercer, Dawes, Mercer and Staarman (2009) all agreed that the importance of questions is to engage students in meaningful dialogue to develop their interest and motivate them. Another is to develop critical thinking skills and an inquiring attitude to stimulate students to further seek knowledge on their own. Since these forms of questions found to be prominent in this research fail to meet the classroom objective for questioning, then teachers should improve the quality of their classroom questions and ask students thought-provoking questions and questions related to their life experiences. These support Vygotsky's (1978) idea that teachers and students must learn together as a team, sharing and building on their own and other students' ideas.

In summary, the teachers' main types of questions were pseudo-questions and close-ended questions despite pseudo-questions not being genuine forms of checking students' understanding of topics, and close-ended questions were not useful as forms of student engagement and meaningful thinking. Teachers must be able to use thought-provoking questions to explore more clear, affirmative responses and make students more confident and respectful of their peers' contributions. Questions can be used as recall as well to encourage creativity through imagination.

9.1.5 Nonverbal cues.

The discussion of this section is guided by sub-research questions 3 and 4 (Sub-RQ3 and Sub-RQ4): What are non-verbal interaction patterns used by teachers in basic science lessons, and what are non-verbal interaction patterns used by students in basic science lessons?

A prominent feature of the pre-intervention results is that non-verbal activity accounts for less than 10% of the average lesson time: the teachers' non-verbal activity accounted for 5.1% while the students' accounted for 2.7%, which is an insignificant result. The teachers' non-talk cues can be found in the complete copy of the transcript of discourse analysis of teacher turn mainly by pointing to students and fixing eyes on the lesson notebook in Turn 53, and the students' non-talk turns can be found in Turn 110 on pages 10, 15, 30 and 35 by

clapping of hands, showing their fingernails and raising up their hands to answer questions and touching their skin. The teachers' eyes were either fixed on the lesson's note or the chalkboard or roaming randomly around the classroom.

The teachers agreed in their responses that nonverbal cues are important in the classroom through their interview responses. For instance, Teacher AD's statements were, "Yes, it is important", "I do not normally frown", and "... but I have to be very firm", and Teacher OL's responses were " , We cheer them up to make the class interesting" and "They are very good." The above responses were in contrast to the results obtained in the lesson. Different values in different societies indicate that teachers may lack skills to interpret non-verbal cues, forget to use nonverbal cues, or underestimate their benefits in the classroom. Ledbury et al. (2004) agreed that teachers often forget about or underestimate the importance of nonverbal communication in their own or their students' performance, even though speech is only one aspect of communication.

The lack of effective nonverbal cues in this study can be explained by the Nigerian culture, which has a negative attitude towards touching someone and looking straight into someone's eyes. Looking straight into one's eyes is mostly used when signalling warning signs or a sign of lack of morals if used by a younger person in many Nigerian cultures. This aligns with most studies showing that nonverbal cue displays, and their meanings depend on cultural and biological origin (Floyd, 2006; Matsumoto, 2006). Some studies showed that about three-quarters of most communication in the classroom is non-verbal (Ali and Muhammad, 2011; Darn and Eryilmaz, 2005; Akinola, 2014). Some findings suggest that two-thirds of our interaction is nonverbal (Ali and Muhammad, 2011). According to another study, in each conversation, only seven per cent of the concepts are expressed as spoken words (Bambaeeroo and Shokrpour, 2017). Non-verbal cues are often more sophisticated and effective than verbal cues, conveying more meanings than words. For instance, a smile conveys our feeling much more subtly than words. Most information is passed through the complex combination of appearance, posture, body movement, sight, and facial expressions.

In summary, teachers seemed not to be cognisant about using non-verbal cues in their lessons, despite there being good reasons to think that these forms of communication could be useful in the classroom.

9.1.6 Discussion of teacher's wait time.

The discussion of this section is steered by sub-research question 6 (Sub-RQ6): How is silence as a wait time used by teachers in basic science lessons?

In terms of the wait time, in an average lesson time of 32 minutes, the teachers' total wait time after posing questions is 0.2 minutes, which is negligible and the least among the result of all other patterns of interaction. Two of the individual teachers had no wait time, while the highest teacher had a wait time of 0.5 seconds. Throughout a lesson, this wait time is not long enough for students to think through a good answer (Choudhury, 2005; Li, 2011; Nystrand et al., 1997; Stahl, 1994; Tofade et al., 2013; Albergaria-Almeida, 2010; Shahrill, 2013). Studies have indicated that 3 second wait time is to be allowed for low cognitive demand questions, and more than 10 seconds or 30 seconds wait time is commonly agreed to be suitable to consider a more challenging question and to prepare to think through a full answer (Hastings, 2003; Irvine and Garling, 2015; Rowe, 1972).

Meanwhile, some have found a wait time of 1 to 2 minutes adequate for high-ordered questions (Tofade et al., 2013). However, more wait time is needed so that students can dialogue and bring out thorough arguments if students are to collaborate or discuss questions in groups (The Ohio State University, 2020; Chin and Osborne, 2010; Webb, 2009; Rowe, 1972; Stahl, 1994). Since the teachers in the present study had a wait time (0.2 seconds) that is less than the above research agreed time (3 seconds) to wait for low cognitive demand questions, it implies that the questions asked by the teachers demand no cognitive thinking, the questions did not require time to think about their responses, the students and teachers already know the responses, how and when to respond. This supports the fact that most of the questions found to be asked by the teachers were not genuine questions.

In the present study, the teachers moved on to resume the teacher's talk or move to the next available respondent even when teachers perceived that the student did not know the answer to the question or was unwilling to wait any longer. The teacher's wait time for the student to answer questions did not show any significant value concerning the type of question that teachers asked or their perception of an individual student's ability. Because students were not thinking of the responses, which were mostly chorus, follow-up of questions and provision of clues, comments, and probes were rare as most of the teachers'

questions were information-seeking and required predetermined short answers as they were usually pitched at recall or a lower-order cognitive level.

In summary, the teachers' wait time is generally insignificant; hence teachers did not seem to be aware of the value or importance of effective use of wait time. This could be due to factors such as time pressure in lessons, work pressure, large class sizes, emotional issues due to poor condition of service and the absence of teaching and learning materials that could foster classroom interaction.

9.1.7 Discussing the students' pre-intervention focus group interviews.

This section is concerned with the baseline data from students about their perceptions of the classroom interaction patterns they experience in basic science lessons.

In Chapter 7, the analysed students' interview responses were reported. The students ranked ten statements by employing a diamond ranking technique, with the best of their experiences at the top and the least at the bottom. The students' most important basic science classroom experiences reported in the study varied from feeling comfortable talking to their basic science teachers and requesting that teachers award them more praise and encouragement when they answer questions correctly. The students' feeling of being inadequately rewarded in basic science lessons is supported by reports from teachers' statements and reports of teachers' pre-intervention indirect talk. Another prominent experience that students reported was their request for more time to be able to talk in basic science lessons. This is supported by reports of the pre-intervention verbal interaction analysis, with students' talk occupying just 12.8% of the total lessons and 13.9% of all lesson talk. The fact that all the teachers reported talking most of the time during lesson presentations and felt that allowing classroom discussion can make the classroom rowdy shows why the teachers do not give the students time to talk.

The students' focus group interviews also reported a high-ranked request that their teachers ask them questions that apply to live events or make connections between everyday experiences and scientific explanations, not just questions requiring yes and no answers. This is supported by the reports of the teachers' extraordinary habitual high frequency of pseudo questions, followed by a high frequency of close-ended questions. In a single lesson, one teacher asked 134 pseudo-questions. The highest frequency of open-ended questions asked in a single lesson by all the teachers is 7. Furthermore, one of the teachers reported not asking

any open-ended questions throughout the lesson. Another highly ranked experience was when the students reported that they learn a lot in their basic science lessons because of the friendly atmosphere. In contrast, the reports from the teachers claimed that they hardly ever joke or smile in class. Some teachers reported that smiling could lead to a loss of class control or a sign of weakness.

The most probable explanation for this is that the students may be concerned that their teacher would come to know their comments; hence, they gave socially acceptable answers. Another explanation may be that the students are enculturated into thinking that there is nothing unfriendly or inappropriate about adults not joking or smiling around them.

Experience ranked low by students were their experiences relating to learning best by discussing with other students in the class about a topic in basic science and that they get to be corrected with “love” when they misbehave in basic science classes. The student ranked getting to talk to other pupils in the class about the teacher’s question and participating fairly in basic science class as their least experience. The students’ responses testified to the reports of the videotaped classroom lessons. The students expressed feelings of being inadequately rewarded and requested more friendly and collaborative classrooms with more time to talk in basic science lessons. Also, they expressed their desire for more open-ended questions that will enhance their high cognitive development.

The researcher, therefore, infers from the results of this present study and findings from previous studies that the teacher’s talk dominates classroom lessons in Ekiti State. This talk is characterised by recitation, followed by the initiation of responses from students and feedback. Feedbacks were usually not provided or in the form of chorus clapping. The teachers’ type of questions was found to be non-genuine questions and simple questions that required no deep thinking and were mostly from previous recitations. The lessons’ non-verbal activities and teachers’ wait time were found to be insignificant. From this conclusion, teachers should contemplate improving the quality of questions they ask and listening more to student’s responses and making quality use of their talk to probe and follow up on student’s responses and allow students to expand their thinking, justify and clarify their ideas to provoke arguments, negotiation and make connections between known and unknown. Teachers should equally consider exploring the importance of non-verbal behaviours in encouraging, provoking, and stimulating students’ thinking and responses. In order to achieve

these, teachers should increase their wait time and allow students to think deeply through each response.

9.2 Discussing the effects of the intervention.

This section discusses the effects of the intervention on the teachers' classroom interaction patterns. The effects of the intervention can be measured by the changes in the qualitative and quantitative results obtained after the intervention. These changes can be found in the quantitative values, the transcripts of the classroom discourse analysis, the interview responses, the Wilcoxon signed-rank test, and the percentages.

9.2.1 Discussion of the effects of the intervention on the classroom talk.

In the quantitative analysis, after the intervention, the teachers' talk was reduced by 9%, the students' talk increased by 10% of the lessons' total talk, and teachers' talk was reduced by 10.7%, and students' talk increased by 8.8% of total lesson time. In the transcript of the discourse analysis in Table 7.2.2.2, the changes observed in the pattern of talk concerning the teacher were a change in teaching style to facilitating, mentoring, and encouraging students' individual contribution in each group and encouraging teamwork and group classroom discussions and presentations. The teacher tried to group the students and instructed the re-arrangement of the desks to create convenient interaction and tiny spaces between the desks to ease movements, creating space between desks to avoid major lesson disruption.

The students presented group ideas, and the teachers asked for more contributions from group members and the whole class to build on the responses, and the teachers made efforts to move around the groups, improving on probing and clarifying students' responses. These activities can be found in teachers' Turns (9, 15, 17, 19, 34, 73, 79, and 27, which shows encouraging teamwork) and students' turns S-Turns-26, 28, 30, 33, 35, 45 and 60 as against the teacher's monologic lecture method consisting of ritualised initiating and re-initiation of students responses by stretching phrases or word or omission of words for students to complete and use of pseudo questions as evaluation of students understanding found in chapter 7, Table 7.2.2.1.

The teachers' responses of acceptance of the change in practice indicated in teacher AD's comments that "I am really committed to the change in practice when I watched the

recorded video of my lesson before your training, and then I decided to use it”, and “Yes, I feel excited and encouraged moreover with additional knowledge from other extra training.” These responses indicate that the teachers yielded to the students’ request - “I would like more opportunities to talk in basic science class. This is contrary to the pre-intervention opinions of the teachers that Teacher AD’s responses were, “I do not give students the room to talk anyhow,” “.... It leads to a rowdy class,” “I do not allow this,” and “.....I do try as much as possible to maintain class control and not allow students to talk in my class.” The teachers’ acceptance of the change of practices shown by the teachers in this study is encouraging.

The images of the students showing their engagement in classroom discussions are shown in image B in chapter 7. The teachers’ indirect classroom talk also improved by 22%, while the teachers’ direct talk was reduced by 22%, thereby fulfilling one of the purposes of the intervention. The teacher improved on activities that can stimulate learning, such as seen in Turns, T (22, 25, 27, 34, 36, 38, 39, 41 and 42), with improvement in opened ended questions, genuine praises, probes, and clarification of students’ responses. These are also evident in Teacher AD’s comment that the “Lessons learnt from the pre-training showed that I do most of the work in class, looks like a one-way traffic class and not given the students room to contribute, so I now allow students to talk”.

Ekiti State teachers face many challenges, including lack of food, unpaid wages, overcrowding, lack of instructional material, lack of access to quality continuing professional development, time pressure in content delivery and assumption about the nature of teaching. These challenges hinder the patterns of classroom interaction in Ekiti state, therefore, may minimise the effect that a single-day intervention may have on the teachers’ classroom practice. Despite these challenges discussed in Chapter 8, the teachers accepted a change in practice and achieved a little change, so if teachers are provided with an enabling environment, instructional materials, and wages paid as when due, continuous training with an expansion and update, teachers’ classroom practice may improve.

Mercer et al. (2004); Mercer et al. (2006); Mercer et al. (1999); Rojas-Drummond et al. (2010); Löfgren, Schoultz et al. (2013) showed that when children are encouraged to work together, think together, subject learning and general reasoning skill is stimulated.

Interpretatively, the most significant finding is that the teachers seem to shift from the dominant, oppressive classroom nature, which might be due to the intervention.

The findings in the current study are supported by Alexander (2018), as explained in the literature reviewed, who found a positive relationship between teachers' professional development and teachers' and students' talk. Alexander (2018) found that the drastic changes that occurred in both teachers' and students' talk, positively influenced students' engagement and confidence in the intervention group. This may be related to Hardman et al. (2008) observational study, previously reviewed in Chapter 4, and Alexander's (2018) suggestion and argument for a need for teachers' continuing professional development as an intervention to change and expand classroom talk. Lyle (2008) suggested that integrating elements of dialogic teaching into whole-class teaching could improve students' classroom interaction, engagement and participation and identified that teachers need to be supported to identify needed professional development programmes in changing from monologic teaching.

9.2.2 Discussion of the effects of the intervention on the nonverbal cues.

The intervention had little effect on the non-verbal classroom interaction patterns. Chapter 7 shows that the teachers' non-verbal cues were reduced by 2.2% while the students' nonverbal cues increased by 3.9% of the total lessons' time. In the transcript of the post-intervention discourse analysis of the classroom conversation, students were seen moving around by walking to the front of the classroom to present their group work, smiling within the groups, and peeping to have a glimpse of peers' ideas about the task. The teachers' major non-verbal pattern was moving around the classroom S (18, 30, 33, 37, and Turns-T (15, 17, 25 and 44). The teachers confirmed that they had not done much about their non-verbal classroom interaction pattern through their responses in the post-intervention interview even though, in the pre-intervention interview, four of them believed that non-verbal interaction pattern improves the quality of teaching and learning.

The pre-intervention responses- Teacher OL's responses were, "We cheer them up to make the class interesting and", "They are very good", and Teacher IR's comments were, "they are essential", and "It is good." However, the teachers' responses in the post-intervention show Teacher OL's comment was, "I just move around groups to explain to students", and Teacher EK's response was, "I have not done a lot in that aspect." The possible explanation for non-significant changes might be found in the prior study that has

noted this is Ledbury, White, and Darn (2004), who submitted that even though speech is a part of communication, teachers often underestimate or forget or are not aware of the importance of non-verbal cues in both their own and student's performance.

As mentioned earlier in the literature, very little attention was paid to non-verbal communication in education. Flanders (1970), who developed the category system adopted in this study, did not consider non-verbal classroom behaviour with the assumption that a person's verbal behaviours are consistent with non-verbal behaviours. Many scholars believe that non-verbal messages are equal to or more important than verbal messages (Akhtim, 2018; Zeki, 2009; Singh, 2018).

The insignificant value of the nonverbal interaction pattern may be due to the fact that the intervention was a single day and considering the various challenges stated earlier facing the teachers and students in their patterns of interaction. An extensive intervention in future might show the hindering factors at play and produce a different result.

9.2.3 Discussion of the effects of the intervention on the types of questions and wait time.

The quantitative analysis after the intervention showed that the intervention had a significant effect on the teacher types of questions. This was evident in the teachers' reduction in the frequency of 134 "do you understand" questions to 20, opened ended questions like "explain" and "how" increased, and the instances of a decrease in the frequency of closed-ended questions. The transcript of the post-intervention discourse analysis confirmed this in Turns 17, 19, 22, 29 and, 31, 74, 86 with questions such as "who can tell me how to take care of fingernails" and "how do we take care of our skin?" that featured in the transcript of the post-intervention discourse analysis in Figure 7.2.2.2.

The teachers' interview responses showed a move away from simple questions in the pre-intervention interview responses such as (Teacher OL's responses were, "...so, we ask simple questions that produce a one-word answer, close-ended questions like define, state, or mention," and Teacher AW's response was "...according to the topic.") to responses showing more high ordered thinking questions after the intervention like Teacher OL's response was, "Today, I asked students to explain growth and development to make them think deeply and " Teacher AW's response was, "I have been able to ask thought-provoking questions in class, moving away from simple single-response questions."

As agreed for a change in practice, the teachers tried and made efforts to ask open-ended questions to improve the quality of their questions and enhance students' engagement to improve high cognitive development. For example, teacher OL's topic of the lesson was growth and development. Teacher OL was naive and inexperienced in questioning skills, and to refine and upgrade her questioning ability, the teacher, in one instance, asked a complex and broad question that covered the whole lesson topic that is almost impossible for a student to answer in a lesson. The implication is that there is scope for the teachers to further CPD in effective questioning.

The teachers opened ended questions have been found to be a useful tool in exploring more ideas, stimulating high cognitive thinking in students, allows probing and expansion of contributions. This result corroborates the findings of some previous work of Alexander (2005a) and (2005b) that was confirmed by Leftein and Snell (2014), which found that an intervention used as teachers' professional development resulted in positive outcomes where teachers use more questions which probed and encourage analysis and speculations. Alexander (2018) also found that teachers that were provided with the intervention were making use of open-ended questions than the control group and argued that what or closed-ended questions require pre-ordained responses, "how?", "why?" and "what if?" encourage reasoning and promotes social engagement.

A striking finding is a teacher's massive reduction of pseudo questions, especially from 134 to 20, and another teacher increased the frequency of open-ended questions from zero to 11. However, one unanticipated and interesting result was an effect that occurred differently in a teacher's pattern of questions in the opposite direction from others; the pseudo questions increased, while both the open and closed-ended questions reduced. This is also in favour of students' request that "I like to be asked questions related to life events in basic science class", which was ranked second highest, next to the request to be allowed more opportunities to talk more in class. A lot more could be achieved if the teachers allow adequate wait time for students to think and reflect on their responses.

The quantitative results of the teachers' wait time show that the intervention did not have a significant effect on the teachers' wait time after the intervention, with an average of 0.2 to 0.5 wait time that the teachers' wait time as a percentage of the total lesson time before intervention is 0.6%, and the teachers' total wait time as a percentage of the total lesson time after the intervention is 1%. This indicates a positive 0.4% change in teachers' wait time. The

transcript of the post-intervention discourse analysis also revealed this in Turns T- 80 and T - 74.

The little wait time might be due to the fact that they were participating in group discussions and not in individual responses, just like it happened in the pre-intervention results where the students' responses were in the chorus of teacher-initiated and re-initiation. Although the change in the teachers' wait time was not significant, the teachers stated in their post-intervention responses that they were able to wait patiently for the students to think over their responses.

The above is evident in Teacher IR's response, "I have been able to wait for students to provide a correct response after a wrong one," and Teacher AD's response, "I have been patient with students providing responses to questions.". This is in contrast to results obtained in the quantitative analysis and the transcription of the post-intervention of the disc analysis.

The inability of the teachers to significantly improve their ability to wait for students to think over their responses to the teachers' questions might be connected to the teachers' opinion that time pressure for lesson planning, presentation, writing notes, and homework on the chalkboard, marking tests, among others. The teachers in this study described dealing with individual students' needs as challenging, with waiting for responses and probing understanding as additional time pressures. Although Alexander (2018) found that intervention teachers allowed adequate wait time for students' responses against the non-significant change in wait time found after intervention in this study. The minimal changes and the inability of the teachers in this study to significantly improve their wait time may be due to the intervention being one day and considering various challenges facing the researcher, teachers, and students.

9.2.4 Discussion of the statistical significance of the results.

This section discusses the result of the statistical analysis of the quantitative data presented in the Wilcoxon signed-rank test in chapter 7 and section 7.8.

The Wilcoxon signed-rank test showed significant relationships between the intervention and the patterns of both the teachers' and the students' talk. However, there was no statistically significant relationship between the intervention, the teachers' and students' nonverbal interaction patterns and the teachers' wait time. The Wilcoxon signed-rank test

was contrary to the researcher's expectations because of the old traditional importance attached to the uses of nonverbal communication in Yoruba culture that has previously been discussed in chapter one of the present study. This finding is consistent with that of Choudhury (2005), Tofade et al. (2013), Albergaria-Almeida (2010), Li (2011), Shahrill (2013), Nystrand et al. (1997), Rowe (1972), Stahl (1994), who had previously shown that teachers do not wait for enough time for students to respond to questions. The chi-squared test was statistically significant for four teachers, showing a relationship between the teachers' questioning patterns and the intervention phase. There was a general reduction in patterns of pseudo-questions and closed-ended questions and an increase in the open-ended questions, which tend towards achieving one of the aims of the study.

However, this study is a mixed method of quantitative and qualitative analysis that involve the collection, analysis, and integration of qualitative and quantitative data within the study. The statistical analysis can provide only a little evidence for generalisation, bearing in mind the five cases studied; inferences cannot be drawn from the data but provides a basis for analytical generalisation by comparing the results of the cases studied to previously developed theories and making projections about likely transferability of the findings in similar situations. In order to support the evidence for improvement in practice, the statistical analysis triangulates the results to provide rigour. However, the triangulation process of integrating the qualitative and the quantitative data reveals that the data converge.

The researcher has provided a detailed description of the individual sample case characteristics, a deep description of the study context and in-depth descriptions of the observed discourse exchange in the pre-and post-intervention. The researcher conceptualised classroom interaction in the Nigerian context by being reflexive and developing a deep perspective about essential contextual features of "what is going on" in Nigerian classrooms using the 5 cases studied. This provides scope for a larger sample with multiple cases to facilitate replication of the results, provide more insight into the above relationships, and help to improve the validity of the statistical analysis. The researcher employed the use of theories in the designed stage to improve the external validity. The purpose is to make an analytical proposition and to expand the proposition but not to make a statistical generalisation.

9.3 Discussion of the findings from RQ3: What are the issues teachers say affect classroom interaction patterns in basic science lessons in Ekiti State, Nigeria?

This section discusses the teachers' opinions about issues affecting classroom interaction in basic science lessons.

9.3.1 English language.

This section is concerned with the teachers' opinions about issues affecting the use of classroom interaction patterns in basic science lessons.

The thematic analysis of the interview data of the current study shows that the policy of imposing English as an official medium of teaching in Nigeria influences the patterns of interaction in classrooms in Nigeria. This replicates what has been found in other studies (Thyab, 2016; Bamgbose, 1991; Abubakar, Hassan, Yosof and Yusof, 2017; Danladi, 2013; Aito, 2005; Hardman, Abd-Kadri and Smith, 2008; Ibrahim and Gwandu, 2016). Some Area Education Authorities (AEOs) even impose sanctions on both teachers and students for speaking their native language, thereby making it more impossible to interpret difficult words in the native language. English is seen as a prestigious language, which regrettably relegates the mother tongue language, often referred to as vernacular (Teklesellassie and Boersma, 2018; Ajepe and Ademowo, 2016).

These studies above explained that when a second language is not mastered correctly, the mother tongue dominates and influences the second language and leads to interference through the appearance of linguistic structures and structural elements of the mother tongue. When a person is under pressure or compelled to speak a second language, he borrows words as substitutes from the mother tongue. This eventually leads to the formation of irregular grammar rules and different sound letters in English. This probably affects the teachers' proficiency in the use of English. Teachers, however, seem to try to choose a safe method of code-switching with chorus responses and the use of pseudo questions to cover up their low English proficiency or students' lack of understanding, and this is less demanding of their English as observed in this study and supported by (Chimbganda and Mokgwathi, 2012; Arthur, 2001; Hardman et al., 2008; Obanya, 2004; Abubakar et al., 2017). The resultant effect is the teachers' dominance of the classroom with whole-classroom teaching, the inactivity of the students, and a low level of intellectual attainment. Studies and policies acknowledging the importance of cultural background and the relationship between previous

local knowledge in enhancing teaching and learning process highlighted the significance of native language, alongside the use of the official English language in classroom interaction in Sub-Saharan Africa (Dembele, 2003; Fafunwa, 2004;2018; NPE, 2013; Obanya, 2004). These studies suggested that they can perform essential roles in students' active participation.

9.3.2 Poverty.

In this study, the teachers reported high child poverty in their classrooms, with students coming to school tired, hungry, and worried in tattered clothes. Various studies support evidence of hunger in classrooms in Nigeria (Action Against Hunger, Nigeria, AAH, 2020; Amzat, 2010; Njok and Edinyang, 2014; Lawal and Atueyi, 2018). Malnutrition disorders affect more than 42% of students in the country and are responsible for 49% of primary school children's absenteeism (Lawal and Atueyi, 2018). About 2 million Nigerian children are estimated to suffer from acute malnutrition (National Nutrition and Health Survey (NNHS), 2018). Hunger causes problems with concentration and memory and leads to impairment in motor skills, which can invariably have long-term effects on learning abilities.

With hunger, the impaired activity level limits movement and exploration, leading to poor cognitive development. These are evident in the video films where some students dozed off, and some were very passive. According to the food portal, Nigeria's Global Hunger Index score (2017) is 14.7%. It is estimated that 70% of Nigerians live on less than \$1.25 a day and more than half below the poverty line. There are also reports from the United Kingdom and the United States of America on cases of hunger in schools (Walthouse, 2014). These may also be among the reasons why the students were passive, they may be weak, and because they have not eaten, they were not able to concentrate and effectively interact with the teacher and their peers in the classroom. Hunger has been shown in a study by the American Psychological Association to cause depression, anxiety, withdrawal, and behavioural problems, which obstruct the child's focus on learning (Walthouse, 2014). This is supported by the results of this study, where the students were not actively participating. This may be because they could not engage in high cognitive thinking and could not produce challenging and negotiating responses and ideas to questions.

Lingard, Hayes, and Mills (2003) found that in classrooms with a high number of students living in poverty, students talk less, and teachers talk more. This finding supports the report of this study, where students give chorus or teacher-solicited responses mostly in

completing teachers' sentences or phrases. This may probably be because their mind is focused on what to eat. Therefore, they seem to be pleased with giving short and teacher-tailored responses. In addition to this, teachers tend to use extrinsic-oriented control motivational strategies (Pelletier et al. 2002) where students seem to be unmotivated because they are hungry and, due to poverty, were not provided with learning materials like workbooks and textbooks that could motivate and enhance students' active demonstration and participation.

9.3.3 Lack of exposure to innovations.

Variation in data between the rural and the urban setting was only recorded in the area of inadequate knowledge of new technologies: lack of exposure to new technologies is discovered to be more significant in the remote part of the state. The issue of lack of access to basic amenities, which could facilitate more knowledge about the day-to-day improvement of materials and equipment in science, is pronounced in the rural areas as the teacher mentioned that nearly all in the class do not know the water system of a toilet. They still use the old pit latrine system. Rural society usually lacks electricity to operate radios, televisions, and audio/visual materials where those innovations can be viewed.

Teachers in these rural areas need more time and attention from authorities in charge of education, and they need to be adequately skilled in interaction patterns for the teachers to effectively make connections between the learners' background or prior knowledge and new scientific knowledge. The amount and quality of previous knowledge have a positive influence on knowledge acquisition and the capacity to apply high order-cognitive problem-solving skills (Ahlam and Gaber, 2014; Nathanson, Paulhus, Williams, 2004; Liu, Lin and Paas, 2014; Ausubel, 1990; Yang and Hsu, 2013; Wenk, 2017). Learners cannot relate new knowledge to existing knowledge because they have no adequate prior experience of what they are learning, leading to rote memorisation (Ahlam and Gaber, 2014; Cook, 2006; Weeks, Lyne, Torrance, 2000).

9.3.4 Lack of instructional materials.

The evidence of the lack of instructional materials in all the schools was apparent in the videotaped classroom lessons. It was a concern in hampering the quality of the classroom interaction patterns in most of the classrooms filmed. The chalkboard was the only thing present and was used mainly for writing notes and assignments rather than for illustrating and

answering questions because of the lack of textbooks and workbooks. There were no information and communication tools such as computers, radios, or videos despite the enormous contribution these can make to enhance interaction patterns in the classroom, making participation more interactive (Osokoya, 2013; Alabere, 2017; Ogaga, Igori and Egbodo, 2016; Westbrook et al., 2013; Guthrie, 2011; Maribe and Twum-Darko, 2015). These studies agreed that instructional materials and ICT complement classroom interaction patterns, enhance students' interest, and ensure classroom demonstration. Resource materials such as quizzes, puzzles and whiteboards can also make lessons highly interactive.

9.3.5 Lack of basic classroom amenities/poor learning environment/poor school climate.

The classroom conditions captured hampered the quality of the classroom interaction with no electrical power supply anywhere. Some of the roofs of the buildings are leaking, no access to water, no standing or ceiling fans, noisy environment, therefore affecting hearing, comfort, and brightness. The learning environment is boring and stuffy impeding concentration, and it is not conducive to quality classroom interaction patterns, thereby affecting the cognitive growth of students (Akhiero, 2011; Ogedi and Obionu, 2017; Nnachi, 2009; Angus, Doris, Prater, and Steve, 2009). It makes sense that students learn better in a positive environment.

9.3.6 Overcrowding.

Overcrowding in schools has been a cause of both emotional and physical challenges in most public schools (Olaleye, Ajayi, Oyebola, Ajayi, 2017; Gaillard, 2019; Maura, 2017; Shah, 2012; Lawal, (2019). The National Policy on Education (2013) prescribed 30 students per teacher for effective teaching and learning. However, according to the data centre of the Institute of Statistics, UNESCO cited by Lawal (2019), of all 189 countries, Nigeria is one of the four nations with the highest amount of overcrowding in secondary school classrooms, with no fewer than fifty students in a class and some schools between 70 and 120 students per class. The teachers in this study stated that overcrowding with above 50 students in a **class is** one of the major problems affecting the quality of interaction patterns in their classrooms. Teachers have more homework to mark and more students to deal with a stuffier environment as movements within the classroom are also impeded.

9.3.7 Unpaid wages.

Teachers' unpaid wages seem to hamper teacher-student(s) interaction, with teachers' dissatisfaction, disappointment, low morale, irregularity at work, and stress related to financial worries being apparent in this study. Teachers' mention of their unpaid wages may sometimes be responsible for teachers' appearance of boredom and lack of interest and sometimes overreaction to students' perceived misbehaviours, as also shown in the videotaped. This finding is supported by (Getange, 2016; Tomori, 2014; Akindele, 2014; Ogundele and Olarewaju, 2014; Oredein and Awodun, 2013; Adeyemo, Oladipupo and Omisore, 2013) agreed that unpaid teachers' wages affect teacher's effectiveness and quality of interaction in classrooms. The studies explain that these can affect teachers' families and can spill over into classroom interaction, fostering low morale and productivity. The Sutton Trust (2011) explains that if teachers are not regularly paid to support themselves and their families, irritability and frustration can affect self-esteem and overall well-being. Unpaid wages can produce negative emotions and feelings of distress, and job dissatisfaction that affects teacher-student interaction (The Sutton Trust, 2011).

9.3.8 Habit from experience.

The revelation that teachers' interaction patterns in practices reflect their own experiences in colleges and schools was sounded in this study and other studies (Piaget, 1962; Klauswitz, 2005; Hardman et al., 2008; Luyt, 2013; Owens, 2013; Vygotsky, 1978; Liu, Lin and Paas, 2013; Clarke and Otaky, 2006). These teachers have been through pre-service training, in which they were graded and passed, and according to their interview responses, their patterns of interaction have not been previously observed or criticised, which gives a form of reinforcement (Skinner, 1954; Bearman and Wheldall, 2000; Bandura, 1997). We may say that teachers learn how to teach from their experiences as trainees from colleagues and from various types of prior experiences by building upon these pre-existing practices and through reflective-practice processes.

9.3.9 Culture.

In Nigeria, the classroom is where the teacher is the authority, controls and directs all the teaching and learning affairs, and the teacher-student relationship is built on this powerful, culturally, and socially acceptable. This mode of teaching and learning has its root in parent-child interaction in Africa, especially in the western part of Nigerian families was identified

in this study. Burns and Radford (2008) described this type of interaction as highly instructional and directive. They found similarities between parent-child interaction in Nigerian homes and teacher-student interaction in the classroom. Guthrie (2011), Westbrook et al. (2013) and Namubiru (2021) supported the findings that strong cultural and social influences model teachers' beliefs about the motives behind schooling and form teachers' approaches to teaching and learning strategies. These make teachers believe that they are conveyors of knowledge while students are receivers and not major participants in the teaching and learning process.

The adults dominate conversations: for instance, in adult-child interaction, the child only speaks when told to speak (Busari, Owojuyigbe, Okunola and Meko, 2017; Osokoya, 2013; Okunola, 2003; Law, 1999). The researchers above opined that children are taught to do whatever they are told to do at a very tender age without asking for explanations. Adults socially employ verbal and non-verbal cues to direct, monitor, and guide what and when children can speak in the presence of adults (Brown and Palincsar, 2018). The parents and older children are expected to take the lead, as they are viewed as more experienced and knowledgeable (Law, 1999). In Nigeria, considerable emphasis is placed on teaching the child to behave and be obedient (Fafunwa, 2004; 2018; Osokoya, 2013; Law, 1999). Burns and Radford (2008) stated that it is considered an insult and a display of a lack of home training for a child to speak when not asked to speak by an adult. This action is also regarded as the child's agenda (Burns and Radford, 2008).

9.3.10 Time pressure in lessons.

The teachers in the present study reported time pressure in lessons as they have limited time for planning, presentation, writing notes, and homework on the chalkboard, marking tests, among others. They described dealing with individual students' needs as challenging, with waiting for responses and probing understanding as additional time pressures. A good teacher seems to be viewed by the supervisor as one able to present the content of the lesson plan, so teachers spend most of their time planning and writing lesson notes. The pressure seems to come from leadership/administrators, parents, colleagues, the community, the teacher, school inspectors, and hardcore academic content (Adams, 2018; Pelletier and Sharp, 2009; Shaver, 2017; Kelchtermans, Ballet and Piot, 2009). Time pressure has been found to constrain the capacity, limit exploration, and make teachers rely on already learnt or mastered strategies. Thus, time pressure increases the speed at the expense of quality (Moore and Tenney, 2012;

Hornstra, Mansfield, Ineke van der Veen, Peetsma and Volman, 2015). Time pressure in lessons, therefore, affects teachers' classroom interaction patterns in basic science lessons in Ekiti State, Nigeria.

9.4 Summary of the Chapter.

In summary, considering the results of the current study and combining them with the findings of the previous studies, it can be summarised that in the pre-intervention, the teachers talk mostly through the lessons (95% of the lesson time), with teachers' initiation, re-initiation and excessive use of pseudo questions to elicit students chorus responses and in the post-intervention, the teachers talk reduced by 10.7% while the students talk increased by 8.8% of the lessons' time. This was characterised by students rearranging their desks and chairs to create small spaces for group discussions and teachers facilitating the lessons by moving around and encouraging students' individual contributions.

The problems that were highlighted from the teachers' responses were discussed with previous studies and found that mother tongue interference with English language, poverty, lack of exposure to innovation, overcrowding, unpaid wages, lack of instructional materials, poor learning environment, culture, habits from experience and time pressure affect patterns of basic science classroom interaction in Ekiti State. These challenges featured in the lessons; there were no places where teachers used learning materials except writing notes on the chalkboard, and the average number of students in the classroom is large compared to 1:35 stated in the NPE.

Chapter Ten: Conclusions, Contributions, Limitations, and Implications of the Study.

10.0 Introduction.

This chapter is the final chapter; it presents the general conclusions of the current study, the contributions of the study, the study's implications for pedagogy, policy and research, the methodological implications, and methodological limitations. This chapter is divided into six main sections, and the first three sections are concerned with the study's conclusions in relation to the three main research questions. The fourth section explains the implications of the study with subsections on implications for practice, research and policy on classroom interaction patterns and continuing professional development and a subsection for the study's methodological implications. The fifth section explains the methodological limitations and the lessons learnt from the study. The sixth section summarises the chapter.

The purpose of the present research was not to condemn any culture or belief but to collaboratively reflect on how our present beliefs and culture affect classroom practices and make decisions about initiating a reformation of opinions and views about classroom practices. This study did not also seek to condemn any teaching method but to improve the present classroom situations and discourage the prevalent of teachers' excessive talk with repetitive initiation, re-initiation and recitation talk method that has been found to stifle students' talk and prevent students' reflection on their learning, then introduced teachers to alternative classroom interaction patterns and teaching approaches that could improve students' talk. Teachers could then make informed choices that could increase and enrich students' classroom talk and engagement, promoting improved self-esteem and learning gains.

10.1 Conclusion for the main research question (RQ1): What are the different classroom interaction patterns currently used in basic science classrooms in junior secondary schools in Ekiti State, Nigeria?

Overall, the baseline qualitative and quantitative findings show that teaching and learning of basic science in Ekiti State is dominated by teachers' talk, which occupies almost 80% of the total lesson time. The observed instruction was characterised by teacher-led recitation, and there were few follow-ups of students' responses. The provision of clues and probes was very rare, wait time pattern was insignificant, few teachers commented on students' individual

responses, and few students' talk (about 13% of the total lesson time). The teachers asked questions mainly; 63% of the observed questions were pseudo-questions that did not require students' responses.

The students responded with chorus affirmations that did not require time to think and did not reveal students' understanding of the topic, 32% were closed-ended questions, and 5% were open-ended questions. Other students' responses were chorus affirmations of repetition of teacher-elicited words. Rote learning was the major form of learning. Both the teachers and students were unaware of non-verbal patterns of interaction. Therefore, these were generally in negligible use compared to the verbal pattern. These characteristics are likely to have stifled students' meaningful participation and limited students' deep cognitive thinking based on the ground of social constructivist understanding that suggests that without social dialogue, children are not likely to be constructing new concepts strongly or progressing far through the ZPD (Osokoya, 2013; Hardman, 2011; Hardman et al., 2008; Hardman et al., 2007; Myhill and Fisher, 2005; Ackers et al., 2001; Nystrand, 1997; Barnes, 1992).

The teachers' monologue-based lecture teaching style, which was not different across the five schools, may be connected to the traditional historical images of teaching that have been culturally transmitted and internalised in Nigeria. Like other African cultures, the Yoruba culture, out of respect for authority and elders, has tended to limit children's verbal participation, especially in adult-child discussions. Therefore, adults' regulation and guidance of children's voices appear natural and neutral (Busari, Owojuyigbe, Okunola and Meko, 2017; Osokoya, 2013; Okunola, 2003, Tabulawa, 2013; Guthrie, 2011). This has tended to limit children's expectations of classroom discourse (Lyle, 2008). The interview data revealed that most of the teachers disagreed with students talking in class, as 60% of the teachers said they could talk throughout the whole lesson. 20% claimed they could talk for 25 minutes, while 20% claimed they could talk for 15-18 minutes.

The three statements topping the list of the students' diamond ranking are the students' statements that "I feel comfortable talking to my basic science teacher", "I would like more opportunities to talk in basic science class", and "I like to be recognised for answering a question correctly". These showed that the students want to talk more in their basic science and feel comfortable doing that with their teachers, so teachers need to be aware of the student's wishes, and this might encourage teachers to allocate more time for students' quality talk. Three statements ranked at the lowest level of the diamond are the students' statements that "I learn

best when discussing with other pupils in the class about a topic in basic science”, “I get to talk to other pupils in the class about the teacher’s question” and “I think, everyone participates fairly in basic science class”.

Ranking the above statements at the lowest diamond indicates that these experiences rarely occur in their basic science classrooms. Also, ranking “I learn best when discussing with other pupils in the class about a topic in basic science” as one of the lowest diamond rings shows that students do not strongly agree with this experience and that they do not know whether it is beneficial enough because they do not often experience this, which suggests that students need to be supportive of their learning. The interpretation of this baseline study is in line with the patterns of interaction found in (Abuh, 2021; Domike et al., 2011; Nnorom and Erhabor, 2019; Hardman et al., 2008; Kalu and Ali., 2004; Ackers et al., 2001).

The importance of the baseline results is to create knowledge about current teachers’ classroom practices and provide the basis for teachers’ critical self-reflection and the design of an intervention by the researcher. This baseline provides additional data about teachers’ classroom interaction patterns in Nigeria. Consequently, teachers can consider how to effectively change their classroom practices by employing some elements of sociocultural ideas of how children learn that is within the existing practices and specific to the learners’ culture, traditions, policy environments and school conditions. The baseline data provided a process for self-reflective teaching and awareness that there are alternatives classroom behaviours that have values and can be applied where the quality of teachers’ classroom interaction faces myriads of the challenges, such as those stated by the teachers in Chapter 4 and others highlighted in Chapter 2 of this study.

10.2 Conclusion for research question two (RQ2): what are the effects of the intervention on teachers’ interaction patterns in basic science classrooms?

The qualitative and quantitative data findings highlight the effects of self-reflection and intervention on the teachers’ classroom interaction patterns. The transcripts from the discourse analysis show that the teachers’ talk changed from a monologic lecture method (characterised by initiation and re-initiation of talk, repetitive use of pseudo-questions, and stretch or omission of words) to a more dialogic style (involving grouping, mentoring, probing and affirmation of students’ responses during presentations). Subsection 7.2.1 describes how students were more actively engaged in group discussions and sharing of ideas.

The quantitative results concerning the lessons' total talk time showed that after the intervention, the teachers' direct talk time reduced, while their indirect talk time increased to facilitate an increase in students' talk. Inferential statistical analyses demonstrate that these effects were statistically significant, as reported in subsection 7.9.1. The interview data also indicated improved outcomes regarding changes in the teachers' classroom interaction patterns, specifically talk. The interviewed teachers all attested that they had reduced the length of their classroom talk and now used student group discussions, thereby increasing and improving students' classroom talk. The probable explanation is that the teachers tried implementing the changes learned during the intervention and self-reflective practices by modifying their classroom practice to allow students more engagement through talk in class.

The transcripts of the discourse analysis and Image B in Chapter 7 show students rearranging their desks and chairs to allow spaces for forming small groups and moving between groups so that they can discuss and engage in collaborative co-construction of ideas. The responses from the students' groups were collated, written on the board, and compared by the teacher and students to stimulate reactions from other students who did not present. These new teachers' classroom behaviours reduced teachers' talk and probably increased students' engagement (students were certainly talking more about the teachers' questions). In the column chart, the picture comes out more clearly, with teachers' talk dropping by 9% while students' talk increased by 10% on average.

The difference in the teachers' turns in the pre-and post-intervention discourse analysis transcripts showed a move from ritualised pseudo-questions and closed-ended questions to more open-ended ones. The quantitative analysis also shows that the percentage of teachers' pseudo-questions was reduced by 20%, and the number of open-ended questions increased by 15%. Although the percentage of closed-ended questions increased by 6% collectively, this varies between individual teachers. These changes in teachers' practices corresponded with those intended by the intervention, which appeared to manifest in improving the patterns of the five teachers' types of questions. These types of developmental changes were also noticed by Alexander 2005a and 2005b, 2018; Leftein and Snell, 2014; and Hardman et al., 2017. The patterns of the teachers' questions changed, but the chapter on findings shows that the teachers remain inexperienced in effective classroom questioning, implying a continuing need for specific training targeting teachers' effective questioning.

The chi-square statistics test showed significant associations between all five teachers' questioning patterns and the phase of the study when the teachers are studied collectively. Only four of the five teachers showed this statistically significant association between classroom behaviours and the intervention. One of the five teachers' classroom behaviours showed no statistically significant association between their own practice of questions and the intervention. Therefore, it seems to be the case that the intervention was capable of having the desired effect on teachers' practice, but this effect was not necessarily realised in every case. There may be blocking factors at play. This could be a focus of future research.

Another distinctive finding in one of the teachers' questioning patterns is that although there is a statistically significant association between this teacher's pattern of question and the phase of the study, the pattern of change shows a different form from that observed in others. It is almost in reverse of the others as there was an increase in the frequency of pseudo questions while the frequency of open and closed questions decreased. The reason why the intervention impacted differently on this teacher is unclear, but it may be connected to their context of teaching being different from that of the others.

Essentially, the statistical analysis can provide only a little evidence for generalisation, given the small sample of 5 cases studied. The small five cases studied do not provide the basis to draw inferences from the data to a population, but they are generalisable to theoretical propositions in that the results of the cases studied can be compared to previously developed theories and make projections about the transferability of the findings. A large amount of data from the 28 lesson observations and interviews detailed the analysis. The analytical components of the study provided the detail of the classroom discourse patterns. The process of exploring each teacher's characteristics and the underlying situations in the current study provided a clear picture of the issues for logical and analytical generalisation.

The qualitative results showed that 60% of the teachers confirmed that they have not been effective in the use of their non-verbal interaction patterns but have been able to wait patiently for students' responses. This is in contrast to the quantitative results, which showed that the teachers' non-verbal cues were reduced by 2.2% in relation to total lesson time, and the teachers' wait time was negligible even after the intervention. International studies have shown the essential roles of teachers' continuing professional development in improving teachers' classroom practices regarding talk and other interaction patterns (Hardman et al.,

2011; Alexander, 2018; Corbin and Eick, 2015; Zare-Behtash et al., 2015). These researchers first carried out baseline studies and later trained teachers to improve classroom talk through dialogic teaching. The studies allowed periods of self-reflection and practice; the researchers finally carried out follow-up studies and found positive changes in patterns of teachers' classroom practices, positive students' achievements and outcomes, improved confidence in affective and cognitive domains, and improved confidence.

Another finding in the present study in the Nigerian context is that there were no instances of noise or confusion where the observer did not understand communication. The teachers were observed to have good control of the class, and the lessons were conducted in an orderly way, even though the focus had shifted slightly away from the teachers towards the students. Teachers were still able to correct genuine misbehaviours, even though they had moved towards greater facilitation of dialogue. The minimal modifications made by the teachers to their classroom practices in this study may be due to the fact that the intervention was for a short duration of 1-day, and considering the various challenges that the researcher, the teachers, and students encounter in their basic science classrooms. This study gives scope for a longer duration of intervention under a more enabling classroom environment and teaching conditions with the aim of producing more lasting and sustainable effects.

10.3 Conclusion for research question three (RQ3): What issues do teachers say affect classroom interaction patterns in basic science lessons in Ekiti State, Nigeria?

The qualitative findings of the teachers' perception of issues affecting classroom interaction patterns revealed that the most influencing factor that the teachers reported was the compulsory adoption of English language as a formal language in Nigeria and sanctions against anyone who speaks an indigenous language in schools. Teachers reported that they sometimes struggle to look for English words to describe some science words or scenarios that they could have simply, quickly, and accurately translated into the students' mother tongue, so the teachers end up feeling that the students do not really understand. The use of 'mother tongue' in equivalent contexts has also been recommended by other authors (Ackers, 2001; Arthur, 2001; Thyab, 2016; Bangbose, 1991; Abubakar, Hassan, Yosof & Yusof, 2017; Danladi, 2013; Aito, 2005; Hardman, Abd-Kadri & Smith, 2008; Ibrahim and Gwandu, 2016).

The teachers reported a lack of TLM in their classrooms, such as workbooks that could motivate students' classroom interactions, prevent boredom, and prevent teachers from

talking too long, although the effective use of teaching and learning materials in a very overcrowded classroom may require teachers attending specific training that addresses this (Westbrook et al., 2013). The teachers also reported barriers, including unpaid wages, cultural issues such as children being quiet while adults speak, and the view that student talk will disturb the class. The teachers in the current study also reported the issue of poverty or low economic status in Nigeria. The teachers also claimed that some students come to class on an empty stomach, inhibiting their participation in active learning. Studies that support these findings are Adeyinka (2014) and Akindele (2014) and Action Against Hunger in Nigeria (AAN).

The teachers in the current study also reported, as one of the issues affecting their classroom interaction patterns, the habit of using the old conservative style that has been culturally internalised over a long time. There had been no complaint about this by educational officers or school head teachers. This form of challenge was also reported by studies such as Owens (2013), Vygotsky (1978), and Liu, Lin, and Paas (2013). The teachers reported that the important criteria that inspectors look for are skills in the presentation of lesson notes and plans and the capacity to complete the scheme of work, so there was no challenge to change their teaching patterns, which serves as reinforcement for the teachers as reported by Bandura (cited in McLeod, 2016).

The teachers in the current study also reported some perceived challenges in their classroom interaction, such as time pressure in lessons to cover the syllabus, lesson notes, marking tests and writing on chalkboards, which they feel are constraints to quality classroom interaction patterns. Other researchers have also reported these challenges (Adams, 2018; Porter, 2014; Ferguson, 2019). The current study's teachers also reported a lack of basic classroom amenities such as ICT materials, electricity, cross ventilation, and overcrowding as issues affecting their classroom interaction patterns, as also found by Akhihero, 2011; Olaleye, Ajayi, Oyebola, Ajayi 2017; Alabere, 2017.

In summary, the interview reports allow the researcher to see that there are influences on students' classroom talk that come from beyond the classroom and are deeply rooted in society's traditional and cultural values, socioeconomic contexts, and classroom situations. One advantage of the researcher being a native with the same cultural background as the participants in the study is that most of the teachers were likely to be uninfluenced by the researcher in their cultural approach to situations and the punishment of students. When

students tried to exercise behaviours, such as engaging their peers in classroom discussion, the teachers did not hesitate to punish them by caning or instructing the students to go on their knees or sometimes throwing their books out of the window. Such teacher's behaviour could inhibit changing classroom interaction patterns; they seem perhaps to be culturally normalised – this (and its changing nature) could be a useful focus for future research, but it is beyond the scope of the present study.

10.4 Implications of the Study.

This section discusses the pedagogical and methodological implications of the current study based on its findings.

10.4.1 Pedagogical implications.

In terms of changing the present classroom interaction patterns as found in the baseline data in the current study, the baseline results in this study add to the sparse data that explores classroom talk in Nigeria and therefore serve as a basis to consider increasing students' classroom talk. Increasing students' talk aims at improving learners' cognitive thinking by learning from one another, processing their learning through the integration of information, learning to use academic or science concepts, strengthening team building, building confidence, improving active learning, and relieving classroom boredom. The researchers identified that there is a need to increase students' classroom activities. This is supported by Vygotsky's theory of social interaction, where the learner plays an active role in attaining the ZPD through socio-interaction with more capable peers and skilled adults, learning by discovery and exploration, and developing skills of problem-solving, inquiry, and critical thinking.

The present study suggests that in the Nigerian context, there is scope for changes in pedagogy through a more specific and longer continuous teacher development process, so teachers can more effectively use talk to engage students to stimulate and extend their thinking. The findings from the study suggest scope for strengthening the researcher's passion for providing anonymous information about the results of the current study as evidence to Local Government Education Authorities (LGEAs) to enable them to see the potential and readiness of teachers to improve their classroom practices. This could encourage LGEAs to provide enabling environments and mitigate teachers' challenges in classroom practice. In addition, the study suggests scope for the commitment of the researcher to encouraging LGEAs to provide

various supports, including allowing time for an expansion of the research for the present participant teachers and extension to new teachers. It is important for more and wider cases to be studied and to enable longer participation of teachers in continuing professional development to produce long-lasting effects on classroom practices that can help test the generalisability of the current study's findings.

Also, this study suggests scope for strengthening the researcher's commitment to encourage and involve more teacher researchers to participate and commit to self-reflection. Changing beliefs, culture, and practice needs stronger individual and collective critical reflection by teachers on their practice; it also requires more powerful, more extended, and more robust teacher education, including continuing professional development (Ackers et al., 2001; Frazier and Eick; 2015, Hardman et al., 2008; Mercer et al., 2009). The current study bridges these gaps by offering a pragmatic reflective approach and introducing an intervention to observe and challenge the present classroom interaction patterns. It fulfils the role of classroom observation as essential for teachers' self-reflection and professional development (Pianta and Hamre, 2009).

The effects of the intervention can be explained from the perspective of social constructivism, which holds that learning occurs through the construction and assimilation of ideas with help from a more knowledgeable adult instead of through teacher-led recitation of discrete facts found in the baseline results of the current study and that of Osokoya (2013) and Abuh (2012). The teachers in this study have had little or no in-service training updates about their classroom practices and based their opinions about their classroom practice on their preservice training and personal experiences in secondary schools. This study suggests the scope for training in the provision of their own TLMs and how to effectively use them to improve classroom interaction in consideration of our overcrowded classrooms. This study also suggests the scope for further teacher CPD in effective questioning, in congruence with Alexander (2017a; 2018).

This study adds to the few pieces of evidence for education authority heads, teacher trainers and policy-makers to plan for changes in teachers' class practices through sensitisations and specific training bearing in mind the specific context of Ekiti State and Nigeria classrooms. Apart from planning, this study provides little evidence for generalisation but for analytical propositions that teachers' classroom practices can be improved through critical self or joint reflection and the provision of teachers' continuing

professional development and can be compared to previously developed theories and make projections about the transferability of the findings (as explained on pages 219, 306, 355). There is a potential for teachers and policy-makers to view the immediate introduction of quality classroom interaction that encourages student-initiated talk, sharing, and exploring ideas of teaching and learning as challenging due to the fear of possible loss of control. The experience in this study may be a useful guide to include a phase of preparation to serve as heart- and mind-warming, that can help teachers, students, and head teachers to consider culture and beliefs as challenges and to recognise that there may be a need for change in practice.

This also suggests scope for teachers to modify their present practices and integrate varieties of strategies and techniques, for instance, using open-ended questions effectively, varying methods of feedback, extending follow-up, probing, and incorporating students' answers into subsequent questions (Alexander, 2017a; 2018). The collaborative method of using pair and group work that was found to be useful in this study provides opportunities to improve students' engagement and to jointly construct views and ideas that can later be chained and annexed together; this was modelled with the teachers during the intervention. This is in line with the suggestions of Ackers, 2001; Alexander, 2017a; 2018; Barnes and Todds, 1995; Desimone, 2009; Lyle, 2008; Mercer et al., 2009.

Furthermore, this study indicates that there is likely to be scope for teachers to reduce their patterns of control and allow students to develop high-quality speaking and questioning skills; they need to put their thoughts and ideas to students in the form of propositions that the students can analyse, synthesise, and evaluate. The conclusions of the current study support using videos of classroom events in Nigerian teacher professional development, in which there could be peer analysis of interaction patterns and modelling of alternatives. This could be done, for example, once a week and possibly online to save time and to challenge authoritative and monologic teaching. This is supported by previous literature, as reviewed in sections 4.1.2 and 4.2, and 4.3 (Nishimura, 2014; Desimone, 2009; Postholms, 2008; Schön, 1987).

The current study's findings showed that teachers support continuing professional development and can be positive about changing their practice even though it may take time and require considerable effort and commitment. This could be a starting point. A further implication of this study is that there may be value in specific standardised government- and school-based professional development that can build on teachers' prior knowledge and

change their beliefs, culture, and values (Ackers et al., 2001; Hardman et al., 2008;2011; Lyle, 2008; Osokoya, 2013). Professional development programmes should be compulsory and could be linked to career progression for teachers and should ideally be free of charge (or heavily subsidised to promote equity for teachers and their students), accessible (for example, online), and periodical as also discussed in the McCrone report (2001) and by DfE (2016).

The implication of the findings of the current study is that collaborative CPD could be an effective route to change. Teachers with more experience or various degrees of expertise could work with novice or student teachers to practice collaborative learning techniques together, away from the classroom, to progress towards the intermental development zone (IDZ). The teachers could then try to replicate this with their students in their individual classrooms; the teachers could then come together again to reflect and self-evaluate, readjust, and plan for further classroom activity. This process could also model teachers' classroom behaviours that they could consider replicating with their own students in their own classrooms.

10.4.2 Methodological implication.

A benefit of using a variety of data sources and methods of analysis in the current study in its different phases (pre-and post-intervention) is triangulation, which has achieved complementary interpretive results and thereby increased trustworthiness. This is supported by Denzin, 1970. The methodological focus of the current study was on analysing, interpreting, and presenting the teachers' and students' classroom interaction patterns in a way that is situated within the positivist, interpretive, and transformative views. In addition to the interaction and discourse analysis that focuses on numbers, types, and frequencies of questions, the current study included graphical visualisation of the classroom talk and revealed explicitly how changes in practice occurred in classroom interaction patterns over time.

The interaction analysis allows for the macro and micro level of investigation of the videos of the classroom lessons; interaction patterns were compared between teachers and between different schools. The results of the quantitative interaction analysis were statistically tested and compared to the qualitative results. The teachers' interview responses were compared and contrasted with the graphical data representation. The transcripts support the graphical presentations and allow a quick view or grasp of the classroom events. Although the statistical analysis provides little evidence for generalisation, the inferential statistical analysis triangulates the results of descriptive statistical analysis, the transcripts of the discourse

analysis, and interview responses to provide rigour. The triangulation process of integrating the qualitative and the quantitative data reveals that the data converge.

The methodological implication for the 1-day training and the minimal effects observed in the teachers' interaction patterns in this study provides a basis for the researcher to find out if the effects are short-lived or permanent. Vygotsky (1978) argued that long-term changes are difficult to make and therefore need consistent support. This suggests that there is scope for an expansion of the results and facilitation of generalisation through the researcher and teachers' plan for a meeting with educational stakeholders to give feedback on the outcomes and development, listen to responses and suggestions to address the limitations which might involve a plan for longer, intensive intervention and the establishment of teacher peer support groups and involvement of more experience teaching experts in the project. The design and method of the intervention in this study were not significantly successful in the teachers' nonverbal and wait-time interaction patterns, which suggests scope for the development of different approaches and strategies to address this.

10.5 Methodological limitations.

Methodological limitations are variables or influences from the design and methods of the study that may impact the interpretations of the findings and, therefore, the conclusions of the study. In this section, the prominent methodological limitations of the present study are explained, alongside an evaluation of their impacts and a summary of strategies used to mitigate their impacts. The main methodological limitations that will be considered are:

- The limitations of case study designs and their representativeness
- Demand characteristics
- Limited scale and duration of the intervention
 - Limitation in scope
- Challenges of data transcription
- Situational factor (Nigeria's economy)
- Sparse local and international studies of real classroom events and relevant interventions in Nigeria

The study sample consists of small 5 cases studied, and it is not experimental and does not control extraneous variables, so the study sample neither allows statistical generalisation

nor provides the basis to draw inferences from the data to a population. The case study design inevitably involves a small sample size; the five teachers involved are reasonably representative of their peers. The five cases studied produced a clear picture of the situation and results rather than blurred results, and the use of theories in the design phase improved the study's external validity (Yin, 2003). The cases studied provided a basis for analytical generalisations in that the results of the five cases can be compared to previously developed theories and make projections about the transferability of the findings, suggesting that this could also be an entry point for other research and extension of the present study.

There was a significant possibility of demand characteristics due to the researcher being a teacher educator, solely responsible for implementing the intervention and lesson observations which could make the teacher participants conform to the researcher's expectations of what the teachers think the researcher is passionate about hearing or the change the researcher wants to see. This might mean that the effects described by the teachers or observed by the researcher are not what is happening when the researcher is not looking or present. The change might be short-lived partly because the attention from the researcher was also short-lived. This suggests the need for ongoing coaching and support to secure a long-term, embedded change. Guskey (2000) also supported this suggestion.

The training was a 1-day training, which is relatively short for continuing professional development to produce a long, lasting qualitative effect on the teachers' practice. Desimone (2009) suggested a consistent 20-hour period per term, while Bakkenes et al. (2010) suggested a longer duration of an effective CPD programme for sustainability. The study was pragmatic and small-scaled; only the researcher conducted the baseline, intervention, and post-intervention; six weeks each was spent on the pre-intervention and post-intervention data collection. There was a short period of a month between the two phases for the follow-up of teachers' classroom practice due to the looming teachers' strike in Nigeria, which did not allow a longer period of practice of the interaction patterns learnt during the intervention that could have provided greater mastery of skills and effects on teachers practice.

The above limitations also resulted in the limitation of findings in that the research design was only able to have a minimal effect on the pattern of talk and questioning and not significantly successful in the teachers' nonverbal and wait-time interaction patterns. There may be some hidden factors at play. These suggest the scope for different methods or

strategies and expansion of the study, incorporating more researchers and a longer period of training, and a more extended period between the phases of the study.

The current study is also limited to an in-depth investigation of teachers' classroom interaction patterns and did not look deeply into the students' classroom interaction patterns. There is scope for more research into students' classroom interaction patterns, which may serve as an entry point to effective discourse on classroom interaction patterns in Nigeria. The current study is also limited to the types of questions as categories in the patterns of interaction and did not intensively investigate patterns of classroom questioning, for example, the case of a teacher's inexperienced questioning strategy explained on page 353. This suggests a scope for specific training to improve teachers' questioning skills.

The data was large, and the transcription was done manually. This took a long time because there were discrepancies in terminologies, nomenclature, meanings, and pronunciations of some concepts due to different cultural accents between Nigerian English and the English the software is programmed. Though the transcription was manually done to ensure translation accuracy, there could be a data loss, and the transcript was prone to the translator's subjectivity. To further ensure accuracy, the transcripts were cross-checked by a Nigerian colleague in the UK to ensure they were assigned the correct categories and codes due to cross-cultural accents and meanings and interpretation of non-verbal cues.

A major limitation was the unforeseen state of Nigeria's economic recession, and teachers' salaries were not paid. Teachers were reluctant to be regular and punctual at work, and the researcher often had to pay teachers' transport fares and phone vouchers. The distance, time, and funding were major practical limitations on the study; the researcher could only fund two journeys to Nigeria, so the pilot study was conducted in the UK, and regular visits to Nigeria were not possible, but efforts were made through regular mobile communication with the teachers.

Local and international literature is sparse on baseline studies of real classroom events based on lesson observation with videos and interviews about teachers or policy-makers in Nigeria. Therefore, there is a lack of adequate information about previous work on real classroom interaction in Nigeria. The researcher found no literature on CPD specifically conducted to improve classroom interaction patterns in Nigeria. At the start of this study, this made hypothesising what the researcher of the current study would be working on not clear

and difficult. This suggests the scope for more interventions in classroom practices to improve the quality of interaction patterns in junior secondary schools in Nigeria.

10.6 Summary of the Chapter.

In summary, this chapter presents conclusions, limitations, and implications for practice, policy, and research from the findings obtained in this study, from exploring new knowledge about the baseline characteristics of teachers' monologic lecture method in Nigeria. This chapter also presents the conclusions, limitations, and implications of the findings obtained from the provision of interventions to support teachers on self-reflection and the problems that affect teachers' classroom interaction patterns. These suggest scope for improving the quality of teachers' classroom interaction patterns and thereby improving students' participation with broader implications for extension of the research in ways that could strengthen the evidence and help to generalise the findings.

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List of Appendices

11.1 Appendix 1A. General information form

An exploratory study of Teachers' Classroom Interaction Patterns in Basic Science Lessons in Junior Secondary Schools in Ekiti State, Nigeria.

Dear Principal/Participants/Parents,

I am Rasheedah Agbaje, a research student at the University of York, UK, currently carrying out a research study to investigate the various interaction patterns used by teachers and identify factors that influence patterns of teacher's classroom interaction in basic science lessons in Nigeria. The study will also explore the effects that in-service training will have on teachers' classroom interaction patterns aiming at managing the quality of classroom interaction with a goal of enhancing the quality of teaching and learning. I am writing to request that you/your school/your child will be able to participate in the study.

Anonymity: The data collected will be coded with numbers. Any identifiable information about staff, students and schools will be removed as soon as possible, separated from the data and will be unidentifiable in the reports of the research.

Storing and usage of data: The data will be backed up as soon as possible and locked up in a password-protected computer. The original video recorded will be deleted after use. The data will be kept safely for the duration of the study until 2021, after which any identifiable data will be destroyed. The unidentified or anonymised data may be used for academic presentation, online academic work sharing, future analysis, and future research. However, you hold the right to reject the data for online research-sharing purposes. You will have the opportunity to comment on the written reports of the events. Nevertheless, if you do not want the data to be used for information sharing resulting from the study, please do not sign the consent form. You are free to withdraw your participation/school/child from the data collection period until after two weeks of data collection. You can withdraw by contacting the researcher at: (roa503@york.ac.uk).

Confidentiality: Please indicate on the consent form attached with a tick if you are happy for the anonymised data to be used in the ways listed in this letter. Participants are asked to ensure the confidentiality of co-participants. Please, if the information is gathered that raises legal or moral about the safety of the participants or about the safety of others or concerns perceived by the researcher, the researcher may pass the information to a relevant external body. I do not intend to cause any stress to the participants and do not foresee undue disturbance in the normal classroom lessons. I hope that you agree that you/your school/your child will take part in this research. If you do not agree to participate, please do not fill out the consent form. If you have any concerns, queries and complaints before giving consent or after the data collection, please feel free to contact the researcher (roa503@york.ac.uk) and the following people from the University of York: Prof Judith Bennett at judith.bennett@york.ac.uk and the chair of the Ethics Committee at education-research-administrator@york.ac.uk. **Please keep this information sheet for your own record.**

11.1.1 Appendix 1B. Consent form for Principal

Dear Principal,

The implication of this for your school and participants (teachers and students)

For teachers:

Basic science teachers will be interviewed for a period of 40 minutes at a time and place convenient for the teacher. Additionally, videotaped recordings and pictures of normal basic science lessons will be recorded and taken on three occasions.

A one-day in-service teacher training at a venue chosen by the teachers will be conducted for the teachers. Following this, classroom observations will be conducted again in their normal basic science lessons. A total of three observations of the teacher's lessons will be done after the training.

For students:

The students will be involved in a focus group interview for a period of 40 minutes outside school lesson times on a date chosen by their teacher. An audio recording of the focus group interview will be made.

I am approaching the teacher as a basic science teacher and students selected by their teachers. Phone recharge cards worth £5 will be given out to teachers to thank them for their participation. Refreshments will be served for teachers at the training and for the students after the focus group exercise.

Consent form

Please tick each box If you are happy to participate in this research.

The following statements establish that you have read and understood what taking part in this research by your school will involve.

I understand that the purpose of the research is to investigate the various interaction patterns used by teachers, identify factors influencing patterns of teachers' classroom interactions and equally find out the effects that in-service training will have on teachers' classroom interaction patterns aiming at enhancing the quality of teaching and learning.

I understand that the data will be stored securely in an access-restricted video recorder locked in a cabinet and a password-protected computer; only the researcher will have access to identifiable data.

I understand that my school/student/teacher's identities will be protected by a code.

I understand that the anonymised data will be used in academic publications.

I understand that the anonymised data will be used for academic presentations.

I understand that the data could be used for future analysis and future research purposes.

I understand that we must all ensure the confidentiality of all participants.

I understand that the data will be kept until 2021, after which it will be destroyed.

I understand that I can withdraw the school's participation at any point during data collection and up till two weeks after data collection.

Name of Principal:

Date

Signature:

11.1.2 Appendix 1C. Consent form for the parents

The following information established that you have read and understood the general information page and understood what taking part in this study by your child involves. This form describes the implication for your child and your agreement.

Dear Parent,

The implication of this for your child

The students will be involved in a focus group interview for a period of 40 minutes on a date chosen by their teacher and convenient outside the school lesson. An audio recording of the focus group interview will be made. Video recording of their basic science lessons will also be recorded. Refreshments will be served for both teachers and students after the focus group exercise.

Thank you very much for your time.

Rasheedah Agbaje

Consent Form for Parent

Please tick each box if you are happy for your child to participate in this research and hand in the form to your child's class teacher within two days of receipt of this form.

I understand that the purpose of the research is to investigate the various interaction patterns used by teachers, identify factors influencing patterns of teachers' classroom interactions and equally to find out the effects that in-service training will have on teachers' classroom interaction patterns, aiming at enhancing the quality of teaching and learning.

I understand that the data will be stored securely in an access-restricted video recorder locked in a cabinet and a password-protected computer; only the researcher will have access to identifiable data.

I understand that the identity of my child will be protected by a code.

I understand that the anonymised data will be used in academic publications.

I understand that the anonymised data will be used for academic presentations.

I understand that the data could be used for future analysis and future research purposes.

I understand that the data will be kept until 2021, after which it will be destroyed.

I understand that I can withdraw the participation of my child at any point during data collection and up till two weeks after data collection.

Name of parent:

Name of child:

Date:

Signature:

11.1.3 Appendix 1D: Consent form for teachers

Dear Teacher,

This will be the implications for you as a teacher:

For teachers:

Basic science teachers will be interviewed for a period of 20 minutes at a time and place convenient for the teacher. Additionally, videotaped recordings and pictures of normal basic science lessons will be recorded and taken on three occasions.

A one-day in-service teacher training at a venue chosen by the teachers will be conducted for the teachers. Following this, classroom observations will be conducted again in their normal basic science lessons. A total of three observations of the teacher's lessons will be done after the training.

For students:

The students will be involved in a focus group interview for a period of 40 minutes outside school lesson times on a date chosen by their teacher. An audio recording of the focus group interview will be made.

I am approaching you as you are a basic science teacher. Phone recharge cards worth £5 will be given out to teachers to thank them for their participation. Refreshments will be served for both teachers at the training and the students after the focus group exercise.

Thank you very much for your time.

Rasheedah Agbaje

Consent Form for the Teacher

Please tick each box if you are happy to participate in this research.

I understand that the purpose of the research is to investigate the various interaction patterns used by teachers, identify factors influencing patterns of teacher's classroom interaction and equally find out the effects that in-service training will have on teachers' classroom interaction patterns aiming to enhance the quality of teaching and learning.

I understand that the data will be stored securely in an access restricted video recorder locked in a cabinet and a password computer. Only the researcher will have access to identifiable data.

I understand that my identity will be protected by a code.

I understand that the anonymised data will be used in academic publications.

I understand that the anonymised data will be used for academic presentations.

I understand that the data could be used for future analysis and future research purposes.

I understand that I must ensure the confidentiality of other participants.

I understand that the data will be kept until 2021, after which it will be destroyed.

I understand that I can withdraw my participation at any point during data collection and up till two weeks after data collection.

Name of teacher:

Date:

Signature of researcher:

11.2 Appendix 2. Interview schedule for teachers (IST)

Interview schedule for teachers, IST (ANONYMOUS)

My name is Rasheedah Agbaje, and I am a research student at the University of York. I am carrying out a study on the observation of Teachers' Interaction Patterns in Basic Science classrooms at Junior Secondary Schools in Ekiti State, Nigeria. I am going to interview you for about 20 minutes, and I hope your experience will contribute immensely to the success of the study. For the purpose of concentration, understanding, and not missing out on your points, I would like to record our discussions. This would be used for the transcription of our discussion. I assure you of the confidentiality and anonymity of your responses.

Let me begin by asking the following questions.

Section A (Demographic Questions).

Name of school:

Location of school:

Section B. (Broad Questions)

Question 1

How would you describe the process of your interaction and student responses in your basic science lesson?

Question 2

What would you say are factors affecting your patterns of interaction with the students and the responses they provide during the teaching and learning of basic science in your lesson?

Question 3

To what extent does the availability of resources affect interaction patterns in your basic science classroom?

Section C (Questions relating to teachers' direct talk)

Question 4

How long do you think you talk for in a single basic science classroom lesson, for example, during the teaching of a topic like living and non-living things?

Question 5

Considering the total minutes, it takes you to talk. How long does it take you to present the facts, express your idea or explain a concept to the class during the teaching of a topic like Environmental pollution?

Question 6

In your opinion, would you classify the types of questions you ask as one requiring the student's recall of facts or one requiring critical thinking? You could provide an example if you do not mind.

Question 7

Sometimes pupils' answers could be wrong. Describe how you would check or criticise wrong answers.

Question 8

As we all know that there could be some sort of pupil's unacceptable behaviour; how do you check this?

Question 9

Describe how you would give a directive to a pupil in your basic science lesson.

Section D (Questions relating to teachers' indirect talk)

Question 10

Let's talk about using pupils' ideas or opinions in class. How do you use or react to pupils' ideas in class?

Question 11

When a student provides an idea about an issue, what do you do as a follow-up of the ideas?

Question 12

In the same vein, when pupils' answers are right, explain how you clarify this.

Question 13

In order to initiate or make pupils talk in your basic science class. Do you solicit or ask for a response to your talk, or do pupils initiate talk different from your own?

Section E (Questions related to students' talk)**Question 14**

What do you think about pupils discussing their different ideas or opinions to your question in the basic science lesson?

Question 15

To what extent do you think the use of gestures and smiles is essential in your basic science lessons?

Section F (silence or thinking- time and confusion)**Question 16**

Would you be able to say the period between your question and a pupil's response or complete responses?

11.3 Appendix 3. Follow-up interview schedule for teachers

Follow-up interview schedule for teachers (FIST)

1. Can you give me some examples of how you used the different classroom interaction patterns learnt during the training in your lessons and tell me how you felt they went and how do you feel about using them?
2. Would you rather prefer the use of your former classroom interaction patterns or the new one?
3. What and how did the school management or Principal react to the new practice?
4. Had there been any other new knowledge learnt apart from the one from the intervention or attendance of training related to classroom interaction patterns or recent provisions of new materials like new workbooks, handbooks, worksheets, and new materials for improvisation that can aid students to talk in your lesson?
5. What part of the period of your lesson do you think is most and least important to the pupils?
 - (a). Teacher direct talk time
 - (b). Note writing period.
 - (c). Listening period
 - (d). Students talk period.
6. During your application of the different classroom interaction patterns, did you still feel that pupils' classroom discussions took much of the time for the period?
7. What motivated you to implement the newly learnt patterns of classroom interaction?
8. 8. To what extent were you able to refrain from punishment as a means of correcting misbehaviour?
9. What aspect of questioning were you able to change? For example, asking thought-provoking questions.
10. Did you find it natural to wait patiently for the pupils to think over your question in order to provide a response after being called upon.
11. Were you able to provide clues whenever pupils provide wrong answers to your questions or seemed confused?

11.4 Appendix 4. Focus Group Interview Schedule for Students (FISS)

The following questions will be printed on coloured cards for the pupils to arrange into the grids in groups and compare answers between groups with the most important at the top of the diamond, the next two most important, the next three most important to the least single important statement in the last grid.

Statements to be written on the coloured cards.

1. I learn a lot in basic science class because the atmosphere is friendly and favourable.
2. I would like more opportunities to talk in basic science class.
3. I get to talk to other pupils in the class about the teacher's question.
4. I feel comfortable talking to my basic science teacher in basic science class.
5. I learn best when listening to the teacher in basic science class.
6. I learn best when discussing with other pupils in the class about a topic in basic science.
7. I like to be asked questions related to life events in basic science class.
8. I like to be corrected with love when I misbehave in basic science classes.
9. I like to be recognised for answering a question correctly.
10. I think everyone participates fairly in basic science class.

11.5 Appendix 5. Basic Science Interaction Analysis Categories (BIAC)

		Codes/ Categories	verbal responses
Teacher talk	response	1	Accepts feeling accepts and clarifies an attitude or the feeling tone of a pupil in a non-threatening manner. Feelings may be positive or negative.
		2	Praises or encourages student praises or encourages pupil action or behaviour. Jokes that release tension, but not at the expense of another individual. Nodding head or saying 'UMHM?'
		3	Accepts or uses ideas of pupils: clarifying or building, or developing ideas suggested by a pupil. Teacher extensions of pupil ideas are included, but as the teacher brings more of his own ideas into play, shift to category five.
	initiation	4a	Ask open-ended question.
		4b	Ask closed-ended question.
		4c	Ask pseudo questions such as, Is it clear? Do you understand? Isn't it?
		5	Lecturing: giving facts or opinions about content or procedures; expressing his own ideas
6	Giving direction: directions, commands, or orders to which a pupil is expected to comply		
7	Criticising or justifying authority: statements intended to change student's behaviour from non-acceptable to acceptable pattern; stating why the teacher is doing what he is doing		
Student's talk	Response	8	Pupils talk in response to teacher: talk by students in response to teacher. Teacher initiates the contact or solicits student statement
	Initiation	9	Talk initiated by the student; talk by students, which they initiate. If 'calling on 'student is only to indicate who may talk next, observer must decide whether student wants to talk. If he did, use this category
Silence		10	Silence are periods when thought is being articulated or a reflection period
Noise		11	Noise or short periods of which communication cannot be understood by the observer

11.6 Appendix 6A. Teacher awareness training agenda

Aim: The training aims at changing the present interaction patterns used by teachers to improve the quality of teaching and learning in basic science classrooms in Nigeria.

Goal: To have teachers become self-supervised, evaluate their classroom performance, and decide where to make changes within the period of the training.

Objectives: At the end of the training, the teacher will be able to:

- encourage and increase student-student or students-students active classroom participation and engagement
- Demonstrate the ability to accept and clarify students' attitude, praise, or encourage students' behaviour, accepts, or uses the ideas of students, and builds on these ideas.
- maintain a good physical position in the classroom, develop the ability to address different learning styles of students and establish classroom policy concerning discipline.
- manage the classroom learning time, Increase the period of waiting for student's responses, design excellent quality questioning and feedback skills, provide positive reinforcement
- develop the ability to make students think critically about an issue as a facilitator, encourages students' solicited statements and small group, large group student presentation, and brainstorming promotes student-centred classroom interaction.

11.6.1 Appendix 6B. The timetable or plan

TIME	ACTIVITIES	MINUTES
9:00 - 9:30	Introduction/Expectations/ground rules.	30mins
9:30- 9:45	Pre- test-where we are	
9:45 - 11:00	Ask participants to form groups. Each group should discuss what they think about classroom interaction patterns. Researchers write all their ideas down. Presentation-Interaction -What are classroom observations Ask participants to list the types of verbal and nonverbal interaction patterns they use in classrooms.	1hr:15mins
11:00- 11:30	The IRF mechanism and Dialogue-	30mins
11:30- 13:00	Participant's presentation on reinforcement, motivation, and discipline in classroom management	1hr30mins
13:00- 14:00	Questioning/Feedback Participant demonstration /presentation on questioning	1hr
14:00- 15:00	Presentation-Classroom climate Student- centred teaching strategies	1hr
15:00- 16:00	Recap, Post evaluation/Oral questions/feedback. Watching clips from videos recorded. Self-assessment of events in the video-what we think we are doing right and how to improve	1hr
16:00 pm	Closing	

11.6.2 Appendix 6C. Awareness training material for 1-day intervention on classroom interaction patterns

11.6.2.1 Interaction Patterns

What is interaction: Interaction is a process where two or more people engage in reciprocal actions, and these could be verbal or non-verbal interactions. Verbal interaction is all spoken words which include the type of questions the teacher asks, low-ordered questions or high-ordered questions, whether the teacher answers students' questions, praises and encourages or amends students' answers.

Non-verbal interactions are the frequency of use of gestures, illustrations, or sketches. Nodding or shaking of the head in acceptance or rejection of students' responses. The teacher's ability to keenly observe each student as an individual, different from another by task, ability, time, and attention, will be investigated in the study.

The classroom interaction patterns are the different types of interaction and various possible ways in which students can interact with one another and with their teacher in the classroom. The level of the student's class participation and the activeness or passiveness of the student is also a function of the teacher's competency in selecting appropriate patterns of classroom interaction which might help the learners achieve the lesson aims and objectives. A good choice of classroom interaction contributes to the learner's sense of belonging in a group and group cohesiveness. The more opportunities they have to interact with their peers, the more likely they are to help each other in their learning process.

Elements of classroom interaction

- Teacher and Student
- Teacher and Material
- Student(s) and Student(s)
- Student(s) and Material

Methods that teachers can use to make the class interactive or dynamic.

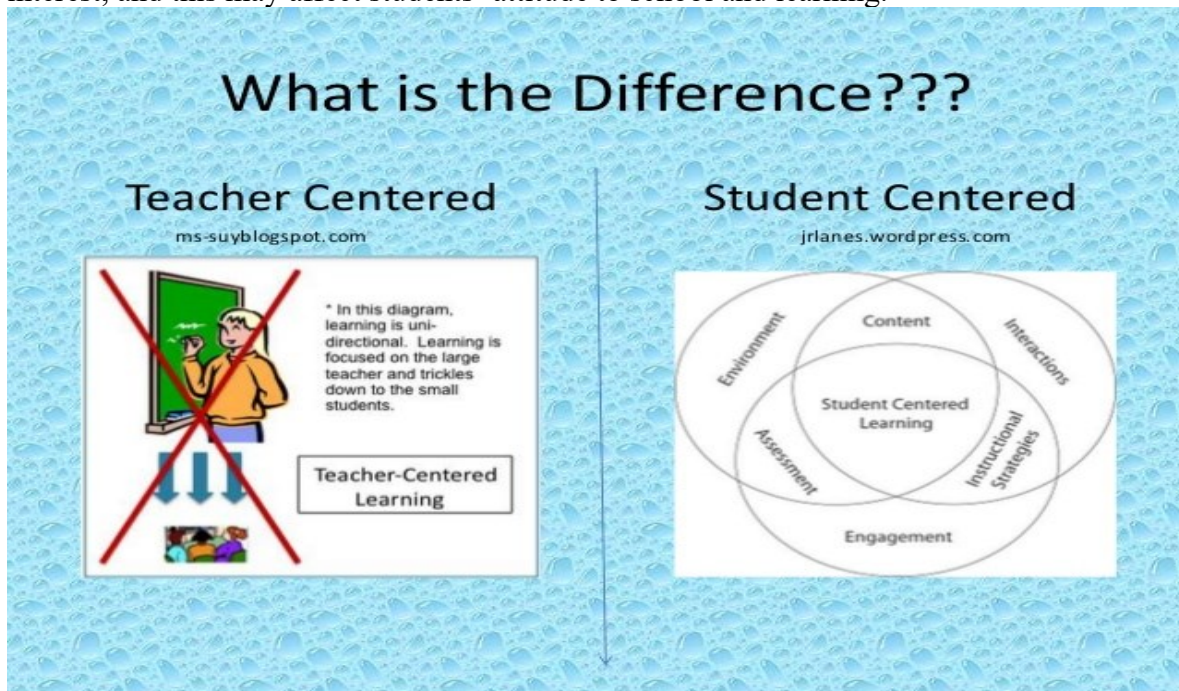
A. Teacher-whole group

Alexander (1996), Mortimer (1988) and Pollard (1994) conclude that the whole class teaching bears little difference from the old traditional didactic teacher-student interaction style. In UK and America, some studies of classroom discourse show that whole-class teaching across all school stages is dominated by a teacher-led recitation, revealed by Sinclair and Coulthard (1975), with three moves: initiation and response and follow-up as feedback (Edwards & Westgate, 1994 and Mehan, 1979)

This is the traditional method of teaching and learning, where the teacher is the authority. The teacher uses an authoritarian voice to dominate the lesson. There is unequal power-sharing between the teacher and the student in whole-group teaching and learning. The whole group method is a teacher-centred approach where students mostly respond to teacher-initiated talk. The teachers (TTT) talk mostly in the lesson. The teacher, apart from dominating the classroom, employs routine, uses open negotiation, and manipulates students. This system leads to non-participation and sometimes personality issues or power struggles and disruption from the students. In a specific sociocultural context, the teacher enjoys cultural authority over students based on tradition. As such, teachers wield a great deal of authority that students are to obey.

The lesson is planned for the students, and it is easier to plan as the teachers use fewer materials to plan. In this method, the teacher usually stands in front of the classroom where the lesson is presented in a chalk-and-talk style, followed by an exercise set for the whole class or a whole-class discussion initiated by the teacher. The low achievers will fail to keep

up and eventually lose confidence in themselves, while the high achievers will be bored because of the non-challenging nature or not providing new knowledge or skills and lose interest, and this may affect students' attitude to school and learning.



B. Pairs and grouping

This is the most common interactive pattern used by teachers. It is a student-centred form of learning where students work together to enable them to help and learn from each other, and this enables them to work collaboratively and feel more confident when contributing to the whole group.

Student-centred learning is based on the need, abilities, interests and learning style of the student, and the teacher is a facilitator in the learning environment. The students become autonomous and independent by having the responsibility for the learning path in their hands by the teaching imparting them to practice and therefore develop skills.

Students can also be paired up to check answers together after they perform a task or answer a question in class. In pairing students, it is better to consider learners with similar or different levels of abilities working together depending on the aim of the activity. Sometimes, it might also be advantageous to allow learners to decide whom they would like to work with. This can foster confidence and increase the feeling of being in a safe environment.

C. Mingling

This method allows students to speak to as many partners as they can. Mingling can be very noisy and disorganising but very engaging, and it allows learners who do not feel confident in whole-group or pair groups to loosen up and interact. However, mingling can be as simple as asking students to stand up and talk to different pairs.

D. Individual work

Some reading and listening can be done individually by students, and this gives students a chance to think, assess how much they have learnt and process what is taking place in the classroom. Students can be given some minutes on their own before a more communicative activity to think and plan what they are going to say. This does not necessarily mean that the

student does not know what to say. This requires the support of the teacher in monitoring and helping shy and less confident learners.

E. Classroom behaviours

In whole-class teaching, the classroom behaviours or moves usually are usually described as **IRF mechanisms**. IRF means initiation moves, response moves, and feedback moves by both teachers and students. This is also used to log in the number of interactions moves in a lesson. Initiation could be: - the types of teacher's questions and the number of pupil initiations in the form of questions and statements. Responses by an individual or choral answers
A common source of methods to initiate responses by teachers is the use of mid sentences rise in tones.

The responses are always in the form of repetition or completion of a phrase or word to which pupils already know whether to provide individual or choral answers, for instance, Wash your teeth -----every day. Or a repetition again by saying, what do I say?

Responses either by whom or choral? Are they all active? Are they participating intelligently, and are they giving choral responses? Sometimes the issue of gender comes in, and the teacher might want to look at equal representation.

Do they voluntarily want to respond, or is the teacher soliciting responses? This is called the teachers elicited designed method.

Follow-up moves. This is whether:

- responses were affirmed or acknowledged by accepting or rejecting the answer
- Whether responses were praised, probed by staying and asking for further clarification from the pupil, commented on by rephrasing, building, or elaborating on?
- Whether the teacher asked another pupil to answer the questions

Strategies that can increase students' classroom participation and Improve learning and teaching.

A. The IRF mechanism used during a whole-class lesson can be improved by integrating student-centred teaching strategies. These are methods that include active learning in which students solve problems, answer questions, formulate questions of their own, discuss, explain, debate or brainstorm during class.

B. Dialogic-the teacher is almost passive; he accepts and allows students to use their own ideas; he builds on this with frequent praises and encouragement; he accepts and clarifies feelings and attitudes. Good quality questions can be used to aid classroom dialogue and hence enhance students' reasoning and challenge their level of knowledge.

C. Questioning and feedback

Questions should be asked based on knowledge, comprehension, application, analysis, synthesis, and evaluation. Questions could be in two categories, low order or high order, low order or close-ended are those requiring recall of facts or information and high ordered.

or open-ended questions are those that involve the application of information, manipulation of information, reasoning, and evaluation.

-High-order questions are important to elicit deeper thinking and high cognitive development and could also be used by teachers to initiate discussion to develop dialogic talk among pupils. This does not have one single answer. Answers could vary depending on individual creativity.

-Low-ordered questions could be used for simple checks, recall and summary of important learning points. Teachers should caution on how, types, numbers, and repetition of questions. All attempts of students to answer questions should be respected and valued in order to protect their self-esteem.

D. Feedback is a sort of questioning process, and it is a very powerful tool for learning and achievement. Cues provide aid to pupils as they try or struggle to provide answers to questions in the classroom. Feedback could be negative corrections or positive feedback on how well they have performed.

E. Cooperative learning is an interesting, organised, and structured way where the teacher serves as a facilitator setting or combining pupils of different ability levels into small groups to interdependent on one another to solve a given task or assignment or projects.

F. Inductive learning –Students are first presented with questions and challenges that are inquiry-based learning, case-based instruction, problem-based learning, project-based learning, and discovery learning and so on.

G. Reinforcement

Reinforcement is simply a method of getting a pupil to act in the classroom so as to maximise the pupil's reward, which usually comes after the response. Reinforcement is in two categories, positive and negative reinforcement. Behaviours that are positively reinforced are likely to be repeated. Teachers use praises and rewards like gifts as reinforcement for positive behaviours. However, specific praise for individuals should be used rather than general praise for the whole class.

H. Motivation

There are two types of classroom motivation, intrinsic and extrinsic.

Teachers can spark their student's intrinsic motivation by getting to know them as individuals, developing a positive relationship, giving them ownership of their classroom, practicing setting small achievable goals with them, giving them a solid foundation, and giving students specific feedback- you are so smart, great job. Find out what interests your student, tap into their innate curiosity, relate this to pedagogical content or make connections between classroom activities and the real world. Give rewards and recognitions, you can set a reward for a whole class, but students tend to be more motivated if their reward is based on individual growth and achievement. Reward consistently good behaviour and high achievement. Recognition and praises are tangible rewards that many students long for, acknowledging the good works and accomplishments of students.

Extrinsic motivation is doing something to earn a reward or to avoid punishment. Teachers should give less extrinsic motivation as they are very weak and do not last and can make them independent learners. They can be applied when a child needs to complete a hard or difficult task.

I. Discipline: Varieties of skills and techniques could be used to keep students organised, orderly, focused, and attentive to classroom tasks. Rather than teachers becoming aggressive, canning, and making students lose interest in science, there are simple methods of discipline in the classroom.

-Focusing- get the attention of everyone; only start when everyone is settled down.

-Direct instruction- tell them what you will be doing together and set a time.

-Monitoring- move around almost every 2 minutes, check on their progress, provide individualised instruction where necessary.

-Do not interrupt the class. Make general announcements with a quiet voice only when you notice that the majority have the same problem.

Environmental control- warm, cheery, change environment, use-coloured pictures, tell them about yourself but no long story.

-Low profile intervention- do not reward misbehaviour by becoming the focus of the class, make your approach to misbehaviour inconspicuous, and do not distract others.

-Assertive discipline-Lay down clear rules and consistently enforce them. No child has the right to interfere with the learning process of others. Include a good mix of praises in your discipline styles and not the routine claps.

-Assertive I messages-These are used when confronting a misbehaving student; they are clear descriptions of what a misbehaving student is supposed to do, e.g I want you to... I need you to... I need you to focus on the task or behaviour the teacher wants and not I want you to stop... focussing on the misbehaviour can trigger a confrontation. Most times, the student's response is I wasn't doing anything, or it wasn't my fault.

Positive discipline- Use rules that describe the behaviour you want; instead of listing what students cannot do; instead of no running in the room, use and move in an orderly manner; instead of no fighting, use and settle conflicts appropriately; instead of no gum chewing, use, leave gum at home, acknowledge good behaviour with a nod, smile or verbally or thumbs up.

J. Classroom climate

This is the classroom environment, the social climate, and the emotional and physical aspect of the classroom, which influences students' growth and behaviour, and which affects peer interaction. It is the prevailing mood, attitudes, standards, and tone that teachers and students feel when they are in the classroom. A negative classroom climate can be hostile, chaotic, and out of control, while a positive climate feels safe, respectful, supportive, and welcoming for students learning.

The classroom climate is very crucial for conducive teaching and learning, and this is built up by the patterns of interaction between the teacher and student, asking questions, responding, and reacting, and the outcome of a good classroom interaction pattern is effective teaching and learning. The attitude of students towards science depends on the quality of classroom experience provided by the teachers.

An effective classroom climate brings about pupils' self-respect and self-esteem as learners.

Non-verbal behaviours

This is a complex part of communication that involves implicit and explicit meanings of words. It is a process of sending and receiving messages without using words, neither spoken nor written. Some researchers believe that 93% of our communication is non-verbal and 7% verbal. This type of communication in some cultures can be very complex and misinterpreted if not well understood. They can reinforce the meanings of verbal words and give information about our emotional states, such as posture, gesture, body language, smiles and facial expressions, eye contact, tone of voice, closeness, or personal space. The interpretation of non-verbal messages differs in communities, societies, and countries.

Summary: The advantages of the teacher's regular provision of an effective and appropriate pattern of classroom interaction for each lesson are to foster students' acquisition of critical thinking, long-term retention, deep understanding, creative problem-solving skills, formulation of positive attitudes towards science, and self-confidence in knowledge and skills. The overall aim is to develop a sound individual and a good citizen who is self-fulfilled.

11.6.3 Appendix 6D Evaluation Form for researcher’s and participants’ intervention and reflective practices

Evaluation Form for researcher’s and participants’ intervention and reflective practices
 Thanks for attending this intervention programme. Please take a moment to evaluate this intervention programme.

Range

4	Outstanding
3	Good
2	Satisfactory
1	Poor

	4	3	2	1
Presentation				
Content covered/Materials.				
Clarity/audio/videos				
Integrative with real classroom practice				
Impact on your level of knowledge				
Impact on your own teaching				
Impact on your attitude towards classroom interaction				
Is the time for the intervention enough				
What are your immediate thoughts on how today’s training will impact your own planning and teaching (list the actions you want to take forward)				

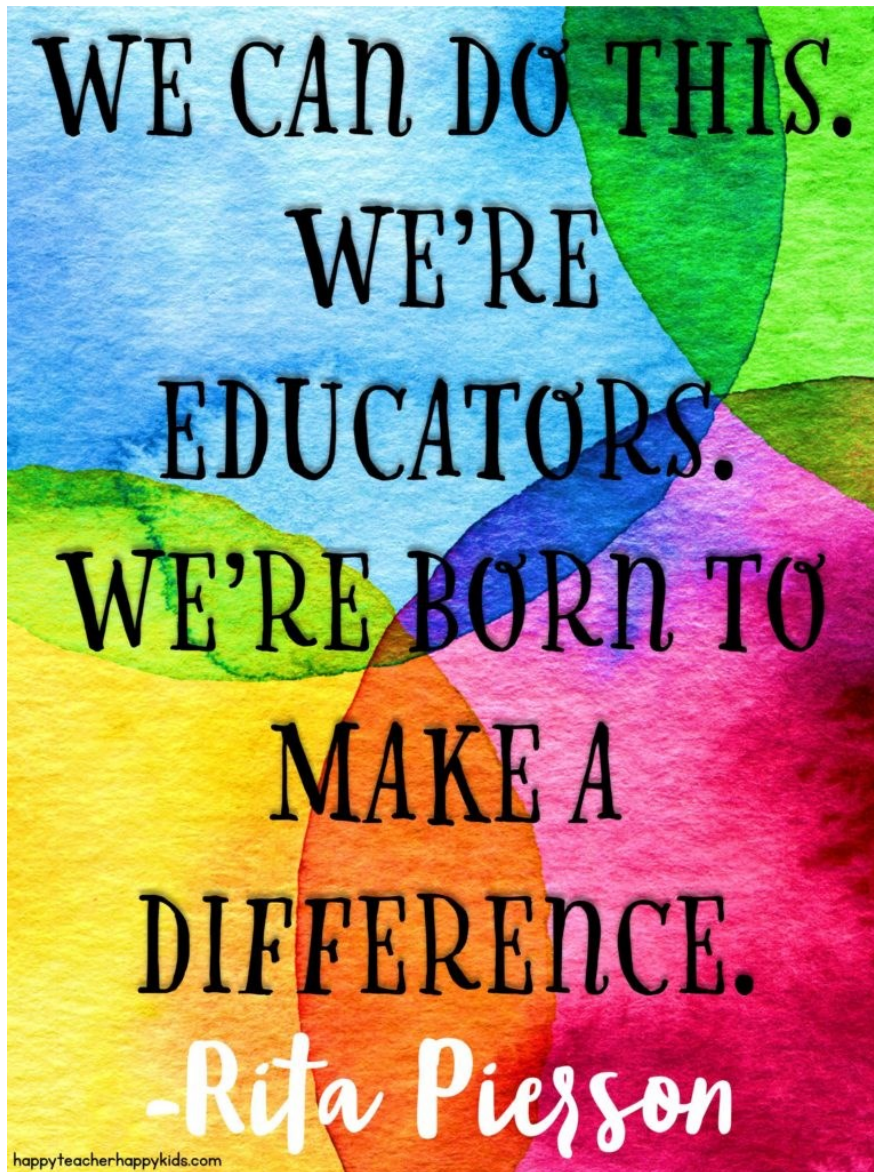
Comments, suggestions, and others if any

Name of teacher participant(optional):

Date:

Facilitator’s name:

Most importantly- LET'S MAKE A CHANGE



11.7 Appendix 7. Themes and codes adapted from Harland and Kinder's inset outcomes.

THEMES AND NODES	DEFINITION
Theme 1: New awareness outcomes Node: Overall teachers' awareness of using newly learnt knowledge.	This is defined as a shift in perception from previous assumptions of content and method of delivery to a new experience
Theme 2: Value congruence Nodes: Teachers' preference for a method Shared values	This is defined as an individualised code of practice, personalised content delivery and classroom management methods, and a personalised preferred approach to content delivery and classroom management. They are issues about teachers' and educators' values, beliefs, ideologies, and a sense of moral purpose.
Theme 3: Affective outcomes Nodes: Negative affective outcomes Positive affective outcomes	Affective outcome is defined as a feeling of excitement, confidence, and competency about a new practice.
Theme 4: Motivational and attitudinal approach Nodes: Inspiration for change	This theme is defined as a keen interest in implementing newly learnt ideas from INSET. This involves changes in teachers' attitudes towards their self-concepts, their professional development
Theme 5: Impact on practice Node(a)General impact of the intervention on teachers' classroom interaction patterns. (b)Questioning. (c)Students' classroom discussion. (d)Waiting- time (e)Misbehaviour correction (f)Non-verbal. (g)Provision of clues to questions.	This theme is defined as direct or indirect methods of intentionally transferring skills to teachers to bring about change in practice
Theme 6: Knowledge and skills	Development of a more in-depth level of knowledge. Development in teachers' self-knowledge and awareness

11.8 Appendix 8A. An excerpt from the teachers' interview transcript before the intervention

Researcher: Good morning, ma. Please can you tell me your name?

Teacher: My name is teacher EK

Researcher: And the name of your school?

Teacher: EK in Ado local government, Ado Ekiti

Researcher: And you teach?

Researcher: Thank you very much

Teacher: You are welcome

Researcher: My name is Rasheedah Agbaje, and I am a research student at the University of York. I am carrying out research on the observation of teachers' interaction patterns in basic science at junior secondary schools in Nigeria. If you don't mind, I would like to interview you about classroom interaction patterns in your lessons.

Researcher: How would you describe classroom interaction patterns?

Teacher: A classroom interaction pattern is a situation whereby the teacher teaches the students, they will both interact, and the teacher will not be the only one doing the talking, listening to responses from the students so as to know how they understand the topic or subject matter, so it has to be an interaction model. The teacher will not be the only one talking. The students have to respond too, and then if there is any student that is not physically okay in the class, then it is the duty of the teacher to bring such a student to be active in class.

Researcher: Thank you very much

Researcher: Thank you very much. In a total lesson, a whole one lesson, how long do you think you talk as a teacher in a single basic science classroom lesson?

Teacher: In this school, you have 40 min for teaching, and in that 40 minutes, you have to squeeze time to explain and also to write the notes, its parts of the factors affecting us, to explain alone can take all the 40minutes, not talk of writing the notes, you also have to explain the notes, and before you explain, 40 mins is already gone, so you have to wait for another period, so we only use 40 mins for a single period.

Researcher: Out of that 40 minute, you talk for....?

Teacher: Ummm. as a teacher, at least for 30 mins

Researcher: For 30 mins?

Teacher: For 30 mins, for more understanding

Researcher: Thank you very much. I am trying to get you right.

Researcher: Considering the total minutes it takes you to talk in the class, how long does it take you to present the facts, express ideas or opinions or explain a concept in the classroom

Teacher: From the 30 minutes that we have, at least 20 minutes will be used on that subject we have on that day to explain the concept; then you ask them to ask questions then they will provide answers.

Researcher: So out of that 30 minutes that it takes you to talk in class, you use 20 minutes to explain the concept and the presentation of the facts

Teacher: responded with a nod and a yes

Researcher: Thank you very much

Researcher: In your own opinion, will you classify the type of questions you ask students in the class as low-ordered or high-ordered questions?

Teacher: You mean about the topic being taught?

Researcher: Yes

Teacher: The questions you ask in a lesson depending on the evaluation of the lesson, those things that you want the students to know at the end of the lesson; initially, you note what you want the student to know at the end of the lesson after explanation then you ask them about the questions, the question you will ask will be based on the evaluation so I can classify it as high....(confusion on her face)

Researcher: Allow me to cut in a little bit, low ordered questions are questions that require a simple answer, a straight answer or a one-word answer like definitions, while high-ordered questions are questions that require complex thinking, like in application, and there is no one straight answer to a complex question, low ordered questions are like what is your name? Define with just one right answer.

Teacher: In most cases, we ask low-ordered questions

Researcher: Sometimes a pupil's answers could be wrong in class, sometimes when you ask a question in class and the pupil answers your question wrongly, how would you check or criticise the wrong answer

Teacher: Umm...When I ask questions in class, initially, the student might not give me what I want, but it might be later, but in a situation whereby the student gave a wrong answer, I will have to put him right.

Researcher: What if you have some unacceptable behaviour? How would you check this? Some behaviours that are unacceptable to you as a teacher because, as a teacher, you may have some ground rules in the class.

Teacher: Yes, as for me, I do discipline them

Researcher: How do you discipline them

Teacher: It is either I ask them to kneel down or I cane them

Researcher: You cane them?

Teacher: Yes

Researcher: Thank you very much

11.8.1 Appendix 8B. An excerpt from the follow-up teachers' interview after the intervention

Interviewer: Can you please give me some examples of how you used the different classroom interaction patterns learnt during the training in your lessons and tell me how you felt they went?

Interviewee: After the training you gave us, I try as much as possible to inculcate teachers interaction patterns into my teaching method; for example, lessons learnt from the post-training showed that I do most of the work in class, talk, looks like a one-way traffic class and not given the students room to contribute, I now give them the opportunity to talk, divide them into groups, give them different roles relating to the topic, I immediately changed my interaction pattern but went on holiday, started as soon as resumption, I am really committed to the change in practice. I had not been able to tolerate students discussing among themselves in her lesson before, but I now allow student-student discussion. I am trying now to find out why some students exhibit some misbehaviour before now, for example, coming late to class.

“I listen more and more now and am friendlier to students in the classroom. And I now give the students more time to ask questions and try to find out what they do not know.

Interviewer: To what extent were you able to refrain from punishment as a means of correcting misbehaviour?

Interviewee: Yes, I have taken the pain not to be harsh to students and now discover that it wastes my time.

Interviewer: What aspect of questioning were you able to change? For example, asking thought-provoking questions.

Interviewee: Not much has been done on that aspect. I still ask close-ended questions. Because in the first week, we normally do not go to class for many reasons. The aspect I have really looked into is making sure the lesson is not just about writing notes and the teacher's explanation.

Interviewer: Did you find it natural to wait patiently for the pupil to think over your question so as to provide a response after being called?

Interviewee: Hmm.yes, I have been patient with students providing a response to her questions, allowing students to think, as against former rushing over, trying to cover the topic and not being patient. The major challenge has been that of consciousness of the time to cover the scheme of work, but since you have told us not to rush over the lessons, I have been patient with the students.

Interviewer: Were you able to provide clues whenever pupils provided the wrong answers to your questions or seemed confused?

Interviewee: Yes, I do that in class now, I provide clues to students' questions in the classroom. If I notice that the student does not understand the question or appears to be confused, I now pay attention to the individual student's needs.

Interviewer: What motivated you to implement the newly learnt patterns of interaction from the educational intervention provided by the researcher

Interviewee: I am really committed to the change in practice when I watched the recorded video of my lesson before your training, and then I decided to use it.”

11.9 Appendix 9A. Excerpt from the pre-intervention interview NVIVO coding sample

Name: Nodes\\The type of question teacher ask

Description: this stores the teachers opinion/evaluation of own question whether close ended or simple question or opened ended or complex question

<Files\\INTERVIEWS\\AD.Pre training T.Interview> - § 1 reference coded [0.28% Coverage]

Reference 1 - 0.28% Coverage

one -word answers, simple questions, close ended questions,

<Files\\INTERVIEWS\\AW.Pre training.T.Interview> - § 2 references coded [0.41% Coverage]

Reference 1 - 0.17% Coverage

According to the topic

Reference 2 - 0.23% Coverage

I can say it is high ordered.

<Files\\INTERVIEWS\\EK.Pre.Training Teacher interview> - § 1 reference coded [0.38% Coverage]

Reference 1 - 0.38% Coverage

we ask low ordered questions or close ended question

<Files\\INTERVIEWS\\IR.Pre training Interview> - § 1 reference coded [0.40% Coverage]

Reference 1 - 0.40% Coverage

I ask simple or low ordered or close ended questions

<Files\\INTERVIEWS\\OL.Pre.T.INTERVIEW> - § 1 reference coded [1.99% Coverage]

Reference 1 - 1.99% Coverage

so we ask simple questions that produce one -word answer, close ended questions like define, state or mention,

Name: Nodes\Teacher's talk time

Description: This will store how long a teacher talks in a single basic science lesson of 40 minutes

<Files\INTERVIEWS\AD.Pre training T.Interview> - § 1 reference coded [0.24% Coverage]

Reference 1 - 0.24% Coverage

then for the next **15 minutes**, I will do the talking

<Files\INTERVIEWS\AW.Pre training.T.Interview> - § 1 reference coded [0.12% Coverage]

Reference 1 - 0.12% Coverage

At least 30mins

<Files\INTERVIEWS\EK.Pre.Training Teacher interview> - § 1 reference coded [0.17% Coverage]

Reference 1 - 0.17% Coverage

at least for 30 minutes

<Files\INTERVIEWS\IR.Pre training Interview> - § 1 reference coded [0.23% Coverage]

Reference 1 - 0.23% Coverage

at least for about 25 minutes,

<Files\INTERVIEWS\OL.Pre.T.INTERVIEW> - § 1 reference coded [0.54% Coverage]

Reference 1 - 0.54% Coverage

I can use the whole 40 minutes

11.9.1 Appendix 9B. Excerpt from the post-intervention interview NVIVO coding sample

Question 1. Can you please give me some examples of how you used the different classroom interaction patterns learnt during the training in your lessons and tell me how you felt they went and how do you feel about using them?

[<Files\\AD.POST.TRA.INTERVIEW>](#) - § 4 references coded [4.75% Coverage]

Reference 1 - 0.56% Coverage

I now give them the opportunity to talk,

Reference 2 - 0.59% Coverage

I now allow student-student discussion.

Reference 3 - 1.44% Coverage

And I now give the students more time to ask questions and try to find out what they do not know.

Reference 4 - 2.16% Coverage

I watched one of the recorded lessons and saw some flaws in my teachings, so I prefer the use of the interaction patterns learnt from the training.

[<Files\\AW.POST.T.TRA.INTERVIEW>](#) - § 1 reference coded [1.79% Coverage]

Reference 1 - 1.79% Coverage

I have been allowing the students to talk more in class now.

[<Files\\EK.POST.T.TRA.INTERVIEW>](#) - § 1 reference coded [1.76% Coverage]

Reference 1 - 1.76% Coverage

I now know that allowing students to talk in class makes them happy.”

[<Files\\IR.POST.T.TRA.INTERVIEW>](#) - § 3 references coded [4.67% Coverage]

Reference 1 - 1.21% Coverage

I has now been allowing students to participate.

Reference 2 - 1.96% Coverage

I now ask them to give me their own opinion about what they know about the topic,

Reference 3 - 1.50% Coverage

I know now that students find participation interesting.”

[<Files\\OL.POST.T.TRA.INTERVIEW>](#) - § 2 references coded [7.07% Coverage]

Reference 1 - 2.97% Coverage

I actually involve the students to participate, and this has really improved our learning. Most of the students find it interesting.

Reference 2 - 4.10% Coverage

Before, if I ask them any question, I do not normally give them time to answer before I divert to another student but now do, but now I am aware that it encourages students' deep thinking.

2). Would you rather prefer the use of your former classroom interaction patterns or the new one?

[<Files\AD.POST.TRA.INTERVIEW>](#) - § 1 reference coded [2.24% Coverage]

Reference 1 - 2.24% Coverage

I am really committed to the change in practice when I watched the recorded video of my lesson before your training, and then I decided to use it.”

[<Files\AW.POST.T.TRA.INTERVIEW>](#) - § 1 reference coded [4.14% Coverage]

Reference 1 - 4.14% Coverage

My inspiration is from the awareness created by you that the class actually belongs to the students, and before I do almost all the talking.”

[<Files\EK.POST.T.TRA.INTERVIEW>](#) - § 1 reference coded [1.25% Coverage]

Reference 1 - 1.25% Coverage

I personally see the need to use the new method.

[<Files\IR.POST.T.TRA.INTERVIEW>](#) - § 1 reference coded [2.66% Coverage]

Reference 1 - 2.66% Coverage

I watched one of the recorded lessons and saw some mistakes in my teachings and like to improve on them.

[<Files\OL.POST.T.TRA.INTERVIEW>](#) - § 1 reference coded [2.38% Coverage]

Reference 1 - 2.38% Coverage

Another science teacher in the school and I discuss classroom interaction together regularly about it, and we encourage each other.

11.10 Appendix 10: A sample of the coding for the focus group interview schedule

Coding of the diamond grids:

0 = Not relevant (Not ranked)

5= Most important (Highest rank)

4=Next important

3=Third most important

2=Second to the least important

1=Least important (Bottom of the diamond)

CODES	STATEMENTS
A	I learn a lot in basic science class because the atmosphere is friendly or favourable.
B	I would like more opportunities to talk in basic science class.
C	I get to talk to other pupils in the class about the teacher's question.
D	I feel comfortable talking to my basic science teacher in basic science class.
E	I learn best when listening to the teacher in basic science class.
F	I learn best when discussing with other pupils in the class about a topic in basic science.
G	I like to be asked questions related to life events in basic science class.
H	I get to be corrected with love when I misbehave in basic science classes.
I	I like to be recognised for answering a question correctly.
J	I think everyone participates fairly in basic science class

11.11 Appendix 11. An excerpt from the lessons' pre- and post-intervention transcripts pre-intervention transcript

Excerpt from the pre-intervention transcript

Turn partition	TIME IN SEC	TEACHER S ACTIVITY	STUDENTS ACTIVITY	BASIC SCIENCE OBSERVATION SCHEDULE BIAC	TYPE OF QUESTION	FIELD NOTE
1	31	verbal		5		Writes on the chalkboard
2	1	verbal		2		Teacher-good morning class
3	1		Verbal	8		Good morning ma
4	1	verbal		2		Teacher- you are welcome back to school
5	5	verbal		5		I want to welcome you back to secondary school. You know you are just coming from primary school.
6	1		verbal	8		Chorus yes
7	1	verbal		4c	pseudo	Is that not so?
8	2		verbal	8		Chorus "yes"
9	8	verbal		5		This is another stage in your academic life. So, I am teacher OL by name.
10	1	verbal		4c	Pseudo question	Teacher asks," Do you understand me now?

11	1		verbal	8		Chorus response - "Yes"
12	11	verbal		5		I am going to be taking you basic science. The first topic we are going to examine in this term is family health. What do I call it?
13	3		verbal	8		Family health (Chorus)
14	7	verbal		5		Teacher writes on the chalkboard
15	1	verbal		5		Family.... re-initiate and stretches the word
16	1		verbal	8		Health. completes teachers sentence in Chorus
17	13	verbal		5		Under family health these are the things that we want to copy under family health. We want to look at the meaning of personal sanitation
18	1	verbal		4c	Pseudo question	Do you understand?
19	1		verbal	8		Chorus response Yes
20	5	verbal		5		We want to look at the meaning of personal sanitation. How are we going to take good care of our own. We are going to make mention of parts of the body, then how the parts of the body are going to be cleaned.
21	1	verbal		4c	Pseudo question	Do you understand me now?

22	1		verbal	8		Chorus response Yes
23	6	Verbal/non verbal with hand movement in front of the class		5		So, the number one thing that we want to examine is the meaning of personal.... sanitation (stretches the last word designed for the student to complete)
24	2		Verbal	8		chorus response- (sanitation.... completes teacher's last word-personal sanitation
25	1	verbal		5		Meaning of what? Stretching to elicit a repetition
26	2		verbal	8		Chorus -Personal sanitation
27	7	verbal		4c		Meaning of what?
28	1		verbal	8		Chorus -Personal sanitation
29	1	verbal		5		- meaning of- personal... sanitation stretches the last word with chorus responses by all
30	1		verbal	8		Chorus -sanitation
31	1	verbal		5		I am going to give you a little definition that you are going to read, and then you can understand.
32		verbal		4c	Pseudo question	Do you understand me now?
33	1		verbal	8		Chorus response "yes"

34	13	verbal		5		What do you mean by personal sanitation? Personal sanitation can be described by the stage of keeping oneself away from dirt or the act of making the body..... stretching the last word for the student to complete (clean)
35	1		verbal	8		Chorus – (clean), Student completes the last word
36	5	Verbal/hand gesture		5		When you say something is personal, you are talking about yourself Lectures
37	1	verbal		4c	Pseudo question	Do you understand?
38	1		verbal	8		Chorus response YES
39	9	verbal		5		If I am talking about myself, I cannot be talking about you, if you say something is personal, you are referring to yourself and not any other person
40	1	verbal		4c	Pseudo question	Do you understand me now?
41	1		verbal	8	a	Chorus YES
42	3	verbal		5		So, how do you take care of yourself, what do you mean by personal sanitation-the way that you take good care of yourself and what does yourself means, your body Teacher lecture
43	1	verbal		4c	Pseudo question	Teacher asks: Do you understand
44	1		verbal	8		Chorus YES
45	3	verbal		5		Lecturing, stretching last word, designed for student to complete together with her,” from what, from.... germ”

7.2.2.2 Extract from post-intervention classroom discourse

Turn partition	TIME IN SEC	TEACHERS ACTIVITY	STUDENTS ACTIVITY	BASIC SCIENCE OBSERVATION SCHEDULE BIAC IN CODE	TYPE OF QUESTION	FIELD NOTE
15	06-1:21,46	Verbal & non-verbal		6		So, this set is going to be group 1, group 2 & moving around the class to indicate different groups for groups, using hand gestures for demarcation
16	22	verbal		4c	pseudo	Can you hear me (No student response)
17	23	Verbal/non-verbal		6 and 4a	Opened-ended	Join them there (ordered a student). Group 3, group 4, and now group 5, so we have different 5 groups. I want to know your idea on the topic, growth, and development (while moving around the classroom group students according to seat settings)
18	46-47		Non-verbal			A student stood up from the group the teacher allocated him to and moved to his own chosen group
19	47-52	verbal		6 and 4a	Opened ended	Then, after telling me, I want to see you start working now, you tell me. What do you mean by growth, the definition of development, and how you understand it? I want to know
20	52-53	verbal		4c	pseudo	Do you understand me now
21	53-54		Verbal	8		Few says yes
22	54-2:10	verbal		4a	Opened ended	Then when you talk about one, then you give me your ideas, then you tell me what you know. Start brainstorming now, then tell me,
23	10-11	verbal		4c		Do you understand me now
24	11-12		Verbal	8		A student says yes
25	12-50	Verbal/nonverbal		7 and 2		Acknowledge a student sitting alone, the says-points to a student “. Why are you isolating yourself? Join your group.

						Teacher continues to provide guidelines and encourages the student sitting alone to join group work so that they can work as a team
26	50-3;15		Verbal	9		Students begin discussing the task
27		verbal		2		work together (teacher mentoring, encouraging teamwork)
28	5-27		Verbal	9		Students discussing within groups
29	27-33	verbal		4a		Not about definition alone. Tell me about the stages
30	33:4:38		Verbal/non-verbal	9		Students discuss within groups, the team leader writes points made by members down, and some students are seen peeping between groups
31	38-42	verbal		4a		Is any group ready for presentation? (Short time for group discussion)
32	42-54	verbal		6		Group 4, come out and tell us your ideas
33	54-5:16		Verbal/non-verbal	9		A member of the group volunteers walked out to present the group work
34	16-30	verbal				Among group members, can anyone add more explanation (more group ideas and from other group members
35			Verbal	9		Another student's voluntary response
36	30-45	verbal		2		Good of you (Teacher accepted the presentation)
37	45-6;04		Verbal	9		Volunteer walked in front for presentation, add own ideas about growth and development and further differentiated them
38	04-05	verbal		2 and 3		Good (rewards student)
39	05-11	verbal		1 and 3		Repeat what you are saying for clarification
40	11-31		Verbal	8		Student repeats idea- growth means a physical change we can see in living and non-living things, and development is overall development in life, socially in the community
41	31-50	Verbal		3		The teacher accepts the idea and says Good)-reward
42	50-7:07	verbal		3		Teacher builds on students' ideas, adds his own ideas, and encourages other group presentation

43	07-47	verbal		5		Teacher writes ideas of group one on the chalkboard at the same time and reads them out
44	47-58	Verbal/nonverbal		1		-You). (Teacher points and recognises another speaker from group 4)

11.12. Appendix 12. An excerpt from the separated categories of the lesson transcript

SAMPLE OF A SEPARATED CATEGORY (8)

TIME/SECS	TEACHERS ACTIVITY	STUDENTS ACTIVITY	BIAC	TYPE OF QUESTION	COMMENTS
1		verbal	8		Repeats after teacher
3		verbal	8		Students repeat again
1		verbal	8		Chorus yes
1		verbal	8		Students repeat teacher's last word-thing
1		verbal	8		Students complete/repeats teacher's last word in chorus-thing
1		verbal	8		Chorus response
1		verbal	8		Chorus yes
1		verbal	8		Chorus YES
1		verbal	8		Chorus YES

12.1 Additional literature for further readings from Chapter 3 on the key concepts of children learning.

This section describes the essential elements of how students learn that are fundamental for effective teaching. Understanding and attending to how and nature of students' learning can allow teachers to improve their methodological delivery of subject content, improve their classroom practices and, in turn, enhance the quality of the learners' classroom experience, especially in a culture where the teacher-student relationship is influenced by deep-seated Nigerian cultural tradition that empowers the teacher to control both classroom affairs and student affairs (Aládésanmí, et al., 2009; Okunola, 2003; Busari et al., 2017).

Teachers in sub-Saharan Africa, especially Nigeria, with specific contexts in socioeconomic and education systems, can view, analyse, and synthesise the elaborated theoretical points below and establish a consensus about thinking of the specific nature of their pupils' learning in relation to the environment. Teachers in Nigeria can also consider the elements against other studies with different emphases. In their effort to reach a consensus, the teachers should understand specific issues in culture, society, and socioeconomic situations in underdeveloped countries. The teachers in specific contexts like Nigeria should consider cultural assumptions, bias and orientation and ways of thinking, our educational background, values, attitude and low economic situations for effective implementation and sustainability.

12.1.1 Verbal Information

Verbal information or declaration is when a learner is able to verbally highlight systematically the knowledge that the learner has learnt or acquired previously, which helps the learner in learning new information (Gagne, 1980). They are the various principles, facts, theories, names, models, and generalisations acquired through an educational experience (Kyriacou, 1999).

12..1.2 Intellectual skills

Intellectual skills consist of concepts, rules, and procedures (Gagne, 1985). The rules and concepts are complex and simple; the complex rules and concepts are usually obtained from the simpler ones. Embedded within the simple rules and concepts are the complex rules and concepts. The complex ones are particularly built upon the simpler ones. This is "knowing

how and why.” It is the ability of the child to think critically and analytically. It is a problem-solving skill and the application of this knowledge in real-life situations (Gagne, 1985).

12.1.3 Cognitive strategies

Gagne defines cognitive strategies as the strategies the child employs in exerting some degree of control on the learning process. These consist of the learner’s self-employed ways of thinking, learning, and perceiving. This type of learning is a child’s typical way of thinking, perceiving, solving, memorising, encoding, and remembering information.

12.1.4 Attitude

Gagne (1985) explained that attitudes are the emotional and cognitive components of the learner’s internal states, which impact or affect his or her behaviours. Attitude is the perception of a child towards an idea, object, and event. How a child views different subjects or peers of diverse cultural backgrounds is very important to the child’s learning outcomes (Kyriacou, 1999). According to the article ‘going back to school with a positive attitude’ (n.d), teachers should help them go over their worries and discuss solutions with them, envisage success together, set a good model, and offer regular praise to help a child develop a positive attitude towards school. Attitude has a direct relationship with reinforcement. Pupils who have been successful are more likely to be reinforced, and those who have not been reinforced are more likely to be less or not successful. Pupils can be assisted to reflect on how they feel about school and the environment, which can help develop positive behaviour.

12.1.5 Motor skills

This is how a learner carries out steps involved in structured or serial procedures or motor performances involving combinations of units of skills or hands-on skills (Gagne,1984). The gradual advancement in evenness, consistency, and precision of the movement is known as motor skill (Gagne, 1984). Bloom’s Taxonomy of Educational objectives and outcomes is a comprehensive account of educational outcomes. The cognitive domain consists of is split into six categories: knowledge, comprehension, application, analysis, synthesis, and evaluation, which enables the specification of extensive detailed educational outcomes. Kyriacou (1999) argued that extreme use of this method might lead to an authoritative description of objectives, direct teaching towards tests, and narrow the value of education.

Different types of instruction are required for each of the five learning outcomes, and the five types of learning outcomes can serve as a guide for the teacher; the teacher can include or combine these learning outcomes in problem-solving strategies (Gagne, 1984). Ausubel stressed two distinct differences between students' learning: the difference between reception and discovery learning and the contrast between rote and meaningful learning. In discovery learning, the content is expected to be discovered by the students first through some activities. In contrast to the reception form of learning, where content is presented to the learner in its finishing form, and the learner is expected to assimilate and integrate the materials presented. Ausubel explained that in meaningful learning, the new learning could be associated consistently with the learner's previous knowledge, but in rote learning, what is learnt is inconsistent and unrelated to the learner's previous knowledge (Ausubel cited in Kyriacou, 1999). These two distinctions are independent of each other. Reception can be meaningful or rote learning, and discovery can either be meaningful or rote learning. Meaningful learning has implications for teaching, retaining, understanding, and applying since it stresses the types of cognitive structural changes that take place during learning.

For learning to take place, Ausubel, Gagne, and Bruner based their approach to student learning on the same learner's model of information processing. And according to Guy (1994), this learner's model of information processing consists of a first step (attention and selective memory), which is concerned with the initial reception of sensory information, which involves consideration for learners' attention, which is subject to selective perception. The second section is short-term memory (STM), which consists of what is in a pupil's immediate conscious memory at a particular time. This is concerned with processing the information, including the learner's experiences, like conscious thinking that involves the application of cognitive processes.

The third is long-term memory (LTM), which consists of all relatively stable information about the world that is not in the pupil's immediate consciousness. It consists of learning or changes that have taken place in the learner's cognitive structure due to processing information (cognitive structure, storage, and retrieval).

Ausubel (1968) recommended the advanced organiser's concept to link new learning materials with existing related ones. The implication for learners is that an advanced organiser can introduce students to new information and make learning more meaningful and

engaging, starting from general to more specific information (Joyce, Wells and Calhoun, 2009).

12.1.6 Motivation and reinforcement

12.1.6.1 Motivation

There are two major concepts for the functioning of the information processing model for the nature of pupils' learning, and these are motivation and reinforcement.

What motivates students' learning, and how do students make mental efforts towards the learning task?

Motivation involves behaviours that influence arousal, strength, interest, satisfaction, and direction in a learning task. "To be motivated means to be stimulated to do something" (Ryan and Deci, 2000). Ausubel, Gagne, and Bruner recognise distinctions between intrinsic and extrinsic motivation, the latter means doing something because of some externally supplied reward, and the former refers to "doing something because it is inherently interesting or enjoyable" (Ryan and Deci, 2000). A teacher can start a lesson by presenting it in the form of a puzzle or question to draw out the student's interest. An important aspect of intrinsic motivation is the satisfaction that can be pleasurable, not for external reward but for its own reward (Lee, Reeve, Xue, Xiong, 2012).

Ausubel, Gagne, and refer to extrinsic motivation as those originating from the fact that successful completion of the task leads to an end in a student's value, for instance, a reward or an escape from punishment. Satisfaction is not derived from the task (Tranquillo and Stecker, 2016). If the same end could be accomplished easily by engaging in other tasks, the person will happily switch over.

Tranquillo and Stecker (2016) and Di Domenico and Ryan (2017) found that each type of motivation can affect a person's behaviours differently, depending on aims and goals. Levy, Deleon, Martinez, et al. (2017) found that for actions that people already find internally rewarding, offering an extrinsic reward (such as money and prizes) for such activities makes people become less internally motivated to seek those activities in the future. If praises are poured extremely on students or children all the time, they tend to lose their intrinsic motivation to repeat the task in the future (Warneken and Tomasello, 2008; Levy, Deleon,

Martinez, et al., (2017). However, extrinsic motivation can be useful in performing a difficult or displeasing task. It can be a source of feedback to reinforce standardised performance and lead to learning new skills, which can trigger an increase in intrinsic motivation (Filimonov, 2017). Studies suggested that external rewards should not be awarded for completing a minimal task, as this can lead to a decrease in intrinsic motivation (Levy, Deleon, and Martinez et al., 2017).

Success in school learning can meet various needs that can be the foundation for extrinsic motivation; the clamour for status, self-esteem, and social acceptance may earn short-term good marks and praise but a long-term professional career. Also, school learning can be motivated by the avoidance of scolding and punishment, which is short-term and extrinsically motivated because of a lack of interest in the school's activities. Some students may be high in their level of both intrinsic and extrinsic motivation (i.e., they find both subject matter and success in the subject matter interesting). Griggs and Jackson (2020) suggest in a book that "a person's intrinsic delights of an activity rationalise his behaviour" and explain further that "with additional external reinforcement, the person may perceive the task as over justified and seeks to understand their true motivation for engaging in the activity." He suggested that people are more creative when they are intrinsically motivated.

Abraham Maslow (1968), cited by McLeod (2018), suggests that the theory provides a framework for student motivation and needs. It highlighted the regard for those needs at the lower hierarchy to be met when educational experiences that draw up higher self-esteem and self-actualisation needs are set up. According to McLeod (2018), the following are Abraham Maslow's (1987) hierarchy of need from the highest to the lowest.

(1). Physiological needs, e.g., air, water, food, shelter, clothing, reproduction (2). Safety needs, e.g., personal security, employment, resources, health, and property. (3) Belongingness and love, e.g., friendship, intimacy, family, and the need to give and receive love. (4) Esteem needs (the need for respect, achievement, status, recognition, strength, and freedom. (5). Self-actualisation, e.g., the need to realise one's potential.

Maslow (1968), cited by McLeod (2018), argued that a worthy and important goal for education is to engender a peak experience of intense delight and ecstasy, involved in being at self-actualisation due to ego augmentation involvement and achievement in school learning. The need for achievement motivation in order to motivate students towards school

learning has received a lot of attention in research (Jeffrey and Zein, 2017; Low and Jin, 2012; Luftenegger et al., 2016; Riswanto and Aryani, 2017). Also, a number of studies, Bailey, and Philips (2015) and Othman and Leng (2011), employed the nature and development of both the need for achievement in general and achievement in the context of academic gains. They found out that students' need for achievement includes both intrinsic and extrinsic motivation (competency as in the former and self-esteem and status as in the latter) (Ryan and Deci, 2020)

12.1.6.2 Reinforcement

BF Skinner, a behaviourist psychologist (1954), is a popular influence in the theory of reinforcement and ascertains the crucial role of reinforcement in learning theories.

Reinforcement refers to the likelihood that any behaviour or response might occur again, and this is characterised by the effect it has on behaviour, either by increasing or strengthening the behaviour (Shahan, 2010). Skinner argued that where behaviour is followed by reinforcement, it is more likely to reoccur in the same situation in the future. In the absence of reinforcement, the response is less likely to occur. There are two types of classroom reinforcement, positive and negative (teacher's praises, stickers, and cancelling student's detention, removal of unpleasant consequences (Beaman and Wheldall, 2000). Positive reinforcement has been in use for several years (Beaman and Wheldall, 2000). Durcikova and Gray (2009) submit that three types of consequence reduce the probability of a behaviour reoccurring, the absence of reinforcement, punishment, and removal of expected reward.

The teacher can indicate and control a student's behaviour by organising reinforcement appropriate to the desired student's behaviour (Beaman and Wheldall, 2000). Woollard (2010) opined that another educational implication of reinforcement theory is that teachers can use it to shape learners' complicated behavioural patterns through successive rewarding steps. The teacher can equally employ the extinction procedure to eliminate the learner's negative behaviours (Janney et al. (2014). They found that the extinction procedure rapidly improved tasks level in elementary-aged students. Schools can use positive reinforcement to eliminate the components of fear from the school atmosphere by providing rewards like high grades, a pen, a verbal compliment, a smile, and praise for positive behaviours. Some studies identified the use of quick corrective feedback in facilitating learning (Michaud and Perks, 2015; Rezaei, Mozaffari, Hatef, 2011). Research has examined the differences between

desirable consequences (e.g., stickers and praise) and undesirable consequences (e.g., sanctions and reprimands) of classroom behaviours over the past 30 years and in the long run, studies show that positive reinforcement is more effective than long term punishment (Asadullah, Juhdi, Islam, Ahmed, and Abdullah, 2019).

Therefore, positive reinforcement should be applied more often than punishment (Beaman and Wheldall, 2000). Findings indicate that teachers use more desirable consequences for academic behaviours and more undesirable consequences for social behaviours (Beaman and Wheldall, 2000). However, some educators are of the opinion that when a child is punished systematically, the strength of the negative behaviour tends to decrease, but Skinner (1971) warned that punished behaviour is likely to reoccur after withdrawing the reprisal consequences. Furthermore, Lukowiak and Bridges (2010) stated that the greatest drawback is that punishment does not offer information about desirable or appropriate behaviour. It gives information about what actions not to perform, but it does not give information on what the person should be doing.

Coley, Kull and Carrano (2014), an American survey conducted in 2014, showed that in the past year, half of the parents sampled admitted to spanking their children aged under 9, and opined that spanking young children lead to aggression, antisocial behaviours, and delinquencies.

Researchers suggested that the following should be considered for the effective use of punishment as a technique for reinforcement: for instance, Low (2019) suggest that if punishment is continual, the student can be adapted to punishment and may not be able to differentiate acceptable behaviours from non-acceptable behaviours. Low (2019) added that punishment should be consistent or applied every time certain behaviour is performed.

Teachers should hence, support students to enhance their skills in distinguishing between acceptable and non-acceptable behaviours because a student who is punished for a behaviour that has no alternative may develop psychoneurotic side effects. Magg (2001) found that teachers' cultural background variables all seemed to play a role in teacher use of positive reinforcement.

Magg (2001) claims that teachers expect students to behave well, so they do not believe in using reinforcement and that there is a wrong idea about positive reinforcement by teachers and educators. Positive reinforcement is misunderstood and rarely connected with discipline,

so the notion is that discipline and punishment are the same (Maag, 2001). Beaman and Wheldall (2000) and Maag (2001) show that if students are inappropriately reinforced, behavioural challenges continue to occur.

In Skinner's reinforcement theory of motivation, reinforcement and motivation are linked together since both successes in learning tasks and behaviours used by teachers to encourage students, like praises, high scores, awards, and elimination of sanctions, are also components of reinforcement.

Beaman and Wheldall (2000) affirmed that teachers fail to take advantage of the strong prospects of reinforcement to manage students' behaviour. Maag (2001) suggested that teachers should spend quality time developing positive behavioural plans as they do in developing instructional lesson plans.

12.2 Student engagement in learning

The attentiveness, receptiveness, and appropriateness processes are important to students' engagement in classroom activities (Johnson, 2013). The teacher has the duty to elicit and sustain students' attention by getting students actively involved by employing various learning activities or using students' interests and attentiveness (Johnson, 2013).

The teacher should be skilled in using students' different sources of motivation to enhance their motivation towards learning, promoting a classroom climate towards learning, and presenting the opportunity to be successful (receptiveness).

The learning experience requires being matched with what knowledge and understanding the students already have and ensuring that the designed learning activities match the educational goals. This can be achieved by monitoring students' progress through the provision of rapid corrective feedback (appropriateness).

12.2.1 Developmental issues in teaching and learning

The idea of relating developmental psychology to teaching and learning remains controversial up till today (Olson and Brunner, 1996; Sarason, 2001; Sigel, 1990; 1998). There are suggestions by experts that understanding child development contributes to teaching, and many consider child development foundation courses for teacher certification and preparation (Downer, Sabol and Hamre (2010); NCATE, 2000).

Extreme behaviourist and biological view intelligence as fixed and maturationist views are that children develop on their own (Brown, 1994). These views have been discarded by psychologists and rather agreed upon and based understanding of intelligence on how children develop and learn (American Psychological Association, 1997; Brown, 1994). According to Dewey (1916), fostering mental growth in children needs teachers who can initiate, recognise, and access the individual inner mind in the subject matter. Promoting education to develop the mind, not rote recall, a need for teachers to be concerned about how to relate the child's past and present experience to the subject matter. Vygotsky (1978) and Piaget (1964) argued that teachers need to understand a child's development, interact with children, nurture high-order reasoning, encourage critical thinking and build independent learners who can function in a swiftly changing information age.

Berns (2015) asserts teacher's task as a guardian of classroom learning can be promoted by understanding how practice, knowledge, language, and socialisation patterns inside the families, communities, and environment influence children's capability to function in the classroom. Understanding families' knowledge, practice, language, and social patterns can help the teacher foster children's active enrollment and social relationships in the classroom (Berns, 2015).