EFFECT OF TEACHERS' SUBJECT AND PEDAGOGICAL KNOWLEDGE ON PERFORMANCE IN MATHEMATICS AMONG SECONDARY SCHOOLS STUDENTS' IN KADUNA STATE, NIGERIA

BY

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DECLARATION

I, Emmanuel YOHANNA, (M.ED/EDUC/12915/2011-2012) do solemnly declare that this Dissertation "Effect of Teachers' Subject and Pedagogical Knowledge on Performance in Mathematics among Secondary School Students in Kaduna State, Nigeria" was written by me and is my hand work; no part of this Dissertation was previously presented for another degree at any University.

……. ……..

Yohanna Emmanuel Date

CERTIFICATION

This Dissertation titled "Effect of Teachers' Subject and Pedagogical Knowledge on Performance in Mathematics among Secondary School Students in Kaduna state, Nigeria" by Emmanuel YOHANNA (M.ED/EDUC/12915/2011-2012) meets the requirements and regulations governing the award of the Degree of Masters of Education (Mathematics Education) of Ahmadu Bello University, Zaria. Thus, it is hereby approved for its contribution to knowledge.

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DEDICATION

I dedicate this study to my late father Mr. Yohanna Bage and my mum Mrs. Kande Yohanna and all those who have contributed immensely towards the success of this Dissertation.

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ABBREVIATIONS

ERC:	Educational Resource Center.
FME:	Federal Ministry of Education.
HPK:	High Pedagogical Knowledge
HSK:	High Subject Knowledge
LPK:	Low Pedagogical Knowledge
LSK:	Low Subject Knowledge
NCE:	National Certificate in Education
NCCE:	National Commission for Colleges of Education
NCTAF:	National Council of Teachers for America's Future.
NCTM:	National Council of Teachers of Mathematics.
NPE:	National Policy on Education.
SMPT:	Students' Mathematics Performance Test.
SPSS:	Statistical Package for Social Science
TPKA:	Teachers' Pedagogical Knowledge Assessment.
TSKT:	Teachers' Subject Knowledge Test.
WASSCE:	West African Senior Secondary Certificate Examination.

Operational Definition of Terms

Subject Knowledge: Subject Knowledge of Mathematics teachers is described as the skills acquired effectively and efficiently when carrying out teaching activity in relation to quality in terms of performing an educative, formative task and doing it well.

Pedagogical Knowledge: Pedagogical knowledge is described as the minimum but an effective skills applied by a teacher for effective delivery of instructions during teaching and learning.

High Subject Knowledge: Mathematics teachers with NCE qualifications who scored from 60% and above.

Low Subject Knowledge: Mathematics teachers with NCE qualifications who score from 01-59%.

Assessment: A process of obtaining evidence on performance by one or a number of means and making judgments on the basis of that evidence about an individual's competence to meet certain prescribed standards.

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Abstract

The purpose of this study was to find out the extent to which Mathematics Teachers' Subject and Pedagogical Knowledge can improve junior secondary school students' performance in Kaduna state. Four research hypotheses were formulated and tested at 0.05 levels of significance. The study population comprised of 218 junior secondary school Mathematics teachers and 35,468 students. A quasi-experimental design was used for this study. Purposive and simple sampling techniques were used to select four Educational Zones in which 70 Mathematics teachers with NCE qualifications and 480 students from 16 secondary schools participated in the study. Three instruments namely, Teachers' Subject Knowledge Test (TSKT), Teachers' Pedagogical Knowledge Assessment (TPKA) and Students' Mathematics Performance Test (SMPT) were used to collect data for the study. Mean and Standard Dev were used to answer research questions while t-test statistics was used to answer the null hypotheses at 0.05 significant levels (95% confidence interval). The result obtained shows a significant difference in the mean performance of students of Teachers with High Subject Knowledge (HSK) and those of Teachers with Low Subject Knowledge (LSK). From the result obtained, the mean score of students of teachers with High Subject Knowledge (36.69), were statistically significantly difference from those of students of Teachers with High Pedagogical Knowledge of (33.12) , students of Teachers with Low Pedagogical Knowledge (29.03), students of Teachers with Low Subject Knowledge had a mean score of (27.02). From the result obtained, the mean score of students of teachers with Low Subject Knowledge (27.02) were not statistically difference from those of students of Low Pedagogical Knowledge Teachers (29.03). From the findings also, the means performance of male and female students of teachers with High Subject Knowledge (HSK), High Pedagogical Knowledge (HPK) and Low Subject Knowledge (LSK) were not significantly difference. Only the result of the male and female students of teachers with Low Pedagogical Knowledge was found to be significantly difference in favour of the male students in terms of gender. The result obtained for correlation was a positive relationship of $r = 0.279*$ which shows that, there exists a weak positive relationship between teachers' subject and pedagogical knowledge and students' performance. Based on the findings of this study, recommendation were made and call on the state and the federal governments to collaborate with the National Commission for Colleges of Education (NCCE) to design an improve curriculum content on mathematics courses at our colleges of education in the country to help in producing NCE graduates with High Subject and pedagogical knowledge. This will enable them to teach effectively in our secondary schools.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

In a research work of Uloko (2006), Mathematics has been described as the mother of all science. There is the need to have teachers who posses good Subject-matter and pedagogical knowledge of mathematics. Mathematics as a tool to compute and conceptualize relationship among variables in science is an important tool in nation building. Thus, Mathematics can be viewed as the pillar of all knowledge (Ayinla, 2011). To achieve this, our Mathematics Teachers need have adequate Knowledge of the Subject-Matter and posses the right Pedagogical Knowledge. Because of its importance, the Nigerian government and education stakeholders is committed to ensuring the provision of high quality mathematics teachers. In this respect, the researcher looked at the problem on the teachers' subject and pedagogical knowledge angle. The major concerns today are the consistently poor performance in mathematics among students at the secondary school level.

A Conceptualized definition of Mathematics Teachers' Subject knowledge by Mogens and Jensen, (2002) in their research work, is one's insightful readiness to act in response to a certain kind of mathematical challenge of a given situation, and then to identify explicitly, formulate and exemplify a set of mathematical content knowledge that can be agreed upon as independent dimensions in the spanning of mathematical knowledge. A definition of "mathematical Subject knowledge for teaching" By this phrase, it means the mathematical knowledge that teachers need to carry out their work as teachers of mathematics. Obviously, the mathematics teachers need to know the Subject content they teach and that students are expected to master that which is taught.

Shulman in a study by Ball, Thames and Phelps, (2005) defined pedagogical

content knowledge as: the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations in a word, the most useful ways of representing and formulating the subject that make it comprehensible to others. Thus, this approach regards pedagogical knowledge as "the ability of an individual to use a coordinated, synergistic combination of tangible resources (instruction materials such as books, articles, cases and technology such as software and hardware) and intangible resources (knowledge, skills, experience) to achieve efficiency and or effectiveness in pedagogy" (Madhavaram & Laverie 2010).

Researchers have described teachers' mathematical Subject knowledge as thorough understanding of mathematics which has breadth, depth, connectedness, and thoroughness (Ma, 1999). Knowing school mathematics in depth and breadth is recognized as an important dimension that proficient mathematics teachers need (Schoenfeld & Kilpatrick, 2008). Why should there be a concern over Mathematics teachers with NCE qualifications' mastery of secondary school mathematical Subject knowledge since they have already acquired the knowledge when they were students, it is possible that they must have some significant exposure to university mathematics at this level of education? There is perhaps the issue of the time lapse since they were studying mathematics at schools. It was found that mathematics teachers with NCE qualifications usually enter teacher education programme with narrow conceptions of mathematics as a set of rules and conventions (Ball, 1990a; Taylor, 2002; Wilson and Ball, 2002). Some areas of weaknesses in teachers with NCE qualifications' mathematical Subject knowledge have been identified by various mathematics education researchers, which deserve teacher educators' attention (Ball, 1990b; Even, 1993).

In appreciating the importance of mathematics and its relevance to national

development, the National Policy on Education (FME, 2014) emphasizes the need for basic knowledge and application of Mathematics in science and technology for purposeful and meaningful economic development. The researcher asserts that the system of training teachers with NCE qualifications in our nation should be given adequate attention, especially those teaching mathematics at the junior secondary schools in Nigeria. A Practical/functional school curriculum should be developed to expose to mathematics teachers with NCE qualifications in Kaduna state with the required subject knowledge to be able effectively and efficiently deliver any difficult concept in mathematics.

It is the teachers' subject knowledge, ability, resourcefulness, and ingenuity through effective utilization of appropriate language, methodology and available instructional materials that will bring out the best from the learners in terms of academic performance. So can we boast in Kaduna State that our Mathematics teachers teaching at JSS levels possess these effective qualities mentioned above?

Over the past three decades, a considerable number of studies seeking to determine a relationship between gender and mathematics learning have been conducted in various countries. Hence this study is therefore, seek to bridge this gender difference as long as the mathematics teacher with NCE qualifications teaching at the junior secondary schools in Kaduna state are well equipped with Good Subject and Pedagogical Knowledge in mathematics would do more good on encouraging female students to pursue higher in mathematics and science related courses.

1.2 Statement of the Problem

The persistent mass failure and poor performance of students in public schools both in internal and external examination in Nigeria today is a serious and challenging issue to the education sector; government, stakeholders, teachers, students, parents and

well-meaning Nigerians. There is the problem of poor teachers' characteristics which according to Okafor (2000) is very vital to the teaching and learning of Mathematics. The National Council of Teachers of Mathematics (NCTM) (2000), Chappell (2003), Yctkin (2003) and Halat (2006 & 2007) see teacher characteristics such as Subject knowledge, mathematical and pedagogical knowledge as very vital in the teaching and learning of mathematics at all levels of education. As observed by Adebule (2004), that the huge investment on education is not yielding the desired dividend. The teachers also complain of students' low performance at both internal and external examinations (Ashiaka, 2010).

The researcher investigated this problem on the mathematics teachers with NCE qualification's angle in Kaduna state. This is because some of mathematics teachers with NCE Certificates teaching at Junior Secondary Schools lack the required knowledge to teach effectively any mathematical concept. And it was observed that teachers with weak or shallow knowledge of the subject-matter increases students' poor performance. Thus their subject knowledge and Pedagogical approaches during instructions in Mathematics were investigated. Obviously, the Junior Secondary School Students' performance generally has not been encouraging and this remains a challenging issue of concern to mathematics teachers and the education stakeholders. Not forgetting the fact that the JSS education is one of the most crucial stages in the schooling system.

The need to have Mathematics teachers with High Subject and pedagogical knowledge is necessary to establish. When the Mathematics teachers posses good subject knowledge and pedagogical knowledge they will teach effectively. This will reduce the movement of students from our public schools to those mushroom Private schools called miracle or solutions centres, a place where the mathematics teachers will

be the ones solving mathematics questions during external examinations for their students in order to maintain their business. This will later have negative effect in the Students' future educational career at the higher institutions, because some of them cannot defend the result they possessed. It is on this background that, the researcher investigated what will be the effect of mathematics teachers' Subject and pedagogical knowledge on students' performance at the junior secondary schools in Kaduna State. The researcher also observed that the inspectorate division of the Education ministry doesn't applied strict monitoring on the use of the available instructional materials in their various schools to better the delivery of instructions by the mathematics teachers.

1.3 Objectives of the Study

The objectives of the study were to:

i. determine the mean performance of students taught mathematics by teachers with High Subject Knowledge and students taught by Teachers with High Pedagogical Knowledge.

ii. determine the mean performance of students taught Mathematics by Teachers with High Subject Knowledge and those taught by Teachers with Low Pedagogical Knowledge.

iii. determine the mean performance of students taught mathematics by teachers with Low Subject Knowledge and those taught by Teachers with High Pedagogical Knowledge.

iv. determine the mean performance of students taught mathematics by teachers with Low Subject Knowledge and students taught by Teachers with Low Pedagogical Knowledge.

1.4 Research Questions

The following research questions were formulated:

i. Is there any significance difference between mean performance of students taught mathematics by teachers with High Subject Knowledge and those taught by Teachers with High Pedagogical Knowledge?

ii. Are there any significance difference in mean performance of students taught Mathematics by Teachers with High Subject Knowledge and students taught by Teachers with Low Pedagogical Knowledge?

iii. What is the difference between mean performance of students taught Mathematics by Teachers with Low Subject Knowledge and those taught by Teachers with High Pedagogical Knowledge?

iv. What is the difference in mean performance of students taught mathematics by teachers with Low Subject Knowledge and students taught by Teachers with Low Pedagogical Knowledge?

1.5 Research Hypotheses

On the basis of the research questions, the following null hypotheses were formulated and were tested at 5% level of significance:

Ho_1: There is no statistically significant difference between mean performance of students taught Mathematics by Teachers with High Subject Knowledge and those taught by Teachers with High Pedagogical Knowledge.

Ho_2: There is no statistical significant difference in mean performance of students taught Mathematics by Teachers with High Subject Knowledge and students taught by Teachers Low Pedagogical Knowledge.

Ho_3: There is no significant difference between mean performance of students taught Mathematics by Teachers with Low Subject Knowledge and those taught by Teachers with High Pedagogical Knowledge.

Ho_4: There is no significant difference between mean performance of students taught mathematics by teachers with Low Subject Knowledge and students taught by Teachers with Low Pedagogical Knowledge.

1.6 Significance of the Study

Following the continuing records of mass failure and unfavorable results of secondary school students in both internal and external Mathematics examinations in Kaduna state.

i. This study is significant in the sense that, the researcher has gone through some studies carried out on teachers' Subject and pedagogical knowledge by different scholars and was able to find out that teachers' Subject knowledge are very powerful ingredients that influence students performance.

The researcher also found studies conducted on teachers' pedagogical knowledge and students' performance. It is said that no educational system can rise above its teachers' quality (FME, 2014). Therefore, the importance of teachers' Subject and pedagogical knowledge cannot be over emphasized. Hence this study seeks to bridge the gap between Mathematics teachers' content and pedagogical knowledge on students' performance in junior secondary schools in Kaduna state because studies such as this, has not been conducted on Mathematics teachers' Subject and pedagogical knowledge in Kaduna state.

ii. Thus, the findings and recommendations will be useful to Mathematics teachers, colleges of educations, the JSS students, Parents, researchers, professional bodies (such

as MAN, STAN, NAE to mention but a few), Mathematics education departments, education stakeholders, government, and the entire Society.

This study can be of great significance to Mathematics teachers because it will reveal to them their inadequate Subject and pedagogical knowledge. This will make them see the need to upgrade their Mathematical Subject Knowledge and Pedagogical Skills through attending training and retraining programs, workshops, seminars among others.

The study also encourages Mathematics Teachers with low pedagogical knowledge to improve on their pedagogical knowledge in order to better their classroom activities. The researcher is of the view that, when Mathematics is taught by teachers with high Subject and pedagogical knowledge, there will be a tendency of capturing more students' interest and attention and disabusing their minds on the phobia they have developed due to bad and inadequate content and pedagogical knowledge of the Mathematics teachers. Hence, adequate and high Subject knowledge mathematics teachers will be produced on regular basis and ensuring that government educational aims and objectives are attained. It will benefit parents, as their wards will always graduate with beautiful results.

The study will benefit researchers and professional bodies, by revealing to them key areas of weaknesses of the Mathematics teachers with NCE qualifications and how to designed special training and remedial programmes to assist in addressing the issues low content and pedagogical knowledge of our teachers teaching the junior secondary schools.

In addition, the study will be significant to colleges of education and mathematics education in checkmating the kind of graduates being produced for the education industry.

1.7 Scope and Delimitation of the Study

This research work was delimited to Junior Secondary School Two (JSS2) because at the time this study was conducted, they were the most senior class and it was expected that they had covered their syllabus for JS1and JS2. The study covered only Mathematics teachers with NCE qualifications teaching at the junior secondary schools which justified the homogeneity of the groups of teachers for the study. The students' performances were examined based on the Mathematics teachers' Subject and pedagogical knowledge which were categorized as Teachers with High Subject Knowledge (HSK) and Teachers with Low Subject Knowledge Teacher (LSK).

The study was also delimited to questions selected based on the junior secondary school curriculum content for the Teachers Subject Knowledge Test (TSKT) and the junior secondary school (JS1-JS2) curriculum content for the Students' Mathematics Performance Test (SMPT). The study was limited to sampling four Educational Zones; sixteen (16) junior secondary schools were used for the study because of the geographical spread of schools in Kaduna state and the limited financial resource. Not all students in the selected four Educational zones were used; four schools from each of the Educational Zones were sampled for the research.

The research area covered both single-sexed and mixed public schools which included Kaduna, Sabon Tasha, Zaria and Zonkwa Educational Zones. Primary schools, private schools, senior secondary schools, and tertiary institutions were not covered.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This study was carried out to examine the effect of Teachers' Subject and Pedagogical Knowledge on performance in Mathematics among secondary school students' in Kaduna state. This chapter reviews previous relevant and related studies on how teachers' content and pedagogical knowledge affects students' performance in Nigerian Secondary Schools with particular focus on Kaduna state. The literature review is outlined under the following sub-headings:

2.2 Theoretical Framework

2.3 Teachers' Pedagogical knowledge and Students' Performance

2.4 Teachers' Subject-matters Knowledge on Student' Performance

2.5 Teachers/Students' Gender and Performance

2.6 Teachers' Experience and Students' Performance

2.7 Overview of Related Studies

2.8 Implication of the Reviewed Literature for the Present Study

2.2 Theoretical Framework

Teachers Subject Knowledge is crucially important to the improvement of teaching and learning. Historically, researchers have focused on many aspects of teaching, but more often than not scant attention has been given to how teachers need to understand the subjects they teach. Furthermore, researchers, educators and policy makers have turned attention to teachers' subject matter knowledge. The assumption has often been that advanced study in the subject is what matters. Shulman in a study by Ball, Thames and Phelps, (2005) identified a special domain of teacher knowledge,

which he referred to as pedagogical content knowledge. He distinguished between content as it is studied and learned in disciplinary settings and the "special amalgam of content and pedagogy" needed for teaching the subject. These ideas had a major impact on the research community, immediately focusing attention on the foundational importance of Subject knowledge in teaching and on pedagogical knowledge in particular.

Teachers' knowledge required for teaching has been described as complex (Chick, Baker, Pham & Cheng, 2006). There are diverse views on what teachers need to know for teaching (Cooney, 1999); (Elbaz, 1983); (Graeber, 1999); (Kilpatrick, 2001); (Shulman, 1986). Shulman identified two main categories of knowledge: content knowledge and pedagogical content knowledge. Subject knowledge refers to the "amount and organization of knowledge in the mind of the teacher" (Shulman, 1998, p.9); pedagogical knowledge involves knowledge of how teachers represent and formulate their content knowledge when teaching (Shulman, 1998).

According to Eraut (1994), teachers' Subject knowledge is not a static entity but evolves; teachers go through the following phases of subject knowledge: (1) professional traditions; (2) practical wisdom; and (3) deliberate reflection. Thus the pedagogical content knowledge affects how teachers think about their subject matter knowledge. The importance of teachers' mathematical Subject knowledge for effective teaching of mathematics has long been recognized (Ball, 1991; Chapman, (2005); Mohr, (2006); (Toh, Chua & Yap, 2007); Usiskin, (2001). The literature abounds with reports by researchers on teachers' mathematical Subject knowledge (An, Kulm & Wu, 2004) and Menon, (2009). Researchers have described teachers' mathematical Subject knowledge as thorough understanding of mathematics which has breadth, depth, connectedness, and thoroughness (Ma, 1999). Knowing school mathematics in depth

and breadth is recognized as an important dimension that proficient mathematics teachers need (Schoenfeld & Kilpatrick, 2008). Recent studies have distinguished between Specialized Subject Knowledge and Common Subject Knowledge as two of the three sub-categories of Mathematical Subject Knowledge (Ball, Thames & Phelps, 2008). While Specialized Subject knowledge is mathematical knowledge that is unique to teaching, common Subject knowledge refers to that knowledge held by an individual who can solve a particular mathematical problem (Ball, Thames & Phelps, 2008). Thus, this points to the fact that mathematics teachers need to know "a great deal of mathematics" (Usiskin, 2001) compared to other individuals.

There is clear evidence on the relationship between teachers' mathematical Subject knowledge and their ability to teach well in classrooms (Ball, Hill & Bass, 2005); Chapman, (2005). The existing literature also contains anecdotes of teachers who wanted to do a good job in teaching mathematics but faced many problems which were largely due to their lack of adequate preparation in school mathematics Subject knowledge Hutchinson, in Toh (2010). Why exactly is mathematical Subject knowledge so important in teaching? First, teachers must be able to understand why a particular content is taught and how the content should be developed. Not only that, teachers must be able to use their mathematical knowledge in teaching for identifying a range of solutions and mathematical connections when they are teaching students, planning lessons and evaluating students' work (Ball, et al. 2009).

Further more, teachers must be able to tap on a wide range of knowledge such as procedural knowledge and fluency, concepts and connections (Ball & Bass, 2003). Why should there be a concern over Mathematics teachers with NCE qualifications' mastery of secondary school mathematical Subject knowledge? Since they have already acquired the knowledge when they were students, and they must have some significant exposure

to university mathematics when they were undergraduates? There is perhaps the issue of the time lapse since they were studying mathematics at schools. If this is the only reason for concern, then enabling the pre-service teachers to wider exposure to school mathematics during their one-year teacher education programme would suffice. However, a greater concern according to some existing literature is that the knowledge acquired during their school programs as students could be limited because it is based mainly on their limited exposure to problem solving and currents issues in Mathematics (Jaworski & Gellert, 2003). It was found that mathematics teachers with NCE qualifications usually enter teacher education programme with narrow conceptions of mathematics as a set of rules and conventions (Ball, 1990a; Taylor, 2002). Some areas of weaknesses in teachers with NCE qualifications' mathematical Subject knowledge have been identified by various mathematics education researchers, which deserve teacher educators' attention (Ball, 1990b; Even, 1993).

This study provides a brief overview of research on Subject knowledge and pedagogical knowledge, describes how we have approached the problem, and reports on our efforts to define the domain of mathematical knowledge for teaching and to refine its sub domains. Subject Knowledge and its Role in Teaching as a Profession a central contribution of the work of Shulman and his colleagues was to reframe the study of teacher knowledge in ways that included direct attention to the role of content in teaching. This was a radical departure from research of the day, which focused almost exclusively on general aspects of teaching such as classroom management, time allocation, or planning. A second contribution of the work was to leverage Subject knowledge as technical knowledge key to the establishment of teaching as a profession. Shulman and his colleagues argued that high quality instruction requires a sophisticated professional knowledge that goes beyond simple rules such as how long to wait for

students to respond. To characterize professional knowledge for teaching, they developed typologies:

- General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter
- Knowledge of learners and their characteristics
- Knowledge of educational contexts, ranging from workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures
- Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds
- Subject knowledge
- Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers
- Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding (Shulman, 1987, p.8).

These categories were meant to highlight the important role of Subject knowledge and to situate content-based knowledge in the larger landscape of professional knowledge for teaching. The first four categories address general dimensions of teacher knowledge that were the mainstay of teacher education programs at the time. At the same time, however, Shulman made it clear that the general categories were crucial and that an emphasis placed on content dimensions of teacher knowledge was not intended to denigrate the importance of pedagogical understanding and skill: "Mere Subject knowledge is likely to be as useless pedagogically as content

free skill" (Shulman, 1986b, p. 8).

The first of the three, Subject knowledge, includes knowledge of the subject-matter and its organizing structures (Grossman, Wilson, & Shulman; Wilson, Shulman, & Richert) in a study by Ball, et al. (2005). The second category, curricular knowledge, is "represented by the full range of programs designed for the teaching of particular subjects and topics at a given level, the variety of instructional materials available in relation to those programs, and the set of characteristics that serve as both the indications and contraindications for the use of particular curriculum or program materials in particular circumstances" (Shulman, 1986b, p.10). The last, and arguably most influential, of the three content-related categories is pedagogical knowledge.

Shulman in a study by Ball, et al. (2005), defined pedagogical knowledge as: the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations in a word, the most useful ways of representing and formulating the subject that make it comprehensible to others. Pedagogical knowledge also includes an understanding of what makes the learning of specific topics easy or difficult. Much of the interest has focused directly on pedagogical content knowledge. Thousands of articles, book chapters, and reports make use of or claim to study the notion of pedagogical knowledge in a wide variety of subject areas: science, mathematics, social studies, physical education, communication, religion, chemistry, engineering, music, special education, English language learning, higher education, and others. And, such studies show no signs of abating. Rarely does an idea or a term catch on at such a scale. The continuing appeal of the notion of pedagogical knowledge is that it bridges Subject knowledge and the practice of teaching, assuring that discussions of content are relevant to teaching and that discussions of teaching retain attention to content. As such, it is the unique province of

teachers a content-based form of professional knowledge.

Two points are worth making here. First, researchers have failed to establish precise or agreed-upon definitions. Throughout the past twenty years, for example, researchers have used the term “pedagogical knowledge” to refer to a wide range of aspects of subject matter knowledge and aspects of the teaching of subject matter. It is often unclear how ideas in one subject area relate to those in another subject area, or even whether findings within the same subject take similar or different views of teacher subject matter knowledge. Second, while the work of Shulman and his colleagues was developed from extensive observation of classroom teaching, most subsequent research takes particular domains of knowledge, such as pedagogical content knowledge, as given or uses only logical arguments to substantiate claims about the existence and the role of these domains.

A working definition of “mathematical knowledge for teaching” By this phrase, we mean the mathematical knowledge that teachers need to carry out their work as teachers of mathematics. Obviously, teachers need to know the content they teach and that students are expected to master. This definition of mathematical knowledge for teaching, explicitly framed in terms of the work teachers do, may seem like a minor point, but it is perhaps more significant than it seems. For instance, it suggests that the way to decide whether teachers should be taught particular content, such as calculus, is by considering when and where such knowledge would bear on what teachers need to do. It also suggests that the connections between subject matter knowledge and teaching be made explicit.

Defining mathematical knowledge for teaching in this way addresses two important problems; it provides a basis for setting priorities for what teachers are taught, and it increases the likelihood that teachers will be able to use what they are taught

when they teach. In their analyses, they also noticed that the nature of that mathematical knowledge and skill seemed itself to be of different types. They hypothesized that teacher' opportunities to learn mathematics for teaching could be better designed if we could identify those types more clearly. If mathematical knowledge required for teaching is indeed multidimensional then professional education could be organized to help teachers learn the range of knowledge and skill they need in focused ways. If, however, it is basically all the same as general mathematical ability, then discriminating professional learning opportunities would be unnecessary.

Johor (2005) defines the Subject Knowledge of Mathematics teacher as the description of skills acquired effectively and efficiently when carrying out a teaching activity, related to quality in terms of performing an educative, formative task and doing it well. This means that these skills necessarily integrate understanding and knowledge in the field of Mathematics teaching with the disposition to do the task well. For the effects of their study, they proposed methods for evaluating mathematics teachers that considered general and specialized skills, content knowledge context frameworks and qualitative dimensions relating to the conception of quality, Poblete and Díaz (2003). Among some of the general skills, we highlight the following: the ability to innovate, investigate and create during the teaching learning of Mathematics; the ability to apply knowledge relating to the discipline; the capacity to create a favorable atmosphere for learning Mathematics; the capacity to adapt, to update and procure projection as a Mathematics teacher.

With regard to the specialized skills of the mathematics teacher, we include: the ability to plan didactic activities in Mathematics; the capacity to meet the new methodological and technological demands of the curriculum; the capacity to apply different teaching strategies; the capacity to understand, identify and apply teaching

theories in mathematics; the capacity to facilitate mathematics learning through problem-solving, research and using active methods; the capacity to follow, develop and explain mathematical reasoning; the capacity to explain mathematical ideas; the capacity to connect different development areas in mathematics and their relationship with other disciplines and the capacity to use contemporary methods of evaluation.

In today's competitive era where good grades seem to be the yardstick of a child's intelligence and many more are the academic goals of parents and children that the teachers' Subject Knowledge is put to test. Subject Knowledge is seen here as the ability of the teachers to deliver knowledge using the necessary medium. Spilkova (2001) is of the opinion that teachers' Subject Knowledge denotes a set of professional skills and dispositions that the teacher should possess in order to carry out his/her job effectively. This is so because teachers' practice is characterized by great complexities and therefore, teachers must have an arsenal of Subject knowledge to be able to react to situations in the classroom and be able to reflect on them.

Spilkova (2001) further considers that teachers' professional Subject knowledge as a qualification for a successful performance of the profession should be a theoretical reflection of practical experience which should include: knowledge of Mathematics, values and personal characteristics. Pobleta and Diaz (2003) defined the Pedagogical Knowledge of the mathematics teacher as the description of skills acquired effectively and efficiently when carrying out teaching activity, the skills according to Pobleta and Diaz (2003) are of two categories, the first are the general skills which include: the teachers' ability to innovate, investigate and create during the teaching-learning of Mathematics, the teachers' ability to apply knowledge relating to the discipline; the teachers' capacity to create a favorable atmosphere for learning mathematics as well as the teachers' capacity to adapt, update and conduct himself well as a Mathematics

teacher. The second are the specialized skills which includes: the teachers' ability to carry out instructional activities in mathematics; the capacity to meet the new methodological and technological demands of the curriculum; the capacity to apply different teaching strategies; the teachers' capacity to understand, identify and apply teaching theories in mathematics, the teachers ability to facilitate mathematics learning through problem-solving, research and using active methods; the teachers' capacity to follow, develop and explain mathematical reasoning; the capacity to explain mathematical ideas; the capacity to connect different development areas and their relationship with other disciplines as well as being able to use contemporary methods of evaluation. So, are our mathematics teachers with NCE Certificates posses these abilities to applies new teaching strategies, ability to innovate and create room to carryout teaching and learning effectively?

2.3 Teachers' Pedagogical knowledge and Students' Performance

The Journal of Mathematics Teacher Education (JMTE) is devoted to researches that seek to improve the education of Mathematics teachers and develop teaching methods that better enable Mathematics students to learn. The journal covers all stages of the professional development of Mathematics teachers and teacher-educators. It serves as a forum for examining institutional, societal, and cultural influences that impact on the teacher. Education reforms currently underway in America focus on improving the pedagogic quality of education in general.

Pedagogical Knowledge have been regarded either as an ensemble of potential behaviours or capacities allowing for efficient manifestation of an activity, or as a minimum professional standard, often specified by law which professionals should reach. It is from these two perspectives that theorists have attempted more and more

complex definitions so as to comprise multiple variables which would lead to better application of education through content knowledge.

Thus, one first definition is constructed by taking into consideration the resources used in an educational process starting from and based on developing Subject knowledge. Thus, this approach regards pedagogical knowledge as "the ability of an individual to use a coordinated, synergistic combination of tangible resources (instruction materials such as books, articles, and cases and technology such as software and hardware) and intangible resources (as knowledge, skills, experience) to achieve efficiency and or effectiveness in pedagogy" (Madhavaram, Laverie, 2010, p. 5). The concept of pedagogical knowledge also tends to be used with the meaning of minimum professional standard, often specified by law, which should raise a person in fulfilling a particular role of the teaching profession (Gliga, 2002). The emphasis in understanding pedagogical knowledge should thus fall on the integrated features which outline the ability to solve pedagogical problems and typical pedagogical tasks occurring in situations of real pedagogical activities by applying knowledge, professional and life experience, values and talents in a creative manner so as to obtain appropriate and effective results.

Other attempts to define Subject knowledge have regarded the notion from the perspective of human resource management, of vocational training and education, in the attempt to observe the importance of the interdependence between personal characteristics, proficiency level and context (Sampson & Fyrtos, 2008, pp. 6–9) but there have also been attempts to regard Subject knowledge (they develop in another paper the distinction between them, Suciu & Mâţă, 2010) from the strict perspective of evaluation (Ryegård, 2010, pp. 15–17) and connect them with professional standards (see Oser & Oelkers, 2001). Regardless of the level at which pedagogical knowledge is

analyzed, a special attention is given to the results obtained in any educational process developed through the perspective of Pedagogical knowledge thus stressing the performance to which the various methodical algorithms for achieving teaching tasks are selected, combined and put into effect depending on the changes of the situational context in which the educational activities are realized with students (Diaconu & Jinga, 2004). In strict reference to the teacher, pedagogical knowledge reflects the teacher's Subject Knowledge in regard to collaboration, comprehensive view and contribution to the development of pedagogy for higher education (Ryegård, 2010, p. 11).

Pollard (2005) stated that we want to encourage teachers as reflective practitioners, to think about what they do well, to reflect on what they could share with colleagues, as well as identifying their own learning needs. Teachers play a basic and dynamic role in an educational system. Good performance of students depends upon the effective teaching of their teachers. One of the most difficult problems in educational research is that of recognizing teacher's effectiveness such as discriminating between more effective and less effective teachers for inclusion (Harley, 2000). Rice (2003) reported that, "National Teachers Examination (NTE) and other state-mandated tests of basic skills and/or teaching abilities are less consistent predictors of teacher performance." The effect of pre-service teachers' field experience and their student achievement has not been widely reported.

It has been reported that field experience has had a positive effect in reducing anxiety and improving professionalism in the new teacher (Rice, 2003). In the school teaching context, this has been complemented by various efforts to identify how best to create the conditions necessary to enhance educational institutions in such a way as to ensure that progress takes the form of viable, effective and lasting transformations that enrich and reform pedagogic practice. Similarly, systems to evaluate the quality of

education have also been developed. Over the past few years, various countries in America have participated in the evaluations carried out by the Third International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA), and the results in mathematics have placed them consistently among the countries with lowest performance rates. In the specific case of Chile, continuous evaluations on national scale of learning processes in Mathematics at primary school level have been characterized by low achievement levels. These results do not reflect either a qualitative improvement in the performance of the teaching staff that are faced with a reformed curriculum, or an effective transversal of the didactic activities to their pupils.

We believe that the success of education reforms from an endogenous perspective of the process, that is teacher–pupil interaction, depends to a great extent, on the development of teacher capacity in the classroom to ensure adequate planning, development and achievement of goals outlined in both fundamental and transversal objectives. Thus, teachers, their disposition to change and the nature of the professional skills they possess, are a key element. On this basis, they developed a didactic strategy that was put into practice in a study on improving the professional pedagogical skills of Mathematics teachers from almost all the schools of one region in Chile. They designed this strategy based on a model of professional pedagogical skills (Poblete & Díaz, 2003). The study was carried out from both a quantitative and qualitative perspective. In this study they presented the qualitative development of this didactic experience. Mathematical and pedagogical awareness is crucial for a teacher to notice, articulate, interpret aspects of classroom practice, and make on the spot.

Awareness is related to teacher knowledge and is rooted in the context of the actual classroom practice. Mason (2008) talks about different levels of awareness both

in mathematics and in mathematics teaching and relates them to the process of noticing that involves systematic reflection on acts or issues. A number of studies at both pre-service and in-service levels that have been published in this Journal of Mathematics Teacher Education (JMTE) focus on what the teachers "notice" in a classroom while teaching or reflecting on it and investigate ways that can support them in the process of developing this ability Mellon (2011*)* Scherer and Steinbring (2007). Approaches that seem to be effective in teacher education and professional development for supporting the development of teacher awareness include teacher interaction and collaboration and the use of theoretical tools in analyzing and studying mathematics teaching.

2.4 Teachers' Subject-Matters Knowledge on Students' Performance

Mathematics is one of the core courses in Nigerian Secondary Schools. Studies in Mathematics have shown that the mode of instruction, especially at the secondary school level remains overwhelmingly teacher-centered, with greater emphasis on the lecture mode of instruction and the use of textbook rather than engaging students in critical thinking across subject area and applying the knowledge acquired to real-world situations (Butty, 2001). The teacher is the most indispensable factor in effective administration of any educational system. Stronge (2007) in a study assert a positive relationship between teachers' verbal ability and composite student achievement where verbal ability has been considered to be an indicator of teacher's quality.

The role of teachers at all levels of education is emphasized in the National Policy on Education. It states "that no educational system may rise above the quality of its teachers" (FME, 2014). This declaration in the policy document underscores the need for teachers' effectiveness in teaching and learning. Daniel (2006) stated that a correlation exists between teacher's verbal ability and student's achievement. Teachers

who have majored in the subject they teach are better teachers of that subject than those who have not. Pedagogy, particularly content-based pedagogy has a positive impact on student achievement and teachers with considerable experience are likely to make greater contribution to student learning than teachers with few years of teaching experience.

Eso in Daniel (2006) conceptualized teachers' effectiveness as the managerial skills essential for enhancing classroom control and discipline. It is the teachers' Subject knowledge, ability, resourcefulness, and ingenuity through effective utilization of appropriate language, methodology and available instructional materials that can bring out the best from the learners in terms of academic achievement. In Contrast, Cavas (2002) found that quality of teaching does not have statistically significant effect on achievement at classroom level.

In appreciation of the importance of Mathematics and its relevance to national development, the National Policy on Education (FME, 2004) emphasizes on the need for basic knowledge and application of Mathematics in science and technology for purposeful and meaningful economic development. The policy also reflects that the teaching of problem- solving in the classroom is very essential in order to prepare the students for problem-solving challenges outside the four walls of the classroom. Over the years, Nigerian governments have been placing great emphasis on the study of sciences and Mathematics with the principal aim of achieving solid foundation in Mathematics and other related science subjects. It is a fact that Mathematics is the science of number, quantities and measurement and it is the backbone of most subjects at all levels of educational systems.

Researchers have also described mathematics as the 'soul' of science and technology. Bande (2004) and Elegbede (2004) stated that Mathematics is at the center

of the modern world, that there is, no sciences without Mathematics. The poor performance and lack of interest in Mathematics has been documented in some studies conducted in some parts of Nigeria by (Awodeji & Harbour, 2000), (Betiku, 2002), (Kajuru, 2006) and (Popoola, 2007). The strongest factors affecting students' enrollment and performance in Mathematics are individual differences such as general ability, personality and environmental factors (government and society).

Lack of manipulative and authentic learning situations coupled with ineffective teaching methods and approaches to Mathematics on the part of the teachers may also affect understanding of Mathematics by students (Awodeji, 2003; Popoola, 2007). Finally, we need to understand better the extent to which our formulation of mathematical knowledge for teaching is culturally specific (Cole, 2008; Delaney, 2008) or dependent on teaching styles. We do not think of the knowledge we have been identifying as being closely tied to a particular view of reform or a particular approach to teaching. For instance, interpreting students' thinking, whether in a whole-class discussion or on written homework or a quiz, is an essential part of effectively engaging students in the learning of subject matter. Explaining mathematical ideas is central to teaching, whatever the approach or style. Writing assessment questions, drawing a clear diagram, choosing a counterexample -each of these is a core task of teaching. Still, although our analyses are designed to consider fundamental tasks of teaching content, the particular sample of data we use clearly influences what we do and do not see, and the question of its limitations remains an empirical question.

2.5 Teachers/Students' Gender and Performance

In Nigeria and perhaps the whole of Africa, gender bias is still in existence. This is a view to which Onyeizugbo (2003) has also alluded to in pointing out that sex role

are somewhat rigid in Africa, particularly in Nigeria where gender differences are emphasized. It is common place to see gender stereotypes manifested in the day-to-day life of an average Nigerian. Certain vocations and professions have traditionally been regarded as men's (Medicine, Engineering or Architecture). Those considered as women's include nursing, catering, typing, arts to mention a few). In a sense, what are regarded as complex and difficult tasks are allocated to boys, whereas girls are expected to handle the relatively easy and less demanding tasks. As a result of this way of thinking, the larger society has tended to see girls as belonging to the "weaker sex".

Consequently, an average Nigerian child goes to school with these fixed stereotypes. According to Adejumo (1981), these stereotypical behaviors persist because in terms of assertiveness, for example in Nigeria men are reported to be more assertive than women in courses such as Teacher Education, law and Pharmacy.

Over the past three decades, a considerable number of studies seeking to determine a relationship between gender and mathematics learning have been conducted in various countries. In recent years research efforts (Fierros, 1999), (Zhang & Manon, 2000), (Johnson, 2000), (Leahey & Guo, 2001) and (Ericikan, McCreith, & Lapointe, 2005) show no significant differences in achievement between boys and girls as they start getting acquainted with mathematics. Nonetheless, differences favoring male students begin to emerge with time (Campbell, 1995) and (Stemler, 2002).

On gender also, the low number of women in science related professions has become a national issue of concern. It has been proposed that the attitude of girls toward mathematics is one factor that influences their lack of participation in science-related careers. This concern has resulted in a variety of studies designed to identify gender differences that could affect the number of girls in the scientific pipeline (Oaks, 2000). Particularly in the United States, boys hold more positive attitudes toward mathematics

than do girls. He stated that teacher's expectation of male students of having a good problem solving behavior that makes the boys more confident than the girls who feel insecure in the subject. He further added; the belief that mathematics is a male domain is communicated in many ways to young girls by parents; media, teachers and school counselors. This study was carried out bridge such gender gabs.

Research finding on gender differences and students' Performance in Mathematics by Wilson and Hart, (2001) has indicated that boys perform better than girls. Lloyed, Walsh and Tailagh (2005) have also indicated that there is a significant difference between the achievement of male and female student in many content areas such as problem solving, computation and measurement application. Similarly, National Council of Teachers of Mathematics (NCTM) (2002) also claimed that although gender inequality still exists in some schools and Mathematics classrooms, gender gap has substantially reduced in the last two decades. It has been stressed that there is need for compatibility between the teachers' way of teaching mathematics and the way girls learn the subject (Becker & Jacobs (2001). Levi (2000) interviewed elementary school teachers about how they addressed the problem of gender equity in Mathematics education. She highlighted the roles that teachers should play namely: (a) to ensure provision of equal opportunities and respect for differences in the classroom (b) to ensure that boys and girls have the same experience, that is, treat boys and girls should to treated equally and (c) compensate for gender differences in the society. While Mau and Leitze (2001) suggested that constructive teaching could alter the imbalance in the Mathematics classroom, Halat, (2006) on the other hand claimed that intervention through standardized Mathematics curriculum and instruction could achieve equity in learning Mathematics. The findings of this study will present suggestions and recommendations to address the above mentioned issue which is perceived to be in

existence in Kaduna state.

Although a number of studies have been done on issues related to gender as well as the teaching and learning of Mathematics at JSS level, the focus has mainly been on gender differences on students performance in Mathematics; teacher gender however, has not been given the needed attention (Li, 1999). Also, it has been reported that teacher gender has a strong influence on students' mathematics achievement than on student gender (Warwich & Jatoi. 1994). Thus, the study is actually new. Forgasiz (2005) indicated that gender is a matter of concern in Mathematics education and therefore suggested that it is significantly important to include gender as a variable in research analysis even if it is not the main focus of a study. Moreover, according to Yailagh (2005), gender is an important factor in learning Mathematics. Are the mathematics teachers with NCE qualifications have the right Subject and Pedagogical knowledge to use and apply diverse models and strategies to temper with the gender imbalances in Kaduna state? This argument kindled the researcher's interest to examine this variable.

2.6 Teachers' Experience and Students' Performance

Rivers and Sanders (2002) suggest that teacher "effectiveness increases dramatically each year during the first ten years of teaching". In the extreme case, Clotfelter (2007) in their study found an evidence of growing teacher effectiveness up to 20 or more years in their analyses of North Carolina teacher data; although more than half of the gains in teacher effectiveness occurred during the first few years of teaching.

Research has shown that teachers become more skilled with experience as in (Rice, 2003), (Kawata, & Williamson, 2000), (Rivers & Sanders, 2002), (Rowan *et al*., 2002), (Wayne & Youngs, 2003), (Nye, Konstantopoulos, & Hedges, 2004), (Hanushek

& Rivkin, 2004), (Hanushek *et al.*, 2005), (Kane, Rockoff, & Staiger, 2006), (Gordon, Kane, & Staiger, 2006), (Harris & Sass, 2007), (Aos, Miller, & Pennucci, 2007), (Clotfelter, Ladd, & Vigdor, 2006, 2007a). The preponderance of evidence suggests, however, that teacher experience matters most during the first several years of a teacher's career.

How long teacher performance continues to improve is a point of contention among researchers. Hanushek (2005), in their study for example, contend that experience matters only in the first year of teaching. By their estimates, "having a first year teacher on average is roughly equivalent to having a teacher a half standard deviation down in the quality distribution" (p. 18). Grissmer's (2000) analysis of state data on the National Assessment of Educational Progress revealed positive effects on student achievement in states with large proportions of teachers who had at least two years of experience, but there is no evidence that additional years of experience were associated with higher achievement. Gordon, Kane, and Staiger (2006) found large gains in teacher effectiveness between the first and second year of teaching, much smaller gains between the second and third year, and there is no substantial improvement after the third year in the classroom. Following these, Charles (2002) suggested the need to involve retired teachers because of their long years of teaching experience to teaching in our secondary schools.

The basic logic is that teachers rely on talk to teach method (explaining, questioning, and providing directions). Thus what verbal ability means and how to measure it turns out not to be straightforward. Lai (2011) measured teachers' verbal ability with a 30-item sentence completion test. Although talk about the importance of teachers' verbal ability persists, it is not a strong measure of teacher's quality. Quality according to Babalola (2007) is most often defined as "fitness to purpose in relation to

the user and customer needs. It can also be taken to mean that the product conforms to standards, specifications or requirements". From the input side according to Babalola (2007), quality of education can be gauged through students' capacity and motivation to learn and the curriculum or the subjects to be learned".

Other ways of inferring quality from the input side are; teachers knowing how to teach, time for learning and the requisite tools for teaching and learning. The output indicators for measuring quality of education would be qualifications and the levels of Subject knowledge in the performance of the output (students) using the body of knowledge and skills acquired. In addition the output indicator include the effective performance of the outputs in the job competitive job market, their impact on moral conduct, Subject knowledge and experience of Mathematics teachers to be able to know which particular instructional materials to improvised in a given topic.

2.7 **Overview of Related Studies**

Over the past decades, educational planners, policy makers and administrators all over the world have become increasingly concerned about the quality of education provided by the school system. They have come to realize that many meaningful improvements in the quality of education that students receive are highly dependent on the quality of teachers (Anderson, 2001). This situation is especially true in the developing countries where teachers are usually the only adults who transact educational inputs to the students. The language of Mathematics or science teaching, attempts to organize human experience (actions and reactions with the nature and the consequences of such interactions) into meaningful system of explanations. Oguniyi in Daniel (2006); this system of explanations constitutes the language of mathematics, physics and Chemistry. The language of Mathematics is clerical and precise in nature. It

is therefore, the duty of the teacher to decode the highly coded and symbolized language of Mathematics as the central role of language as a means of communication in Mathematics cannot be over emphasized.

Poor academic performance of students in Nigeria has been linked to poor teachers' performance in terms of accomplishing the teaching task, negative attitude to work and poor teaching habits which have been attributed to poor motivation (Ofoegbu, 2004). It has also been observed that conditions that would make for effective teaching such as resources available to teachers, general conditions of infrastructure as well as instructional materials in public secondary schools in Nigeria are poor (Oredein, 2000).

In their study which was to determined the influence of teachers' classroom effectiveness on students academic performance in public secondary schools in Delta State, Nigeria. The study was a descriptive survey that employed an ex-post-facto design that involved the determination and description of the influence of teachers' effectiveness on students' academic achievement. A population of 979 teachers, made up of 450 males and 519 females, drawn from 72 out of the total of 361 public secondary schools in the State by stratified random sampling technique. The present study focused on Mathematics teachers with NCE qualifications and this shows the homogeneity of group of teachers used for the present study. The study under review had different categories of teachers. Academic performance records of 50 students per teacher, which is 48,950 students' scores were also used. Two questionnaires and a rating scale were used to collect data for the study. Cronbach's alpha value of 0.98 and 0.79 respectively were obtained from the two questionnaires used for their study. Four hypotheses were tested at the 0.05 level of significance using correlation, simple regression, t-test, and single factor analysis of variance.

The results of their study showed that effective teachers produced better

performing students. However, the observed differences in students' performance were statistically not significant. This could be due to the influence of student and school environment related factors which were not included in this study. It was concluded that teachers' effect is not the only determinant on students' academic achievement. Other factors that may contribute to teachers' effectiveness include; relationship between the students and the teacher; teachers' teaching experience and qualifications. The prevailing conditions will definitely show a negative or positive influence on the instructional quality in public schools, which may translate to either good or poor academic performance, attitude and values of secondary school students.

Consequently, Lassa (2000) in a study claimed that education cannot be provided by just anybody. It requires a teacher who plans and delivers the lessons or instructions in such a way that objectives can be achieved. Corroborating this, Owolabi (2007) stated that government should find all possible means to retain veteran and experienced teachers who are still willing to serve so that they can contribute their wealth of experience to improve the system. Thus, subject-matter knowledge is considered as a measurable performance indicator for assessing teachers' mathematics achievement. In the past decade, teacher's subject-matter knowledge was measured by the scores achieved on standardized tests by a number of academic modules or by the number of courses taken in the University (Ball, 2001; Shulman, 2000).

In Nigeria, most educators have the same view on taking mathematics teachers subject-matter knowledge as the mathematics teacher's mathematics performance. Ajayi (2009) tried to look at the academic achievement scores of students with the new curriculum being used. The research design of their study was descriptive survey design with 120 samples drawn through purposive sampling techniques. The research instruments were a questionnaire and the approved academic results. The findings

showed that the academic achievements of students were poor which called for re-assessment of NCCE curriculum for Colleges of Education in Nigeria. But these quantitative measures do not represent the teacher's entire knowledge of the subject matter, especially in the teaching profession, since subject-matter knowledge also includes pedagogical knowledge. In recent years, pedagogical content knowledge has been considered as another category of teacher's subject-matter knowledge.

Ali (2009) observes that there was a statistically significant relationship between teacher characteristics and student academic achievement. Adeyemo (2005) notes that teacher characteristics influenced teaching and learning in classrooms. Olaleye (2011) establishes that there is a relationship between teachers' characteristics and pupils' performance. Gravestock and Gregor-Greenleaf (2008) state that the explanations for good or poor student's academic performance have been quite exhaustive yet controversy still exists among scholars as to what contribute singly or jointly to students' poor performance. The teacher characteristics found to be dominant in cross-country studies are related to; qualification, experience, attitude and personality.

Akinsolu (2010) asserts that the availability of qualified teachers determines the performance of students in schools. Ibrahim (2012) in Coonen; agrees that teachers involvement in in-service training were more effective in classrooms as compared to teachers who have not undergone training. Wirth and Perkins (2013) indicate that teachers' attitude contributed significantly to student attention in classrooms whereas Adesoji and Olatunbosun (2008) illustrate that students' attitude is related to teachers' characteristics. This therefore means that teacher's attitude directly affects students' attitude. On teacher personality, Adu and Olatundun (2007) contend that teachers' characteristics are strong determinants of students' performance in secondary schools. Scholars and researchers generally are in agreement that the school variables, which

include teacher administration, perform a critical role in educational achievement than other variables (Patrick, 2005).

The important role of teachers in learning is unquestionable. Teachers have a lot of influence on their classroom practices. Teachers should have and apply specific abilities without which their influence may not be reflected in their students' performance in the subject. For students to be able to make connection between what is taught in school and its application in problem solving in real life, the teacher has to be effective in their teaching. There has been no consensus on the importance of specific teacher factors, leading to the common conclusion that the existing empirical evidence does not find a strong role for teachers in the determination of academic achievement.

Ball (2001) and Shulman (2000) feel that this kind of knowledge can be described as knowing the ways of representing and formulating the subject matter and making it comprehensible to students. Since teachers' instructional devices influence the processes of learning, it is therefore important to understand how teachers explain mathematical knowledge to students, understand what they emphasize and what they do not; and what methods they choose to help students understand. Research also shows that teachers' knowledge of specific subject matter, particularly at the secondary level is a good predictor of students' performance.

Monk (2000) finds a strong correlation between teacher subject matter preparation in Mathematics and students' success for both low and high scoring students. Sowder and Schappelle, (1995) make similar observation as they indicated that a major explanation for the drop in Mathematics performance among JSS students is that the teachers lack experience and understanding of mathematics Subject-matter knowledge at this level. They therefore suggested the need for research which explores ways to effectively prepare JSS Mathematics teachers. This is to strengthen their

methodology and Subject knowledge for teaching Mathematics. Perhaps, a study of this nature can be considered as a step in that direction. Research has also identified a number of directly observable teacher characteristics that are linked to teachers' Subject knowledge, quality and performance (Goldhaber & Brewer, 2002).

Rowan and Ball (2005) emphasized in their study that, Teachers' Subject Knowledge is critical and must be placed as a priority because according to them, teachers' mathematical knowledge was significantly related to students' achievement in elementary classrooms. (Hill, Rowan & Ball 2005) cautioned that programs must examine the type of mathematical content that is explored as well as the explicit links they make to pedagogy. Ball, Hill and Bass (2005) further opined that Subject knowledge for teaching Mathematics requires an understanding of the relationships between teachings and learning content. Their study survey students' achievement from data of student and teachers in 115 elementary schools during 2000-2001 through 2003-2004 school years. The major instruments used for their study were; Students Assessment, parents' interview and 30 items Teachers' Content Knowledge for teaching Mathematics (CKT-M). Linear mixed model were used to estimate the influence of teachers and school characteristics on gains in students achievement. The teachers CKT-M measures were correlated, but not as strongly as one might expect: 0.39 and 0.37 in the first and third grades respectively. They found that Teachers Mathematical Knowledge for teaching was significantly related to students' achievement gains in both first and third grade. It was based on this that Oguntebi, in Ibrahim (2012) in a study, hypothesized that this situation will continue unless Bachelor of Education (B.Ed.) and Bachelors of Science Education B.Sc. (Ed) mathematics are accepted as a starting point of mathematics education programs at the secondary school level.

As the teaching and learning of Mathematics continues to raise serious concern

to stakeholders in Nigeria Mclilyville Consulting (firm) limited in collaboration with Lagos State Ministry of Education has begun to offer free Mathematics clinic to students in State Secondary Schools. This initiative is being carried out across the six educational districts of the state as part of efforts to improve teaching and learning of Mathematics in public schools. (*By Titus Eleweke, 24 November,2009).* Mathematics, being crucial to meaningful technological development, have made it become imperative for Lagos state to support any move geared towards improving the teaching and learning of the subject, hence the decision to partner with Mclilyville.

A strategy was designed based on a model of professional Subject knowledge (Poblete & Díaz, 2003) and on a classification of types of problems and types of mathematical skills (Díaz; Poblete; 2004). The study was carried out from both a quantitative and qualitative perspective. In this article, they presented the qualitative development of this didactic experience. Journal of Mathematics Education of the 21st century proposed a method for evaluating Mathematics teachers considering general and specialized skills, Subject knowledge context frameworks and qualitative dimensions relating to the conception of quality (Poblete; Díaz, 2003). The Subject knowledge of Mathematics teachers in this regards would be of immeasurable value. One thing is to be well grounded in the conceptual understanding of the subject and another thing is to be well acquainted with the best method to pass the concepts across to the learners for proper comprehension, a professional teacher would be desirable in this regard. The issue of professionalism in teaching has been on course for quite some decades. Scholars argued the necessity of skilled teachers for effective learning. Ngada in Fajonyomi (2008) emphasized that the success or failure of any educational programme rests majorly on the adequate availability of qualified (professional), competent and dedicated teachers. Seweje & Jegede (2005) noted that the ability of a teacher to teach is

not derived only from one's academic background but it is based upon outstanding pedagogical skill(s) acquired.

The realization of the national growth in technology as highlighted in the Nigeria national policy on education hinges (among others) largely on the quality of the Mathematics teachers. This view is supported by Nkwodimah's (2003) submission that the teacher's quality will inevitably be seen in the citizens tomorrow. Okebukola in Ngada (2008) while remarking on teachers' quality observed that over 80% of respondents in a research survey were of the view that teachers are carriers of weaknesses. These weaknesses include among others, inadequate exposure to teaching practice, poor classroom management and control, shallow subject-matter mastery and lack of professionalism. Population of their study comprised of all the students in senior secondary in Ekiti state with a sample of 100 senior secondary school physics. The result of their study showed that teachers' gender has no effect on their ability to impact knowledge on the students, much as he/she is a skilled teacher in the field of study. From Ajayi's (2009) point of view, the professional qualities of a teacher have to do with the following:

- Mastery of the subject matter
- Sense of organization
- Ability to clarify ideas
- Ability to motivate students
- Good imagination
- Ability to involve the students in meaningful activities throughout the period of teaching
- Management of the details of learning

- Frequent monitoring of students' progress through tests, formal and informal, written and oral quizzes.

The availability of professional teachers in our schools is low, according to (Ngada, 2008). The reasons may not be farfetched. Teaching is seen as a dumping ground for any unemployed school leaver irrespective of their area of specialization. This group of able bodied young men and women thus handle the job as a bye-pass venture to their desired ends. Consequently, their input on the job would be very low since it lacks the dedication demanded by the job. The few ones that seem to show little dedication lack the technical knowhow of teaching since they were never trained on the job. The resultant effect on the students' performance is catastrophic. The major evil done is producing half-baked and shallow-knowledge students who often perform poorly in their examinations. This eventually culminates in to a decline in the national technological growth.

2.8 Implication of the Reviewed Literature to the Present Study

From the review of previous related literatures we can observe that the influence of Mathematics Teachers' Subject and Pedagogical Skills on JSS students' performance in Kaduna state could be positive. Previous studies have tried to see teachers' Subject and pedagogical knowledge in terms of the required teachers' pedagogical skills, experience, instructional strategies, mode of assessment and subject-matters' mastery of the Mathematics teachers. Some scholars in their studies conceptualized that Subject knowledge is the required skills and the ability of the teacher to use any necessary medium to impact knowledge to learner, Subject-matter Knowledge was also seen in terms of teachers' quality however some scholars generally agree that teacher quality is probably the most important school-based factor affecting achievement.

Specific estimates are difficult to arrive at because economists have been unable

to link a portion of the variation in student achievement to any particular input (Sawchuk, 2011). Deep Subject-matter knowledge is also an attribute of teachers that seems to have a positive impact on student achievement. This appears especially true for Mathematics teachers. A variety of studies have found that factors such as math-licensure test scores, math certification, a math undergraduate or graduate degree, and math-focused professional development for secondary educators bear a relationship to student scores (Hill et al, 2005); Harris and Sass, (2007); Goldhaber and Brewer (2002); Clotfelter, (2007a, 2007b). So, is it the case for the mathematics teachers' teaching Mathematics at the JSS in Kaduna State? However, it has been established in another study that, no amount of resources put into the nation's education system can yield tangible results without adequately prepared and motivated teachers.

Therefore, the recruitment of incompetent/inadequately trained teachers on some of the above mentioned characteristics to the teaching profession may grossly continue to have negative influence on students' performance on JSS Mathematics in Kaduna State. In the same vein, poor teachers' pedagogical skills could continue to heighten the math phobia in students and as well increase the enrolment of children to fake schools commonly known today as "Solutions or Miracles Centres with unqualified and unprofessional teachers. This in turn has adverse effects on the education sector, economics status, health and technological development of the society. Hence, the need to conduct studies of this kind on a regular basis will necessary.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This study was carried out to examine the effect of Teachers' Subject and Pedagogical Knowledge on performance in Mathematics among secondary school students in Kaduna state. The chapter presents an outline of procedures for the study, the effect of teachers' Subject and pedagogical knowledge on junior secondary school students' performance in Kaduna state. This was discussed under the following sub-headings:

3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sampling Techniques

3.5 Instrumentations

3.6 Validity of the Instrument

3.7 Pilot Testing

3.8 Reliability of the Instrument

3.9 Procedure for Data Collection

3.10 Data Analysis Procedure

3.2 Research Design

The research design used for this study is a quasi-experimental research design involving a single testing technique. The design comprised of two-groups, experimental and control. The Experiment Group (EG) comprised of teachers with High Subject and Pedagogical knowledge while the Control Group (CG) was made of teachers with Low Subject and Pedagogical knowledge. Both groups were pretested on the teachers'

mathematics Subject knowledge. The Experimental group (High Subject and Pedagogical Knowledge Teachers) and Control group (Low Subject and Pedagogical Knowledge Teachers). The researcher assessed the teachers' pedagogical knowledge based on the objective to be achieved, the language of instruction, method employed, strategies applied, evaluation procedure during teaching and learning process and others. The researcher used Teaching Practice assessment form in order to assess teachers' pedagogical knowledge on students' performance.

Where:

EG = Experimental Group (Teacher with High Subject Knowledge or HSK)

CG = Control Group (Teacher with Low Subject Knowledge or LSK)

3.3 Population of the Study

The population of the study comprised of all junior secondary schools Mathematics teachers and year two students of public junior secondary schools in Kaduna State. JS2 students were considered for the study because JS3 had written their JSCE/BECE and the study was conducted when they were writing the third term promotion examinations. Thus, the researcher assumed that they must have covered the syllabus of JS1 to JS2 curriculum content. There were 12 educational zones, with a total of 218 teachers and 35,468 students. This comprised of a total of 19,383 male students and 16,085 female students. Table 3.1 shows the population of the study.

Table 3.1 Population of the Study

S/N	Educational Zone	Students			Teachers
		Male	Female	Total Students	
1	Anchau	1813	821	2634	14
2	BirninGwari	692	260	952	3
3	Giwa	1590	1103	2693	11
4	GodoGodo	476	429	905	12
5	Kachia	498	424	922	13
6	Kaduna	3395	3865	7260	44
7	Kafanchan	666	724	1390	25
8	Lere	2452	1639	4091	13
9	Rigachukun	689	736	1425	12
10	SabonTasha	3112	2663	5775	26
11	Zaria	2913	2516	5429	30
12	Zonkwa	1087	905	1992	15
Total	12	19383	16085	35468	218

Source: (Kaduna state ministry of Education headquarters, Kaduna 2014)

3.4 Sample and Sampling Technique

Purposively, teachers with NCE qualification teaching Mathematics at junior secondary schools in four of the Educational zones which included Kaduna, Sabon Tasha, Zaria and Zonkwa were selected for the study. Four schools were purposively selected from each educational zone; with two schools as controls and two schools as experimental groups this gave a total of 16 schools. 70 mathematics teachers participated in the study as follows: 22 were from Kaduna Education Zone, 21 from

Sabon Tasha Education Zone, 18 from Zaria Zone and 9 teachers from Zonkwa Education Zone. A simple random sampling technique was used to select 30 students from each of the selected sixteen (16) junior secondary schools. This gave a student sample size of 480. Table 3.2 shows the sample for the study. This was done in line with (Krejcie & Morgan margin error, 1970) reviewed version by research advisors (2006).

Table 3.2 sample of the Study

S/N	Zones Name	No of students Male	Female	Total students	No of Teachers
1	Kaduna	60	60	120	22
2	S/Tasha	60	60	120	21
3	Zaria	60	60	120	18
4	Zonkwa	60	60	120	9
Total	4	240	240	480	70

3.5 Instrumentation

Three instruments were used for this research. They included Teachers' Subject Knowledge Test (TSKT), Teachers' Pedagogical Knowledge Assessment (TPKA) and Students' Mathematics Performance Test (SMPT). The Teachers' Subject Knowledge Test (TSKT) was a test developed by the researcher in line with NECO standard in order to determine the teachers' Mathematics Subject-matter knowledge. The test was administered to Mathematics teachers teaching at the junior secondary school with only NCE qualifications in each of the selected Educational Zones. The content knowledge test covered the main topics taught in

Mathematics from JS1 to JS3. The time allocation for the test was $1\frac{1}{2}$ hours to answer a 100 items multiple choices Teachers' Subject Knowledge Test (TSKT)) of five option A to E (NECO) standard. All questions were based on the prescribed junior secondary school Mathematics curriculum content. The teachers were instructed to tick the right option.

The Teachers' Pedagogical Knowledge Assessment (TPKA) was an assessment on the Mathematics teachers' pedagogical skills/approach during instructional processes and it was done using the students teaching practice assessment form to assess the teacher's pedagogical knowledge.

The Students' Mathematics Performance Test (SMPT) was a test developed by the researcher in order to determine the students' level of comprehension of Mathematical concept and their corresponding teachers' pedagogical skills/approaches. The test was administered to JSS2 students in each of the selected schools. The students' test covered the main topics taught in Mathematics from JSS1 to JSS2 content. The time allocation for the test was 30minutes to answer a 20 items multiple choice Students' Mathematics Performance Test (SMPT) of a five options A to E (NECO) standard. All the tests were based on the prescribed junior secondary schools Mathematics curriculums. The students were asked to tick the right option only.

3.6 Validation of the Instrument

The TSKT and SMPT items were subjected to face and content validation by two experts in Mathematics Education Department and one expert from Measurement and Evaluation Department from the Ahmadu Bello University, Zaria. These experts helped in checking the suitability of the Teachers Subject Knowledge Test in ensuring that the questions were of standard and the language used was not confusing. It was also

to make sure that the items were actually testing teachers' Subject and pedagogical knowledge. Amendments were made according to the experts' advice.

3.7 Pilot Testing

A pilot testing was carried out on the scores of the teachers Subject knowledge test (TSKT) and students' mathematics performance test (SMPT). Reliability coefficient was obtained from Cronbach's alpha of 0.75 based on 100 items of the TSKT which involved eight Mathematics teachers, and a test consisting of 20 items multiple objectives test for SMPT which was administered to 20 randomly selected JSS2 students in two different public junior secondary schools in one of the Educational Zone. This was carried out to show the internal consistency of items of the instruments. Analysis was done using PPMC and an r-value of 0.745 was obtained to guarantee the validity and reliability of the instruments. After the pilot testing, the instruments were adjusted to correct and reduced/add to the standard measures of items of Teachers' Subject Knowledge Test (TSKT) and Students' Mathematics Performance test (SMPT).

3.8 Reliability of the Instrument

The scores of instruments, TCKT and SMPT obtained from the pilot testing were analysed using Cronbach's alpha formula and establishing the reliability of the instrument with an r-value of 0.75. Cronbach's alpha formula was used because the items were dichotomous and to justify the homogeneity of the variables, which shows how valid and reliable the instruments were. The result of the pilot testing was presented in appendix U.

3.9 Data Collection Procedure

The researcher obtained an introductory letter from the Department of Science Education, A.B.U, Zaria; titled "Students' Field Research". This letter was issued to State Ministry of Education Headquarters, through the Director planning and Statistics. Thereafter, Zonal Educational Directors were contacted through letters of introduction/approval from the Ministry of Education headquarters to the following Zones; Zaria, Kaduna, S/Tasha and Zonkwa Education Zones.

Researcher was assisted by research assistants, who were senior officers from the Educational Zones. Compliance was ensured by the teachers to respond appropriately to the test instruments (TCKT) and to also ease data collection for onward analysis of the data collected using appropriate statistical tools.

The researcher conducted and supervised personally the administration of the Students' Mathematics Performance Test (SMPT) in order to make corrections where necessary.

3.10 Data Analysis Procedures

The research questions were answered using mean and standard deviation statistic. While research null hypotheses 1, 2, 3 and 4 were analysed using t-test statistics for comparing the mean of independent samples differences at 95%, confidence interval. Statistical Package for Social Science (SPSS) was used for data analyses. It was employed because it is the best statistical tool that expressed the mean difference of two independent samples.

CHAPTER FOUR

DATA PRESENTATIONS, ANALYSES AND DISCUSSIONS

4.7 Introduction

This study was carried out to examine the effect of Teachers' Subject and Pedagogical Knowledge on performance in Mathematics among secondary school students' in Kaduna state. In this chapter, the results obtained were presented and interpretations of the analyses of the data were carried out. This was done under the following sub-headings:

4.8 Data Presentation

4.9 Analyses of Data

4.10 Testing of Research hypotheses

4.11 Findings and Discussion of Results

4.12 Summary of Findings

4.2 Data Presentation

The data obtained from the field were tagged according to Teachers' categories, for the purpose of analyses of research questions and hypotheses. The scores of Teachers Subject Knowledge Test (TSKT) and the scores of Teachers Pedagogical Knowledge Assessment (TPKA) guided the researcher in placing teachers into groups as: Teachers with High Subject Knowledge (HSK); that is teachers who scored between 60 - 100 %, Teachers who scored between 01- 59% as Low Subject Knowledge (LSK) from the Teachers' Subject Knowledge Test (TSKT) and Teachers with High Pedagogical Knowledge (HPK) were teachers who scored between 60 – 100% while Teachers with Low Pedagogical Knowledge (LPK) were teachers who scored between 01 – 59% from the Teachers' Pedagogical Skills Assessment (for the purpose of this

study). The score of Student's Mathematics Performance Test (SMPT) obtained from a 20 items multiple choice objective tests given to JSS2 students. Details of the data obtained with respect to Teachers Subject Knowledge Test (TSKT), Teachers Pedagogical Knowledge Assessment (TPKA) and Students' Mathematics Performance Test (SMPT) were presented in appendices C, D, E, F, … to T respectively.

4.3 **Analysis of Data.**

Data were collected, presented and analyzed using Mean and SD statistics. The result obtained from the descriptive statistics has the following mean scores: students of teachers with Low Pedagogical Knowledge (LPK) =29.07, students of teachers with Low Subject Knowledge (LSK) =27.02, students of teachers with High Pedagogical Knowledge (HPK) =33.12, students of teachers with High Subject Knowledge (HSK) =36.69.

4.4 Testing of Null Hypotheses:

Ho_1: There is no significant difference between performance of students taught mathematics by teachers with High Subject Knowledge and those taught by Teachers with High Pedagogical Knowledge.

To test the null hypothesis (Ho_1), t-test statistic was used and the summary was contained in Table 4.1below.

Table 4.1: t-test Compared Mean Scores of Students of Teachers with High Subject and Pedagogical Knowledge

Variable	N	Mean	Std Dev	Df	t-val	p-value	Decision
HCK Group	240	36.69	15.395				
HPK Group	330	33.12	14.848	568	2.772	0.005	H_o Rejected

*Significant at $p \leq 0.05$

From Table 4.1, the p-value, $p = 0.005$ this is less than 0.05. Therefore, the null hypothesis was rejected and therefore, we retained the alternative hypothesis that there was significant difference in the students' means performance between those taught by teachers with High Subject Knowledge (HSK) and those taught by teachers with High Pedagogical Knowledge (HPK). Hence it was concluded that the students under Teachers with High Subject Knowledge (HSK) were significantly better than students under Teachers with High Pedagogical Knowledge (HPK).

Ho_2: There is no significant difference in performance between students taught Mathematics by Teachers with High Subject Knowledge and students taught by Teachers with Low Pedagogical Knowledge.

To test the Null hypothesis (Ho_2), t-test statistic was used and the summary was contained Table 4.2 below.

Table 4.2: t-test Compared mean of Students Of teachers with High Subject Knowledge by Low Pedagogical Knowledge

Variable	N	Mean	Std Dev	Df	t-val	p-value	Decision
HSK Group	240	36.69	15.395				
LPK Group	150	29.03	13.532	388	7.686	0.001	H_o Rejected

*Significant at $p \leq 0.05$

From Table 4.2, the p-value = 0.001 which is less than 0.05. It means that the null hypothesis is rejected, and then we retained the alternative hypothesis that, there was a significant difference in the students' means performance between Students of Teachers with High Subject Knowledge those of teachers with Low Pedagogical

Knowledge. It can be seen in Table 4.2 that there exists a significant difference in students' performance between those taught by teachers with High Subject Knowledge (HSK) and those taught by teachers with low Pedagogical Knowledge (LPK). Hence the students performed better under Teachers with High Subject Knowledge than those with low Pedagogical Knowledge.

Ho_3: There is no significant difference between difference in performance between students taught mathematics by teachers with High Pedagogical Knowledge and students taught by Teachers with Low Subject Knowledge.

To test the null hypothesis (Ho_3), t-test statistic was used and the summary was contained in Table 4.3 below.

Table 4.3: t-test Compared Mean of Students of Teachers with High Pedagogical Knowledge by Low Subject Knowledge

Variable	N	Mean	Std Dev	Df	t-val	p-value	Decision
HPK Group	330	33.12	14.848				
LSK Group	240	27.02	11.944	568	5.248	0.001	H_o Rejected

* Significant at $p < 0.05$

From Table 4.3, the p-value $= 0.001$ this is less than 0.05. Therefore, the null hypothesis was rejected and therefore, the alternative was retained that there was significant difference in students' performance between those taught by teachers with High Pedagogical Knowledge (HPK) and those taught by teachers with Low Subject Knowledge (LSK). Hence it was concluded that the students under High Pedagogical Knowledge Teachers (HPK) were significantly better than students under Teachers with Low Subject Knowledge (LSK).

Ho_4: There is no significant difference between in performance between students taught mathematics by teachers with Low Subject Knowledge and students taught by Teachers with Low Pedagogical Knowledge.

To test the null hypothesis (Ho_4), t-test statistic was used and the summary was contained in Table 4.4 below.

Table 4.4: t-test Compared Mean of Students of Teachers with Low Subject Knowledge by Low Pedagogical Knowledge

Variable	N	Mean	Std Dev	Df	t-val	p-value	Decision
LSK Group	240	27.02	11.944				
LPK Group	150	29.03	13.582	388	1.535	0.126	H_o Retained

**Not Significant at $p > 0.05$

From Table 4.4, the p-value $= 0.126$ this is greater than 0.05. Therefore, the null hypothesis was retained and therefore, the alternative hypothesis was rejected that there was significant difference in students' performance between those taught by teachers with Low Subject Knowledge (LSK) and those taught by teachers with Low Pedagogical Knowledge (LPK). Hence it was concluded that the students under Low Subject Knowledge Teachers (LSK) were not significantly better in performance than students under Teachers with Low Pedagogical Knowledge (LPK).

4.5 Summary of Findings

1. From Table 4.1, the students of teachers with High Subject Knowledge had a mean score of 36.69 while students of High Pedagogical Knowledge Teachers had a mean score of 33.12. Thus, the performance of students of teachers with good Subject-matter Knowledge was better than those of teachers with High Pedagogical Knowledge. Hence it was concluded that the difference between the performance of Students of

teachers with better subject knowledge and those of Teachers good Pedagogical Knowledge were statistically significant.

2. From Table 4.2, the students of teachers with good Subject-matter Knowledge had a mean score of 36.69 while students of Low Pedagogical Knowledge Teachers had a mean score of 29.03. Thus, the performance of students of teachers with better Subject Knowledge was better than those of teachers with weak Pedagogical Knowledge. Hence it was concluded that the difference between the mean performance of Students of HSK and LPK Teachers were statistically significant.

3. From Table 4.3, the students of teachers with the right Pedagogical Knowledge had a mean score of 33.12 while students of Teachers with Weak Subject-matter Knowledge had a mean score of 27.02. Thus, the performance of students of teachers with good Pedagogical Knowledge was better than those of teachers with weak Subject Knowledge. Hence it was concluded that the difference between the mean performance of Students of HPK and LSK Teachers were statistically significant.

4. From Table 4.4, the students of teachers with weak Subject Knowledge had a mean score of 27.02 while students of Teachers with Low Pedagogical Knowledge had a mean score of 29.03. Thus, the performance of students of teachers with weak Knowledge of mathematics was not better than those of teachers with weak Pedagogical Knowledge. Hence it was concluded that the difference between the mean performance of Students of LSK and LPK Teachers were not statistically significant.

5. Based on a 50% pass criteria and considering the entire students sample (480 students), 73 students representing 15.2% passed while 407 students representing 84.8% failed.

4.6 **Discussions**

The major finding of this study concerns students' performance in public

junior secondary schools with respect to Mathematics Teachers' Subject and pedagogical Knowledge in Kaduna state. The results indicated that students taught by Teachers with right mathematics Knowledge have the highest mean score of 36.69 greater than the mean score of students of Teachers with weak Subject-matter Knowledge who have 27.02 as the mean score. This research finding is in line with the research findings of Darling-Hammond in Ibrahim (2012) where she found that students performed poorly in the hands of teachers with weak Subject Knowledge than in the hands of teachers with good Subject-matter Knowledge. Molnar (2012) also reported in a research study that students taught by teachers with the right mathematics Subject Knowledge scored better than those taught by teachers with poor Subject Knowledge. The result also agrees with the research finding of Ollerton (2002) which indicated that the perennial poor performance in Mathematics in the National mathematics examinations is as a result of teachers' weak Subject Knowledge teaching mathematical concepts at these levels.

From the result of the findings, it can be seen in Table 4.3 that students taught mathematics by teachers with High Pedagogical Knowledge had a better mean score of 33.12 and those taught mathematics by Teachers with Low Subject Knowledge had a mean score of 27.02. Thus the result of this study is in agreement with the findings of Kajuru (2010) which states that, poor teaching strategies (pedagogical approaches) applied during teaching and learning of Mathematics especially problem solving by Mathematics teachers will continue to double students poor performance in Mathematics at all levels of schooling. The reason for this is clear that teachers with good Knowledge of mathematics subject-matter and teaching skills should be able make any concept simple, clear and comprehensible to learners. The researcher also analysed the data collected based on gender.

And it was found that the performance of male and female students taught by teachers with good Subject Knowledge and those taught mathematics by teachers with weak Subject Knowledge, were not statistically significant in their mean performance. The means score of male and female students of Teachers with High Subject knowledge and those taught by teachers with weak Subject Knowledge were Male=37.92, Female=36.54 and Male=25.92, Female=28.08 respectively. This result agrees with the research conducted on gender differences and performance in Mathematics by National Council of Teachers of Mathematics NCTM (2000) which claimed to have witnessed such a decrease in gender gap. This decrease in gender difference may be due to their family background, some social and environment factors of the students.

The male and female students under Teacher with weak Pedagogical Knowledge had a mean scores (Male = 31.27) significantly difference from those of the (Female = 26.53) students in favour of the male students and this result is line with the findings of Wilson and Hart (2001) who found out that boys perform better than girls. Also Lloyed, Walsh and Tailagh (2005) have all indicated that there are significant differences between the achievement of male and female students in many content areas such as problem solving, computation and measurement application. One other finding by this study was that, there is a weak positive relationship between Mathematics teacher's Subject and Pedagogical Knowledge and Students' performance. Some scholars have found some positive relationship like those of Darling-Hammond (1999, 2000b), Goldhaber and Brewer (2000), while Monk and King (2002) found positive and negative relationship.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study was carried out to find out the effect of Teachers' Subject and Pedagogical Knowledge on performance in Mathematics among secondary school students in Kaduna state. This chapter was discussed under the following subheadings:

5.2 Summary

5.3 Conclusion

5.4 Contribution to Knowledge

5.5 Recommendations

5.6 Limitations of the Study and

5.7 Suggestions for Further Studies

5.2 Summary

This study was undertaken to find out the extent to which Teachers' Subject and Pedagogical Knowledge can improve students' performance in Mathematics among junior secondary school mathematics in Kaduna State. To achieve this, attempts were made to find out the effects of Mathematics Teachers' Subject and Pedagogical Knowledge. This is because there are problems of poor performance in both internal and external examinations in our junior secondary schools.

From the analyses of the research data, it was found that: based on the 50% criteria for that a student is considered to have passed at credit level which is criteria set by ERC/NECO for placement to Senior Secondary School one (SS1) and even for admission into tertiary institutions. 73 out of 480, representing 15.2% passed while the remaining 407 students representing 84.8% failed. Students of Teachers with High

Subject Knowledge have mean score of 36.69; Students of Teachers with High Pedagogical Knowledge have mean score of 33.12. The difference between performance of the students of Teachers with better Subject Knowledge and students of Teachers with good Pedagogical Knowledge was found to be statistically significant. Students of Teachers with better Subject Knowledge have mean score of 36.69 and students of Teachers with weak Subject Knowledge have mean score of 27.02. The difference between the mean performance of the students of Teachers with good Subject Knowledge and those taught by Teachers with weak Subject Knowledge was found to be statistically significant.

The data collected were also analysed based on Students' gender. And it was found that the difference between the mean performance of the male and female students of Teachers with High Subject Knowledge, students of Teachers with High Pedagogical Knowledge and those of Teachers with Low Subject Knowledge were statistically not significant. The male and female students mean performance of Teachers with Low Pedagogical Knowledge was found to be statistically significant in favour of the male students. Their means scores were as follows: (HSK, Male = 37.92, Female = 36.54), (HPK; Male = 31.67, Female = 34.58), (LSK; Male = 25.92' Female = 28.08) and (LPK; Male = 31.27, Female = 26.53) respectively.

The study found a weak positive correlation of ($r = 0.279*$) between Mathematics Teacher Subject and Pedagogical Knowledge and students' performance in Mathematics.

5.3 **Conclusions**

From the findings of this study, the following conclusions were made:

1. If the teacher teaching mathematics is well loaded with the sound Subject knowledge of mathematics and the right pedagogical approaches, there will be less issue of concern on poor performance in our secondary schools.

2. It is true that teachers' knowledge of the subject matter content of a discipline has influence on students' performance.

3. The secondary school Mathematics teachers' Subject-matter knowledge and pedagogical approach must be strengthened and expanded.

4. The teacher must know, love and have the right attitude to Mathematics and be able to use that knowledge effectively in the classroom.

5. The National Commission for Colleges Education (NCCE) should as a matter of urgency revisit its curriculum content of mathematics at NCE level especially on problem-solving and current issues in mathematics and on its pedagogical approaches.

5.4 Contributions to Knowledge

This research's contributions are as follows:

i. The researcher was able to establish that some Mathematics teachers with NCE qualifications lack the requisite content knowledge to deliver some basic concepts in mathematics effectively and efficiently during teaching and learning at the junior secondary school level.

ii. The study established that, teachers with High Subject Knowledge and the right pedagogical approaches makes students develop love and interest for the subject. It will also help in disabusing students' mind and deliver them from math phobia.

5.5 Recommendations

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

1. Some Teachers with NCE qualifications need to be further train in order to improve on their Mathematics Subject-matter Knowledge to better their delivery during teaching and learning.

2. Teachers' pedagogical knowledge should be given more attention during training of Students of National Certificate of Education (NCE) so as to acquire enough teaching skills to be able to give concrete foundation of Mathematics at the secondary school level.

3. Mathematics Association of Nigeria (MAN), Kaduna State chapter should always collaborate with the National Mathematical Centre (NMC) on training and re-training of mathematics teachers in our secondary schools on regular basis in order to accommodate the new technologies, innovations and methods in the education industry. This will give our teachers, teaching Mathematics in our senior and junior secondary school levels the good stand to deliver effectively and efficiently.

4. A Mathematics Teachers' Subject Knowledge test should be conducted by the Ministry of Education regularly in order to make Mathematics teachers always be alive.

5. Based on the findings of this study, recommendation were made and call on the state and the federal governments to collaborate with the National Commission for Colleges of Education (NCCE) to design an improve curriculum content on mathematics courses at our colleges of education in the country to help in producing NCE graduates with High content and pedagogical knowledge. This will enable them to teach effectively in our secondary schools.

5.6 Limitations of the Study

i. This study used only four Educational Zones in Kaduna state due to the geographical spread and the financial implication of the study. It is not all students in the selected schools of the four Educational Zones were used.

ii. Another limitation of this study was that of getting teachers together for the Teachers' Content Knowledge test was not an easy because most of the Zonal Education Directors were not ready to cooperate with the Ministry's directives.

5.7 Suggestions for Further Studies

Since this research intended to promote and encourage further findings in the related studies, the following areas have been suggested.

1. The impact of teachers' Subject Knowledge and instructional approach among senior secondary school students' performance in Geometry.

2. Effect of teachers' Subject and pedagogical knowledge and instructional materials on students' performance in mathematics among senior secondary school.

3. The effect of Mathematics teacher's Subject knowledge and gender on senior secondary school students' performance in Mathematics.

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Appendix A:

Teachers' Content Knowledge Test

(TCKT)

Instructions: Answer All Questions.

1. A metallic rectangular tank contains 4000m^3 of liquid gas. If the base and height of the tank are 10m and 25m respectively, what is the length of the tank?
A. 8m
B. 12m
C. 24m
D. 16m
E. 20m

2. The sum of angles of a polygon is 1440^0. How many sides has the polygon?
A. 7
B. 8
C. 11
D. 10
E. 9

3. If one of the angles in an isosceles triangle is 40^0, then one the base is
A. 81^0
B. 70^0
C. 67^0
D. 60^0
E. 53^0

4. A triangular field has an area of 500m^2. if the base is 20m, what is its height?
A. 150m
B. 200m
C. 50m
D. 100m
E. 250m

5. What volume of gas is required to fill a cylindrical gas jar which is 5m long and 4m in diameter?
A. 20πm^2
B. 32πm^2
C. 16πm^2
D. 24 πm^2
E. 28 πm^2

6. Calculate the area of a circle whose radius is $3\frac{1}{2}m,$ take $\pi = \frac{22}{7}$
A. $6\frac{1}{2}m^2,$
B. $30\frac{1}{2}m^2$
C. $14\frac{1}{2}m^2$
D. $38\frac{1}{2}m^2$
E. $22\frac{1}{2}m^2$

7. The sum of 4 angles of a heptagon is 780^0. If the other three angles are equal, what is the value of each?
A. 160^0
B. 120^0
C. 80^0
D. 200^0
E. 40^0

8. Approximate 0.001528 to 3 decimal places.
A. 0.001
B. 0.002
C. 0.0015
D. 0.00152
E. 0.00153

9. What percentage of 10km is 4km?
A. 40%
B. 60%
C. 10%
D. 100%
E. 4%

10. A piece of land was cultivated by 50men in 6days. How long would the same land be cultivated 30men working at the same rate?
A. 10days
B. 25days
C. 12days
D. 60days
E. 100days

11. What is the result of dividing the positive difference between 2 and 7 by the sum of 2 and 8?
A. 2
B. $1\frac{1}{2}$

C. $1/2$

D. $2/3$

E. 3

12. Express 123,000 in standard form.

A. $1.23X10^{-4}$

B. $1.23X10^{5}$

C. $1.23X10^{3}$

D. $1.23X10^{4}$

E. $1.23X10^{-3}$

13. What is the place value of 7 in 5.792?

A. Units

B. Tens

C. Thousandths

D. Tenths

E. Hundredth

14. A man receives ₦800.00 per day for a job done for nine days. How much is he paid at the end of the nine days?

A. ₦88.89

B. ₦710.00

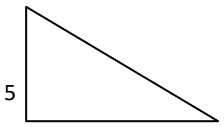
C. ₦800.00

D. ₦7200.00

E. ₦809.00

15. Find the length of the hypotenuse side in the

right-angled triangle below.



A. 8

B. 10

C. 13

D. 12

E. 9

16. Find the simple interest on ₦1200 for 5 years at 4% per annum.

A. ₦24.00

B. ₦120.00

C. ₦240.00

D. ₦480.00

E. ₦48.00

17. A cyclist travelled a distance of 28km using 4litres of petrol. How far would he travel with10litres of petrol?

A. 280km

B. 70km

C. 14km

D. 38km

E. 56km

18. If 75% of a farmer's produce is rice and the rest is millet. Find the ratio of millet to rice.

A. 1:1

B. 1:3

C. 1:4

D. 3:1

E. 4:1

19. Tolu had 8 oranges and Audu has 5. They put their oranges together, gave 3 Elijah and shared the rest equally between them. How many oranges does each now have?

A. -5

B. 5

C. -8

D. 8

E. 3

20. Find the value of $\frac{a+b+c}{c+a}, if$ a=3, b=6 and c=-2

A. -7

B. 7

C. 5

D. -5

E. 3

21. If $\frac{1}{y}+\frac{1}{2x}=\frac{1}{z}$, make x subject of the formula.

A. $x=\frac{yz}{2(y-z)}$

B. $x=\frac{yz}{2(z-y)}$

C. X=$\frac{yz}{2(y+z)}$

D. $x=\frac{2yz}{(y-z)}$

E. $x=2\frac{(y-z)}{yz}$

22. Solve the equation $\frac{x+2}{x+1}=\frac{3}{2}.$

A. -7
B. -1
C. 1
D. 0
E. 7

23. Which of the number lines correctly represents the solution of the inequality $3x + 2 < 8$?

A.
B.
C.
D.
E.

24. What are the values x and y in the pair of simultaneous equations? $2x + y = 6$ and $2x - y = 2$

A. $(0,2)$
B. $(1,2)$
C. $(2,-1)$
D. $(2,2)$
E. $(-2,-2)$

25. Which of this is the expansion o $(a+2)(a-2)$?

A. $a^2 + 4a + 4$
B. $a^2 + 4$
C. $a^2 - 4$
D. $a^2 - 4a + 4$
E. $a^2 - 4a - 4$

The scores of students in a mathematics test are as shown below.

X	0	1	2	3	4	5
F	1	1	5	3	0	2

26. From the table, calculate the mean of distribution.

A. 1
B. 0
C. 1.5
D. 2.5
E. 2

27. What is the probability of getting a 2 when a die is thrown?

A. $\frac{1}{2}$
B. $1/3$
C. $\frac{1}{5}$
D. $\frac{1}{4}$
E. $\frac{1}{6}$

28. Solve for u in the equation: $u + \frac{1}{2} = 1$

A. 2
B. 0
C. $2\,1/2$
D. $1\,1/2$
E. $\frac{1}{2}$

29. A bag costs ₦r and a ball cost 20k less than the bag. Find the cost of one bag and one ball in Kobo.

A. $(200r + 20)kobo$
B. $(100r - 20)kobo$
C. $(100r + 20)kobo$
D. $(200r + 10)kobo$
E. $(200r - 20)kobo$

30. Factorise $x^2 - 8x - 20.$

A. $(x-4)(x+5)$
B. $(x+10)(x-2)$
C. $(x-10)(x-2)$
D. $(x+10)(x+2)$
E. $(x-10)(x+2)$

31. Write 1979 in Roman Numerals.

A. MCMCIIX
B. MCMCIX
C. MCMLXXIX
D. MCMXCI
E. MCMLXI

32. A girl bought a book for ₦y. She sold it for ₦80.00. what was her loss?

A. ₦80y
B. ₦$(80 + y)$
C. ₦y

D. ₦$(y-80)$

E. ₦$(80-y)$

33. Solve x in $3x > 10 - 2x.$

A. X>2

B. X>0

C. X<1

D. X<2

E. X>1

34. Which of the following statements is /are correct?

I. All angles of an equiangular triangle are equal.

II. All sides of an equilateral triangle are equal.

III. All sides of an isosceles triangle are equal.

A. I only

B. II only

C. I and II only

D. I and III only

E. II and III only

35. If in a right angled-triangle, $\tan x^0 = \frac{3}{4}$, what will be the length of the longest side?

A. 4

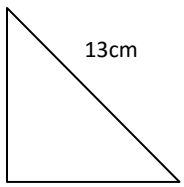
B. 3

C. 5

D. 6

E. 7

36. In the right-angle triangle below, $\overline{AB} = 12cm, \overline{BC} = 13cm.$ find $\overline{CA}.$



A. 25cm

B. 15cm

C. 1cm

D. 18cm

E. 5cm

37. Find the perimeter of a rectangular board which is 4.5m by 2.5m.

A. 7m

B. 16m

C. 11m

D. 14m

E. 12m

38. The following are properties of a parallelogram EXCEPT

A. diagonals bisect each other.

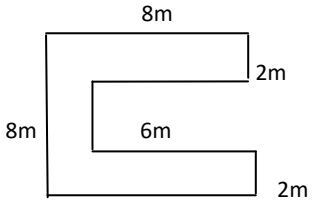
B. diagonals are lines of symmetry.

C. opposite angles are equal.

D. opposite sides are equal.

E. opposite sides are parallel.

39. Find the area of the figure below.



A. $40m^2$

B. $48m^2$

C. $88m^2$

D. $12m^2$

E. $16m^2$

40. If the area of a square cardboard is $81m^2$, find the length of each side.

A. 3m

B. 21m

C. 9m

D. 18m

E. 27m

41. Three lines meet at appoint, if the sum of two angles is 197^0, what is the other angle?

A. 260^0

B. 107^0

C. 37^0

D. 163^0

E. 17^0

42. The volume of water in a cylinder is $231cm^3$. If the area of the bottom of the cylinder is $\frac{77}{2}cm^2$, What is the depth of water in the cylinder?

A. 11cm

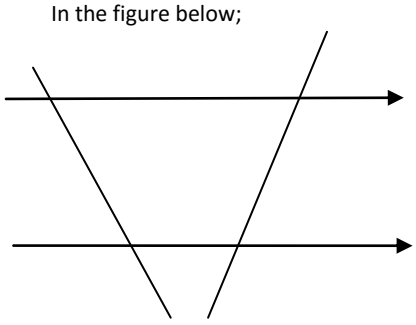
B. 6cm

C. 9cm

D. 10cm

E. 8cm

43. In the figure below;



Which of the angle(s) is/ are equal to a?

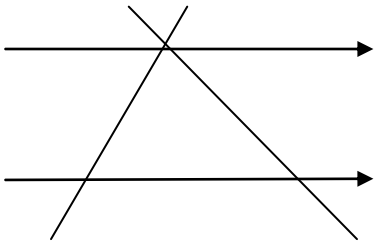
(i) b and e
(ii) c and d
(iii) b and c
(iv) b and d

A. (i) and (ii)
B. (i) and (iii)
C. (ii) and (iii)
D. (iii) only
E. (ii) and (iv)

44. A sector of a circle in which the angle subtend at the centre is 70^0 and radius is 7cm, find the area of the Sector to the nearest whole number.

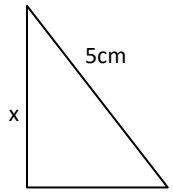
A. $25cm^2$
B. $26cm^2$
C. $27cm^2$
D. $30cm^2$
E. $29cm^2$

45. What is the value of x in the below?



A. 40^0
B. 80^0
C. 50^0
D. 70^0
E. 60^0

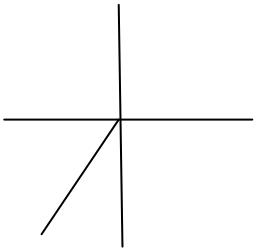
46. Calculate the value of x in the figure below.



3cm

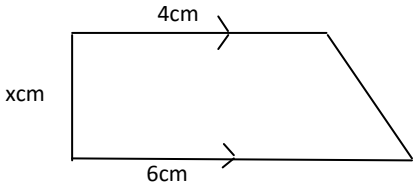
A. 1ocm
B. 2cm
C. 4cm
D. 8cm
E. 6cm

47. The bearing of X from Y in the diagram below is



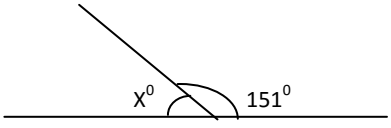
A. 35^0
B. 145^0
C. 180^0
D. 215^0
E. 55^0

48. Calculate the height x of the shape below, if its area is $15cm^2$.



A. 4cm
B. 6cm
C. 3cm
D. 2cm
E. 5cm

49. The value of x in the diagram below is



A. 29^0
B. 61^0
C. 331^0
D. 51^0

E. 209^0

50. Find the coefficient of x in the expression $(x+9)(x-2).$

A. -11
B. 11
C. 7
D. -7
E. -9

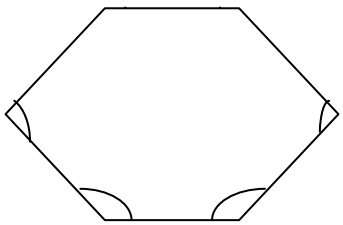
51. Simplify $\frac{x^2-y^2}{x-y}.$

A. xy
B. $x+y$
C. $-x+y$
D. $x-y$
E. $\frac{1}{x}+y$

52. Solve the inequality $4x-8\le 0.$

A. $x\le -4$
B. $x\le -2$
C. $x\le 2$
D. $x\le 12$
E. $x\le 10$

53. Find the value of y in the hexagon below.



A. 720^0
B. 7^0
C. 223^0
D. 497^0
E. 71^0

Use the following table of values for

$y=1-2x$ to answer questions 54 to 55.

X	0	1	2	3	4
Y	A	-1	b	-5	C

54. Obtain the value of a^2+2c

A. 13
B. 14
C. -13
D. -14
E. -15

55. Evaluate $\sqrt{(b^2-c^2)+49}$

A. -10
B. 3
C. 9
D. 4
E. 7

56. Make R the subject of the formula if $A=M^2R.$

A. $\left(\frac{A}{M}\right)^2$
B. $\frac{A}{M^2}$
C. $\frac{M^2}{A}$
D. $\frac{M}{A^2}$
E. $\frac{A}{M}$

57. If $b-2$ is a factor of $5b^2-7b-6,$ what is the other factor?

A. $3-5b$
B. $3b-5$
C. $3b+5$
D. $5b-3$
E. $5b+3$

58. Find the value of a if 24 is the product of 4 and 3a.

A. 2
B. 1
C. 4
D. 3
E. 5

59. Factorise $4c^2+9a+2c-12a.$

A. $-3a+2c$
B. $2c(1-2c)$
C. $2c(1+2c)$
D. $2c(1+2c)-3a$
E. $2c(1+2c)+3a$

60. If L ∝ M, and M=1 when L=5, Find M when L=15.

A. 3

B. $\frac{1}{5}$

C. $1/3$

D. 1

E. 5

61. The expression $A \propto \frac{1}{\sqrt{B}}$ means?

A. A varies as the square root of B.

B. A varies directly as the square root of B.

C. A varies directly as the square of B.

D. A varies inversely as the square root of B.

E. A varies inversely as the square of B.

62. The set of numbers $\{0,1,2,3\}$ can be represented by the inequality

A. $0 \leq x < 3$

B. $0 \leq x \leq 3$

C. $0 \leq x > 3$

D. $0 < x < 3$

E. $0 < x \leq 3$

63. Solve the equation $\frac{2t+1}{2} + t - 1 = 0$

A. $1/4$

B. $4/3$

C. 4

D. $3/4$

E. 1

64. Factorise $ab + bc$

A. $a(a+b)$

B. $c(a+b)$

C. $b(a+c)$

D. $ac(a+b)$

E. $ab(1+c)$

65. Simplify $(2p+3q)+(2q-p)$.

A. $p+5q$

B. $p-5q$

C. $3p-5q$

D. $3p+5q$

E. $5p+q$

66. A classroom measures 25m by 15m. using a scale of 1cm to 5m, to draw it on a piece of paper, find the area of the room.

A. $3cm^2$

B. $15\ cm^2$

C. $40\ cm^2$

D. $375cm^2$

E. $5\ cm^2$

67. A square has a perimeter of 64cm. calculate the length of a side.

A. 16cm

B. 6cm

C. 8cm

D. 24cm

E. 12cm

68. Simplify: $\left(2\frac{3}{5} - 1\frac{2}{3}\right) \quad X \quad \frac{5}{6}$

A. $\frac{1}{18}$

B. $\frac{1}{8}$

C. $\frac{5}{18}$

D. $\frac{7}{9}$

E. $\frac{8}{9}$

69. Evaluate $1\frac{2}{5} + \frac{3}{4}$ and give your answer to 1 significant figure.

A. 3

B. 2.5

C. 2

D. 2.2

E. 1

70. Find the value of $50 - (-15 \quad X - 8)$.

A. 170

B. -60

C. -170

D. 70

E. -70

71. Find the reciprocal of 0.0016.

A. 160000

B. 125

C. $\frac{2}{125}$

D. 625

E. 125

72. Aisha and Fati shared ₦20000.00 in the ratio of their ages. If Aisha receives ₦7500.00, in what ratio was the money shared?

A. 2:3
B. 5:8
C. 5:3
D. 3:2
E. 3:5

73. Find the positive difference between 10111_{two} and 23_{four} leaving your answer in base ten.

A. -15
B. 0
C. 15
D. 12
E. -12

74. Express 63025 in standard form.

A. $6.3025X10^4$
B. $63.025X10^3$
C. $63025X10^0$
D. $6302.5X10^1$
E. $630.25X10^2$

75. A number is multiply by 5 and the result is twice the number added to 2. Find the number.

A. 0
B. $\frac{2}{3}$
C. $1\frac{1}{2}$
D. $3\frac{1}{2}$
E. $\frac{2}{7}$

76. Find the value of m if $\frac{3m}{5}+\frac{m}{2}=\frac{4}{1}+\frac{2}{5}$.

A. 8
B. 3
C. 4
D. 5
E. 6

77. Find the coefficient of mt in the Expression

$4m(3n-2t)+3t(3t-2m)$.

A. -14
B. -6
C. 12
D. 9
E. -8

78. One-fourth of a certain number is removed from two-fifth of a that number the result is 3, find the number.

A. 27
B. 5
C. 9
D. 12
E. 20

79. Factorise the quadratic expression x^2+x-2.

A. $(x+1)(x+2)$
B. $(x+1)(x-2)$
C. $(x-1)^2$
D. $(x-1)(x-2)$
E. $(x-1)(x+2)$

80. The sum of 3x+2, 2+5x and 1+x.

A. $9x+5$
B. $5-9x$
C. $9x-5$
D. $14x$
E. $-14x$

81. Which of the following is **not** a perfect Square?

A. x^2
B. $2y^2$
C. $16t^4$
D. $25p^2$
E. $4d^2$

82. Solve the equation:

$$\frac{4(m+2)}{4}=\frac{5m-4}{3}$$

A. -5
B. -4
C. -6
D. 5
E. 4

83. Find x if $\frac{3}{8}=\frac{9}{x}$.

A. 8
B. 3
C. 24
D. 16
E. 21

84. An exercise book and two pens cost ₦90.00. If the difference between the Cost of an exercise book and a pen is ₦45.00, determine the cost of a pen.

A. ₦10.00
B. ₦15.00
C. ₦45.00
D. ₦60.00
E. ₦30.00

85. Find the product of the L.C.M. and H.C.F of 9xy, $18y^2$ and 3z.

A. $54xy^2z$
B. $18xy^2z$
C. $54xy^2$
D. $54xyz$
E. $18xyz$

86. Ado cycles at the rate of 20km/h for $2\frac{1}{5} hours.$ what distance will he cover?

A. 40km
B. 43km
C. 44km
D. 42km
E. 41km

87. Simplify: $\left(-21mtn^2\right) \div \left(3mn\right).$

A. 7mtn
B. -7nt
C. 24nt
D. -7mt
E. 7mn

88. The sum of the ages of Ama and Ateh is 45years. If the difference in their ages is 3years, find the age of Ama. (Hint: Ama is older than Ateh).

A. 42years
B. 21years
C. 18years
D. 24years
E. 15years

89. A motorcycle is paid for in twelve equal instalments. Each payment ₦3,500.00. how much does the motorcycle cost?

A. ₦44,000.00
B. ₦42,000.00
C. ₦45,000.00
D. ₦40,000.00
E. ₦41,000.00

90. If $2x + y = -7$ and $3x = 6 + 4y$ are simultaneous linear equations, What is the value $x - y$?

A. -1
B. 5
C. 1
D. -5
E. 6

91. Find the HCF of $16xy^2$, $42x^2y$ and $32x^2y^2z$

A. 2xy
B. 4xy
C. 6xy
D. $2x^2y^2$
E. $2x^2y^2z$

The table below shows the ages of students in a Class. Use the table to answer questions 92 and 93.

Age(yrs)	11	12	13	14	15
No of students	3	12	15	8	2

92. How many are not older than 13years?

A. 3
B. 30
C. 27
D. 15
E. 12

93. What percentage of the students are 12 years old?

A. 10%
B. 50%
C. 30%
D. 15%
E. 20%

94. The probability that Audu will pass an Exams is $3/4$. What is the probability of failing the same exams?

A. $\frac{1}{3}$
B. $\frac{1}{4}$
C. $\frac{2}{3}$
D. $\frac{1}{2}$
E. $\frac{5}{6}$

95. From the table below, find the mode.

Age(years)	35	38	40	43	45
Frequency	33	20	35	38	21

A. 40years
B. 43 years
C. 38 years
D. 35 years
E. 45 years

96. The mean scores of 46 students in Mathematics test is 32.5, what is their total score?
A. 1495
B. 784
C. 788
D. 495
E. 79

97. A fair die is thrown once. What is the probability of getting an even number?
A. $\frac{1}{12}$
B. $\frac{1}{2}$
C. $\frac{1}{3}$
D. $\frac{1}{6}$
E. 1

98. A basket contains 25 oranges, 10 of them are bad. What is probability of picking a good one?
A. $\frac{3}{5}$
B. 1
C. $\frac{2}{5}$
D. $\frac{1}{5}$
E. $\frac{1}{2}$

99. Abdul tossed a fair coin once, what is the probability of having a head?
A. $\frac{1}{3}$
B. $\frac{5}{6}$
C. $\frac{1}{2}$
D. $\frac{1}{6}$
E. $\frac{2}{3}$

100. A fair die is thrown once, what is probability of getting a prime number?
A. $\frac{3}{4}$
B. $\frac{1}{5}$
C. $\frac{1}{4}$
D. $\frac{2}{3}$
E. $\frac{1}{2}$

Appendix B: Students' Mathematics Performance Test

Instructions : Answer All Questions by ticking the correct option.

1. A metallic rectangular tank contains 4000m^3 of liquid gas. If the base and height of the tank are 10m and 25m respectively, what is the length of the tank?
F. 8m B. 12m C. 24m D. 16m E. 20m

2. If the sum of angles of a polygon is 1440^0. How many sides have the polygon?
F. 7 B. 8 C. 11 D. 10 E. 9

3. If one of the angles in an isosceles triangle is 40^0, then one the base is
F. 81^0 B. 70^0 C. 67^0 D. 53^0 E. 60^0

4. A triangular field has an area of 500m^2. If the base is 20m, what is its height?

F. 150m B. 200m C. 50m D. 100m E. 250m

5. What volume of gas is required to fill a cylindrical gas jar which is 5m long and 4m in diameter?

F. 20πm^2 B. 32πm^2 C. 16πm^2 D. 24 πm^2 E. 28 πm^2

6. Evaluate $\frac{-2x^2}{x^2-y^2}$: when x=-2 and y=3

A. $-1\frac{3}{5}$ B. $-\frac{4}{5}$ C. $-\frac{5}{8}$ D. $1\frac{3}{5}$ E. 4

7. The sum of 4 angles of a heptagon is 780^0. If the other three angles are equal, what is the value of each?

F. 160^0 B. 120^0 C. 80^0 D. 200^0 E. 40^0

8. Approximate 0.001528 to 3 decimal places.

F. 0.001 B. 0.002 C. 0.0015 D. 0.00152 E. 0.00153

9. If 25% of a number is 75, find the number.

A. 700 B. 500 C. 300 D. 400 E. 600

10. Find the sum of angles of a hexagon.

A. 720^0 B. 360^0 C. 1440^0 D. 900^0 E. 1080^0

11. What is the result of dividing the positive difference between 2 and 7 by the sum of 2 and 8?

F. 2 B. $1\frac{1}{2}$ C. $\frac{1}{2}$ D. $\frac{2}{3}$ E. 3

12. Express 123,000 in standard form.

F. $1.23X10^{-4}$ B. $1.23X10^{5}$ C. $1.23X10^{3}$ D. $1.23X10^{4}$ E. $1.23X10^{-3}$

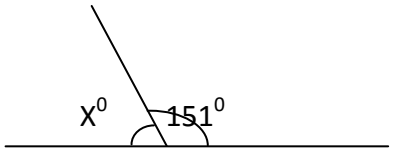
13. What is the place value of 7 in 5.792?

F. Units B. Tens C. Thousandths D. Tenths E. Hundredth

14. Write 1979 in Roman Numerals.

F. MCMCIIX B. MCMCIX C. MCMLXXIX D. MCMXCI E. MCMLXI

15. The value of x in the diagram below is

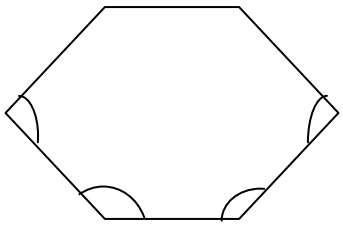


F. 29^0 B. 61^0 C. 331^0 D. 51^0 E. 209^0

16. Find the coefficient of x in the expression $(x+9)(x-2)$.

F. -11 B. 11 C. 7 D. -7 E. -9

17. Find the value of y in the hexagon below.



F. 720^0 B. 7^0 C. 223^0 D. 497^0 E. 71^0

18. Find x if $\frac{3}{8}=\frac{9}{x}$.

F. 8 B. 3 C. 24 D. 16 E. 21

19. Find the H.C.F. of 63 and 90.

A. 10 B. 9 C. 7 D. 5 E. 3

20. The sum of 3x+2, 2+5x and 1+x is

F. $9x+5$ B. 5_9x C. $9x-5$ D. $14x$ E. $-14x$

Appendix C: Scores of Students of Teachers with Low Pedagogical Knowledge

35	55	55	40	60	60	55	30	30	30
30	35	50	15	60	40	40	15	25	30
15	10	35	35	25	35	75	15	45	10
10	55	35	35	30	20	20	20	15	30

25	45	40	50	20	20	40	20	20	40	
50	60	35	30	35	25	45	25	30	40	
40	40	40	30	15	20	40	35	10	15	
30	20	10	35	10	35	20	30	10	45	
30	20	35	50	35	35	30	10	30	50	
10	15	15	15	10	20	25	20	10	20	
20	20	10	30	25	25	15	25	20	15	
35	10	25	10	45	30	10	15	30	30	
50	30	15	10	30	20	15	30	20	40	
30	45	35	35	40	15	30	35	25	15	
35	35	15	20	50	20	25	40	20	10	**N=150**

Appendix D: Scores of Students of Teachers with High Pedagogical Knowledge

40	25	15	10	15	25	20	25	25	45
35	45	20	35	25	15	20	10	30	45
25	10	20	10	45	45	20	50	55	30

25	35	20	10	10	15	45	30	45	25
15	30	35	10	25	30	20	35	10	30
15	35	35	10	25	25	25	30	20	25
20	25	25	40	30	30	25	35	30	15
20	20	20	15	10	30	55	45	40	30
60	40	25	25	15	40	35	40	10	15
10	35	40	20	45	25	20	55	55	30
30	20	15	25	25	30	50	40	30	15
35	25	50	30	25	30	10	50	50	10
20	40	25	30	20	15	30	15	40	10
35	25	40	50	15	25	40	25	30	20
30	40	50	50	30	25	25	30	35	40
15	60	30	40	20	30	50	20	30	35
35	35	30	15	35	20	25	30	45	20
10	25	60	10	30	25	25	45	25	35
45	30	15	15	15	30	30	20	25	40
10	40	35	40	45	15	20	35	40	20
10	20	35	35	15	25	30	30	15	25

55	55	40	15	20	30	45	35	15	10	
20	20	50	20	70	60	65	40	50	30	
45	50	20	25	40	60	45	50	50	65	
70	60	75	40	45	50	45	65	10	45	
50	65	40	20	30	45	20	15	60	45	
15	55	70	50	30	50	45	45	30	20	
45	30	45	60	30	45	35	45	65	30	
55	40	35	45	20	65	55	35	55	25	
15	25	35	25	25	55	55	60	40	45	
25	45	50	35	45	65	45	40	55	45	
35	20	50	75	10	30	35	30	65	35	
30	50	20	45	30	40	65	20	25	35	N=330

Appendix E: Scores of Students of Teachers with Low Subject Knowledge

40	25	15	10	15	25	20	25	25	45
35	45	20	35	25	15	20	10	30	45

25	10	20	10	45	45	20	50	55	30
40	40	40	30	15	20	40	35	10	15
30	20	10	35	10	35	20	30	10	45
30	20	35	50	35	35	30	10	30	50
50	30	15	10	30	20	15	30	20	40
30	45	35	35	40	15	45	30	45	25
60	40	25	25	15	40	35	40	10	15
10	35	40	20	45	25	20	55	55	30
30	20	15	25	25	30	50	40	30	15
35	25	50	30	25	30	10	50	50	10
10	15	15	15	10	20	25	20	10	20
20	20	10	30	25	25	15	25	20	15
35	10	25	10	45	30	10	15	30	30
45	30	15	15	15	30	30	20	25	40
10	40	35	40	45	15	20	35	40	20
10	20	35	35	15	25	30	30	15	25
15	30	35	25	15	35	35	15	20	50
20	25	40	20	10	25	35	20	10	10

15	30	35	10	25	30	20	35	10	30	
15	35	35	10	25	25	25	30	20	25	
20	25	25	40	30	30	25	35	30	15	
20	20	20	15	10	30	55	45	40	30	N=240

Appendix F: Scores of Students of Teachers with High Subject Knowledge

50	60	35	30	35	25	45	25	30	40

20	20	50	20	70	60	65	40	50	30
45	50	20	25	40	60	45	50	50	65
70	60	75	40	45	50	45	65	10	45
50	65	40	20	30	45	20	15	60	45
15	55	70	50	30	50	45	45	30	20
45	30	45	60	30	45	35	45	65	30
55	40	35	45	20	65	55	35	55	25
15	25	35	25	25	55	55	60	40	45
25	45	50	35	45	65	45	40	55	45
35	20	50	75	10	30	35	30	65	35
30	50	20	45	30	40	65	20	25	35
35	55	55	40	60	60	55	30	30	30
30	35	50	15	60	40	40	15	25	30
15	10	35	35	25	35	75	15	45	10
20	40	25	30	20	15	30	15	40	10
35	25	40	50	15	25	40	25	30	20
30	40	50	50	30	25	25	30	35	40
15	60	30	40	20	30	50	20	30	35

35	35	30	15	35	20	25	30	45	20	
10	25	60	10	30	25	25	45	25	35	
55	55	40	15	20	30	45	35	15	10	
10	55	35	35	30	20	20	20	15	30	
25	45	40	50	20	20	40	20	20	40	N=240

Appendix G: Scores of Male Students of Low Pedagogical Knowledge (LPK)

35	55	55	40	60	60	55	30	30	30
30	35	50	15	60	40	40	15	25	30
15	10	35	35	25	35	75	15	45	10
10	55	35	35	30	20	20	20	15	30
25	45	40	50	20	20	40	20	20	40
50	60	35	30	35	25	45	25	30	40
40	40	40	30	15	20	40	35	10	15
30	20	10	35	10	N=75				

Appendix H: Scores of Female Students of Low Pedagogical Knowledge (LPK)

30	20	35	50	35	35	30	10	30	50
10	15	15	15	10	20	25	20	10	20
20	20	10	30	25	25	15	25	20	15
35	10	25	10	45	30	10	15	30	30
50	30	15	10	30	20	15	30	20	40
30	45	35	35	40	15	30	35	25	15
35	35	15	20	50	20	25	40	20	10
35	20	30	10	45	N=75				

Appendix I: Scores of Female Students of High Pedagogical Knowledge (HPK)

40	25	15	10	15	25	20	25	25	45
35	45	20	35	25	15	20	10	30	45
25	10	20	10	45	45	20	50	55	30
25	35	20	10	10	15	45	30	45	25
15	30	35	10	25	30	20	35	10	30
15	35	35	10	25	25	25	30	20	25
20	25	25	40	30	30	25	35	30	15
20	20	20	15	10	30	55	45	40	30
60	40	25	25	15	40	35	40	10	15
10	35	40	20	45	25	20	55	55	30
30	20	15	25	25	30	50	40	30	15
35	25	50	30	25	30	10	50	50	10
20	40	25	30	20	15	30	15	40	10
35	25	40	50	15	25	40	25	30	20
30	40	50	50	30	25	25	30	35	40
15	60	30	40	20	30	50	20	30	35

35 35 30 15 35 N=165

Appendix J: Scores of Male Students of High Pedagogical Knowledge (HPK)

10 25 60 10 30 25 25 45 25 35

45 30 15 15 15 30 30 20 25 40

10 40 35 40 45 15 20 35 40 20

10 20 35 35 15 25 30 30 15 25

55 55 40 15 20 30 45 35 15 10

20 20 50 20 70 60 65 40 50 30

45 50 20 25 40 60 45 50 50 65

70 60 75 40 45 50 45 65 10 45

50 65 40 20 30 45 20 15 60 45

15 55 70 50 30 50 45 45 30 20

45 30 45 60 30 45 35 45 65 30

55 40 35 45 20 65 55 35 55 25

15 25 35 25 25 55 55 60 40 45

25 45 50 35 45 65 45 40 55 45

35 20 50 75 10 30 35 30 65 35

30	50	20	45	30	40	65	20	25	35
20	25	30	45	20	N=165				

Appendix K: Scores of Female Students of Low Subject Knowledge (LSK)

10	15	15	15	10	20	25	20	10	20	
20	20	10	30	25	25	15	25	20	15	
35	10	25	10	45	30	10	15	30	30	
45	30	15	15	15	30	30	20	25	40	
10	40	35	40	45	15	20	35	40	20	
10	20	35	35	15	25	30	30	15	25	
15	30	35	25	15	35	35	15	20	50	
20	25	40	20	10	25	35	20	10	10	
15	30	35	10	25	30	20	35	10	30	
15	35	35	10	25	25	25	30	20	25	
20	25	25	40	30	30	25	35	30	15	
20	20	20	15	10	30	55	45	40	30	N=120

Appendix L: Scores of Male Students of Low Subject Knowledge (LSK)

40	25	15	10	15	25	20	25	25	45	
35	45	20	35	25	15	20	10	30	45	
25	10	20	10	45	45	20	50	55	30	
40	40	40	30	15	20	40	35	10	15	
30	20	10	35	10	35	20	30	10	45	
30	20	35	50	35	35	30	10	30	50	
50	30	15	10	30	20	15	30	20	40	
30	45	35	35	40	15	45	30	45	25	
60	40	25	25	15	40	35	40	10	15	
10	35	40	20	45	25	20	55	55	30	
30	20	15	25	25	30	50	40	30	15	
35	25	50	30	25	30	10	50	50	10	N=120

Appendix M: Scores of Male Students of High Subject Knowledge (HSK)

50	60	35	30	35	25	45	25	30	40	
20	20	50	20	70	60	65	40	50	30	
45	50	20	25	40	60	45	50	50	65	
70	60	75	40	45	50	45	65	10	45	
50	65	40	20	30	45	20	15	60	45	
15	55	70	50	30	50	45	45	30	20	
45	30	45	60	30	45	35	45	65	30	
55	40	35	45	20	65	55	35	55	25	
15	25	35	25	25	55	55	60	40	45	
25	45	50	35	45	65	45	40	55	45	
35	20	50	75	10	30	35	30	65	35	
30	50	20	45	30	40	65	20	25	35	N=120

Appendix N: Scores of Female Students of High Subject Knowledge (HSK)

35	55	55	40	60	60	55	30	30	30
30	35	50	15	60	40	40	15	25	30
15	10	35	35	25	35	75	15	45	10
20	40	25	30	20	15	30	15	40	10
35	25	40	50	15	25	40	25	30	20
30	40	50	50	30	25	25	30	35	40
15	60	30	40	20	30	50	20	30	35
35	35	30	15	35	20	25	30	45	20
10	25	60	10	30	25	25	45	25	35
55	55	40	15	20	30	45	35	15	10
10	55	35	35	30	20	20	20	15	30

25	45	40	50	20	20	40	20	20	40

N=120

Appendix O: Students Scores based on Teachers to students Ratio Students of HSK

47	47	49	60	40	44
33	50	26	31	45	25
20	30	33	51	53	41
53	39	35	35	425	345

N=24

Appendix P: Students Scores based on Teachers to students Ratio Students of LSK

6	6	10	6	7	4
11	7	6	4	5	5
6	5	7	13	10	7
8	9	12	10	13	7
10	11	10	8	13	12
18	16	16	14	12	15
11	10	11	39	36	43
36	31	36	26	N=46	

Appendix Q: Scores of Teachers with High Subject Knowledge (HSK)

71	64	66	76	72	67	73	75	66	89
84	71	63	61	71	67	62	65	73	73
61	63	82	67	N=24					

Appendix R: Scores of Teachers with Low Subject Knowledge (LSK)

44	57	46	59	57	57	47	53	51	40
16	52	59	44	47	55	26	19	46	56
18	45	51	33	59	43	55	57	45	47
58	59	54	56	59	57	59	57	57	49
57	59	54	53	58	54	**N=46**			

Appendix S: Score of Teachers with High Pedagogical Knowledge

67 66 61 67 65 68 69 64

68 67 63 **N=11**

Appendix T: Score of Teachers with Low Pedagogical Knowledge

57 56 59 56 57 N=5