ASSESSMENT OF TEACHERS' CREATIVITY IN TEACHING MATHEMATICS IN SENIOR SECONDARY SCHOOLS IN KEFFI LOCAL GOVERNMENT AREA OF NASARAWA STATE

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ABSTRACT

The purpose of this study was to assess teachers' creativity in teaching mathematics in secondary schools in Keffi LGA of Nasarawa State. One hundred SS2 students and ten mathematics teachers were selected from five senior secondary schools in Keffi LGA through stratified random sampling technique. The descriptive survey design was used. Two instruments developed by the researcher were used to collect the data. The Pearson's product moment correlation statistic was used to test reliability of the instruments to obtain the reliability coefficient of r = 0.87 for teacher's questionnaire and r = 0.74 for student's questionnaire. Three hypothesis were formulated and tested using t-test at 0.05 level of significance. The results revealed that there is no significant difference in the mean responses between male and female teachers' use of creativity in teaching mathematics. Also there is no significant difference between the mean responses of teachers' use of creativity in teaching mathematics on the basis of experience. There is significant difference between the mean responses of professional and non-professional teachers on use of creativity in teaching mathematics. The findings of the study revealed that, teachers used creativity assessment scale of originality, flexibility, fluency and motivation in teaching mathematics to foster creativity, but they rarely used fluency and no proper used of motivation component of creativity since; Mathematics teachers do not organize practical lessons for students in mathematics to enhance their performance, Mathematics teachers do not use audio-visual and computer-assisted instruction in teaching mathematics in their schools. Based on the findings it was recommended that Mathematics teachers should endeavour to relate mathematics concepts to real life situations by proper utilization of fluency and motivation.

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ABBREVIATIONS

SS 2 – Senior Secondary Two

SS3 – Senior Secondary Three

NECO - National Examinations Council

SSCE - Senior School Certificate Examination

WAEC – West African Examinations Council

NBTE – National Board for Technical Education

CAI – Computer-Assisted Instruction

FRN – Federal Republic of Nigeria

CHAPTER ONE

INTRODUCTION

1.1 The Background of the Study

The knowledge of science and technology is rooted in mathematics, which is achieved through creative teaching of mathematics. Mathematics is the foundation of all sciences, technology and modern development, and for any nation to survive and develop, that nation has to improve its technology which could only be achieved through the effective teaching and learning of mathematics (Azuka in Gimba and Agwagah, 2012). Nigeria, like most other African countries repose implicit confidence in the power of science and technology to salvage her from the ravages of poverty, ignorance and diseases, the three indices of under development (Gimba and Agwagah, 2012). The influence of mathematics on science and technology as well as other fields of human endeavour today cannot be under estimated.

Therefore, mathematics is an important subject that is needed at any level of education. Consequently, the National Policy on Education (FRN, 2004) prescribed mathematics as a core-subject in both primary and secondary schools and equally made it compulsory for students. According to Setidisho in Yusuf (2003) no other subject forms such a strong binding force among the various branches of sciences as mathematics. Without it, knowledge often remains superficial. Obi in Yusuf (2003) suggested that, because mathematics underlies the whole build-up and fabrics of modern science and technology, there should be a desire to break away from the teaching techniques and concentrate on developing students abilities to see the subject in the real life situation and to use their

knowledge to solve the problems arising from it. To achieve this goal, the teacher must be creative. Teaching creatively means teaching with variations and innovations. A creative lesson in mathematics is interesting, unconventional, productive and motivating. There are variation in teaching techniques, instructional materials, instructional activities and assessment. Creative mathematics teaching allows flexibility in adopting various pedagogical approaches that are suitable for students level of understanding and that are appropriate for the nature of the content (Eid, 2000).

Nevertheless, the advances in technology have made it possible for equipment and materials to be produced to make teaching and learning clearer, more appealing and interesting, enabling the learners to assimilate knowledge and skills faster. Thus, the provision and the use of instructional materials and equipment in the classroom call for the establishment of mathematics laboratories in secondary schools to enhance teachers creativity in mathematics. An undergraduate research conducted by Ityavzua (2008), on the establishment of mathematics laboratories and the implication for the teaching and learning of mathematics, revealed that lack of mathematics laboratories in secondary schools for practical and creative lessons in mathematics was one of the major problems affecting effective teaching and learning of mathematics. The problems result to poor performance of the students in mathematics examinations in the secondary schools as evidenced by WAEC key statistics about the year 2010 in comparison with that of 2011 and 2012, by chief Inspector, Area Inspectorate Office, Keffi, that candidates who obtained credit in mathematics and required admission into tertiary institutions in the respective years were 22.5% in 2010, 23.1% in 2011 and 21.8% in 2012 and NECO analysis from 2010-2012 shows 22.7% in 2010, 28.4% in 2011 and 20.6% in 2012.

Tahir (2003) noted poor teaching process exhibited by inexperience teachers as among the many problems affecting students performance in secondary schools in Nigeria. Adeyemi (2007) revealed that teachers' teaching experience was significant with learning outcomes as measured by their performance in SSCE. Meyer and Koehler in Iwendi and Oyedum (2012) revealed that it is reasonable to believe that lesser confidence or anxiety on the part of females is an important variable which helps to explain sex- related differences in the study of mathematics.

According to Yusuf (2003) majority of the related researches have attributed the poor performance of students in mathematics to acute shortage of qualified and competent mathematics teachers. Consequently, majority of the schools continue to rely heavily on teachers who lack sufficient understanding of mathematics to be able to ensure high students performance. Nevertheless, it has been noted that no attention has been given to assess teachers' creativity in teaching mathematics to enhance students performance. Research analysis on creativity in teaching mathematics is clearly overlooked in mathematics education research. Leikin (2011) reviewed research publications between 1999 and 2011 showed that the issue of creativity was neglected in mathematics education research and that research on creativity is still secondary to research on mathematical thinking, learning, and teaching. Two decades later, Mann (2006) noted that the lack of an accepted definition of mathematical creativity hinders research efforts. Analyzing discussions with prospective mathematics teachers' conceptions of creativity in teaching mathematics, Shriki (2009) argues that their knowledge about creativity is insufficient for a discussion of the subject. Bolden, Harries, and Newton (2010) analysed written questionnaires and semi-structured interviews with prospective elementary school

teachers about their conceptions of creativity and showed that these conceptions were narrow and associated with particular teachers' actions. Whitelaw (2006) evaluated Teachers' creativity on creative components, such as elaboration, originality, flexibility, and resistance to premature closure but did not include fluency and motivation in his work. An exploratory study by Lev-Zamir and Leikin (2011) using a qualitative research paradigm, through observations of lessons and individual semi-structured interviews with the teachers, analysed teachers' conceptions of creativity in teaching mathematics focusing on three components of creativity flexibility, originality, and elaboration but they didn't consider fluency and motivation as a component of creativity. It is, therefore, against this background that this study is being conducted to assess teachers' creativity in teaching mathematics in senior secondary schools in Keffi Local Government Area of Nasarawa State using creativity assessment scale of originality, flexibility, fluency, and motivation as a basis to enhance students' performances.

1.2 Statement of the Problem

The need to develop ourselves for scientific discoveries and technological break-through, sound knowledge of mathematics is what must be the concern of any nation. Despite that mathematics is made compulsory in our secondary schools, the percentage of successful results obtained from Senior School Certificate Examinations (SSCE) in Keffi local government area of Nasarawa State is not encouraging (see appendix B). This lead to fewer number of students who opted for the pursuit of mathematics as well as mathematics oriented careers when compared with other courses. Several reasons including teachers' quality and poor methods of teaching may adduced for the poor performances in mathematics. It is very obvious that if this problem is not given adequate

attention and investigation to provide solutions, this will seriously affect the development of this nation since it has been noted that mathematics is the foundation of all sciences, technology and modern development, and for any nation to survive and develop, that nation has to improve its technology which could only be achieved through the effective teaching and learning of mathematics Azuka in Gimba and Agwagah, (2012) . The problem will lead to insufficient and shortage of mathematics teachers, technologists and scientists. The trend of this problem and its effects on the development of this nation will continue. It is believed that the creative teaching of mathematics by teachers will go a long way in improving students' performances in the subject. It is however, uncertain as to whether there are adequate creative teachers of mathematics on the field with reasonable degrees of fluency, flexibility, originality, and motivation especially in Keffi Local Government Area of Nasarawa State to enhance students performance. In response to the above, this research assessed teachers' creativity in teaching mathematics in senior secondary schools in Keffi Local Government Area of Nasarawa State as a basis to enhance students' performances.

1.3 Purpose of the study

This research work assessed teachers' creativity in teaching mathematics in senior secondary schools. In specific terms the study sought to :

1 Assess the extent to which mathematics teachers use creativity in teaching

Mathematics.

2 Relate students assessment of their teachers use of creativity to that of teachers assessment of creativity in teaching mathematics.

3 Determine the extent of teachers' use of creativity in teaching mathematics between male and female teachers.

4 Compare teachers' use of creativity in terms of years of experience.

5 Compare the extent of teachers' use of creativity between professional and non-professional teachers.

1.4 Research Questions

This research work answered the following research questions:

(1) To what extent do mathematics teachers use creativity in teaching mathematics ?

(2) Is there any difference between students' mean score and teachers' mean score on the use of creativity in teaching of mathematics ?

(3) What is the difference between the mean scores of male and female teachers' use of creativity in teaching mathematics?

(4) What is the difference in the mean scores of teachers on the use of creativity in teaching mathematics based on experience ?

(5) What is the difference in teachers' use of creativity between professional and non-professional teachers in teaching mathematics?

1.5 Research Hypotheses

From the research questions stated, the following hypotheses were formulated and tested.

HO_1. There is no significant difference between the mean responses of male and female teachers on the use of creativity in teaching mathematics.

HO_2. There is no significant difference between the mean responses of teachers on the use of creativity in teaching mathematics on the basis of experience.

HO_3. There is no significant difference between the mean responses of professional and non-professional teachers on the use of creativity in teaching mathematics.

1.6 Significance of the Study

This study could provide a result that will help to improve the teaching of mathematics by mathematics teachers since they are often accused of preferring the use of chalk-and–talk method of instruction in teaching mathematics.

This study may also expose mathematics teachers to creative teaching components and techniques or methods in teaching mathematics as well as creative learning strategies for students as it has emphasise practical teaching in mathematics in secondary schools.

It is hoped that this study will expantiate the difference in ability between professional and non-professional teachers of mathematics. This is very significant because several researches confirmed that one of the major problems that demand the attention of curriculum reforms specialist is that, a large majority of science and mathematics teachers in Nigerian secondary schools are unqualified. The effect of this on school

system can be very enormous and even disastrous academically (Yusuf 2003). It implies that this research will produce a result that will help to make new policies by the government on the issues of unqualified teachers (non-professional teachers).

It will also provide government or administrators and other agency responsible for inspection services to education a critical criteria for inspection on the teachers' method of teaching to foster creativity.

1.7 Scope of the Study

This research work adopted Akinboye's Ibadan Creativity Assessment scale (ICAS) which measured originality, flexibility, fluency and motivation. The scope of participants in this research was restricted to senior secondary two (SS2) and mathematics teachers in Keffi local government area of Nasarawa State.

1.8 Operational Definition of Terms

The following are the definitions of terms that have been used for the purpose of this study:

Creativity: Creativity as used in this research means production of new teaching ideas and better ways of teaching techniques, procedures or methods and to design and use instructional materials in teaching of mathematics to foster originality, flexibility, fluency and motivation to make mathematics real to students.

Originality: Originality means producing statistically something new that is beyond what is written in books, producing new and innovative ideas that are suitable for a lesson and interesting to students, invention of personal teaching aids and activity to solve mathematics in different unusual ways.

Flexibility: Flexibility as used in this study means the use of different methods and procedures in solving mathematics problems to arrive at the same answer, and redirection of lessons in line with students entering behaviours or questions during the classes, changing ideas, approaching a problem in various ways, and producing the required solutions by the teachers in mathematics.

Motivation: As used here refers to intrinsic, task-forced motivation rather than the potential rewards; Frequent giving of assignment, class work, marking and giving feedback, organization of practical lessons, use of audio-visuals and computer instructions and starting teaching from simple to complex.

Fluency: Fluency also as used here relates to the continuity of ideas, flow of associations, and use of basic and universal knowledge. Teaching of mathematics topics that are connected, observed planed repetitions in solving problems, relating mathematics topics to real life situations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

To establish a basis for the research, this chapter has therefore, been devoted mainly on reviewing and referencing some studies that are relevant to the topic under consideration, thus the chapter has been organized logically below.

- Conceptual framework
- Theoretical framework
- Review of previous studies on teachers creativity in teaching mathematics
- Other related review of literatures

2.2 Conceptual Framework

Mathematical creativity in school children must refer to both mathematics and creativity and any definition of mathematical creativity in mathematics teaching must refer to mathematics, teaching, learning, and creativity. From the general literature on human creativity fluency, flexibility, originality, and elaboration are the main components of creativity in each and every field of human activity, including teaching mathematics. Mathematics creativity considering creativity components means; Fluency relates to the continuity of ideas, flow of associations, and use of basic and universal knowledge. Flexibility is associated with changing ideas, approaching a problem in various ways, and producing a variety of solutions. Originality is characterised by a unique way of thinking and unique products of a mental activity. elaboration relates to the ability to describe,

illuminate, and generalise ideas. The four components are mutually related, but not all of them need to be present at the same time. (Lev-Zamir & Leikin, 2011).

Teachers must be fluent in lesson management, including the explanations of mathematical ideas they provide for their students (Leinhardt in Lev-Zamir & Leikin 2011). Simon in Lev-Zamir & Leikin (2011) Teachers must be flexible in reacting to students' unexpected responses. Teacher originality throughout the school year and the ability to surprise their students increase student motivation. motivation of students' mathematical ideas is the main mechanism for moving with the students to a new mathematical territory (Lampert, 2001). At the same time, teaching mathematics should be aimed at developing students' learning and knowledge to enable fluent problem solving, flexible mathematical reasoning, the generation of original ideas, and the elaboration of others' mathematical thoughts (Even, Karasenty, and Friedlander, 2009). Fluency, flexibility, originality, and elaboration also characterise creative problem solving and problem posing in mathematics (Mann, 2006). There is evidence, however, that teachers' ideas about creativity are limited. A child activates imagination when connecting new and previously known concepts, elaborating the known constructs, or developing abstract ideas. Creativity is a basic component of knowledge construction (Bolden *et al*.,2010).

According to Shuaibu (2012) creativity is something every one possesses, though in varying degrees. The environment unfortunately fails to provide the proper nourishment for its growth. Crutchfield in Shuaibu (2012) observed that creativity could be neglected under two implicit assumptions, which are ill founded and incompatible; There is assumption that creative potentials cannot be trained and so they do not need to be

trained. It is also assumed the marked individual differences in creativity found in all ages, may not be readily susceptible to modification. Most teachers therefore seem to conclude that creative potentials cannot be taught and such potentials are capable of disrupting classroom lessons and should therefore be discouraged. “I share the view that the assumptions are merely made because of the influence of the conventional curriculum and teaching methods which have their heavy stress upon the authority of established knowledge”. Literatures abound that educators, particularly counsellors and psychologists, go to the extent of testing students intelligence and even speed in checking numbers and names of the students. None of them bothered about the few creative students and how they could become maximized intellectually (Shuaibu, 2012).

A creative person whether a musician, an artist, primary has the objective of solving particular problem, in a noble way. The creative thinking of Roland Amadi was demonstrated in 1973 when he built a model of Aeroplanes to mathematical specification. A teacher who devices a new conversional method of teaching to replace the traditional methods are all creative. Creativity is therefore a deeper self. It is an inherent in all healthy individuals, all we need to do is to nurture it. Creativity is the openness of an individual to the world around him. This is why creativity is seen as a special quality possessed by few individuals, men and women who have an outstanding contributions in arts or sciences. In view of this, Parnes therefore saw creativity as “ a rare and unique talent in a particular field of endeavour ” . This is correct to some extent if viewed from the fact that our focus is mainly on intelligence (Ortese, 2009). Shuaibu (2012), “I will like to suggest that creativity may not be observed for few if creativity is traced as part of school system, and given the required attention. Every student has inherent creativity that

can be developed in them; all they need is little stimulation or assistance, encouragement and healthy environment, filled with enriching materials to spur its development

2.3 Theoretical Framework

Several theories have been pounded in the area of teaching and learning which emphasise on creativity of a teacher by different scholars in the field of education but this study describes only three theories that involves creativity in teaching of mathematics.

The Puzzle box Experiment

Thorndike in Okereke (2007) developed a theory of learning using a hungry Cat. A hungry Cat was locked in a "puzzle box" with slits through which the Cat could see a dish of food on the floor outside. A string from the door latch led over a pulley to a wire loop hanging in the box. If the Cat clawed at the loop, the door would open and the Cat could escape from the box and eat. When put in the box, the hungry Cat actively scrambled around scratching and clawing at the sides of the box. Eventually in its random movement around the box, it happened to pull the loop, thus opening the door and escaping. Thorndike then put the Cat back in the box for the second trial. Again the cat scrambled around until it accidentally pulled the loop, escaped and was then put back in the box for the third trial. Thorndike and the Cat kept this up for many trials. The Cat took less and less time to pull the ring each time it was put back in the box. Eventually it escaped almost as soon as it was put into the box. Thorndike argued that the problem was solved in a very different way. The classroom application of Thorndike's theory suggested that;

(1) School activities should be organized in an increasing difficulty in order that students may progress without any failure.

(2) Materials should be provided in a varied ways so that flexibility may be maintained

(3) Guidance, praise and encouragement that give pleasure and satisfaction of knowing that one is on the right part should be properly used (motivation).

(4) More and more opportunities should be given to students to use and repeat the knowledge they get in the class (fluency).

(5) Drill plays an important role in learning.

Classical Conditioning Theory

The theory of classical conditioning by Pavlov in Okereke (2007) thus involves the association of two stimuli, one initially neutral in that it elicits no responses called conditioned stimulus. Pavlov explained the distinction between unconditioned and conditioned reflexes. Unconditioned reflexes he held to be essentially inborn and innate ; these are unconditionally elicited by the appropriate stimulus regardless of the animal's history, example food in the mouth which unconditionally elicited salivation. In contrast, conditional reflexes were acquired, this they were conditional upon the animal past experiences and according to Pavlov, base upon newly formed connection in the brain. Pavlov experiment using the Dog produced results which is used in learning in the classroom. That learning as a process of conditioning entails the establishment of bonds between the stimulus and appropriate responses. Here, the teacher can be regarded as the natural stimulus i.e. (food in the Pavlov's experiment) while knowledge which they impact is the conditioned stimulus i.e. (bell) in the process of teaching and learning

situation. The teacher's personality together with the totality of the methods and strategies of impacting knowledge to the learners are very important.

- The teacher must make his lessons enjoyable and interesting. It is when they are done that appropriate responses could be made by learners (originality).
- The teacher must identify the needs of the learners and learning should be made pleasurable with definite use of teaching aids (Originality).
- The teaching of a concept must be repeated and revisited by the teachers while teaching (Flexibility).
- The concept of generalization and discrimination are also important in the learning. As a learner is expected to apply or generalize knowledge gained in one situation to solving of problems in another situation (flexibility).

Operant Conditioning Theory

Skinner in Okereke (2007) proposed his theory of operant conditioning. The use of pleasant and unpleasant consequence to change behaviour is often referred to as operant conditioning. Skinner's work focuses on placing objects on controlled situation and observing the changes in their behaviour produced by systematic changes in the consequences in their behaviour using his apparatus called skinner box. According to skinner, education is the learning of certain responses that will be useful to the learner later in life and reinforcement is the cornerstone of operant conditioning. Behaviour that we wish repeated in the learner must be reinforced. He maintains that the teacher must use techniques that produced meaning behavioural changes. The concept of shaping behaviour can be applied to the classroom setting. Here the teacher may break the desired behaviour into components tasks and each stage or step is reinforced. Reinforcement will

continue till the last response is made correctly. This process can be applied to the steps in answering questions in mathematics, where the whole process is broken into steps and each step attracts a certain marks. However, a step-by-step method of arrival at a designed behaviour in the learner should grow out of ties with the previous knowledge of the learner. Hence, learning should proceed from know to unknown and simple to complex. It is advisable to use teaching aid so as to concretize learning. This dealt with the motivation component of the creativity.

2.4 The Concept of Teaching Mathematics

Mathematics teaching is an interaction between the teacher and the learners that leads to acquisition of desirable mathematical knowledge, ideas and skills necessary for applicability in our everyday life (Tali, Mbwas, and Abe, 2011). Kalu in Yusuf (2003) Teaching is an activity which enables pupils or learners to learn and acquire the described knowledge, skills and disposition necessary for becoming functional members of the society. Bidwell in Yusuf (2003) viewed teaching as a series of interaction between the teacher and the learners with the explicit goal of changing one or more of the learner's cognitive or effective states. Therefore, mathematics teaching can be seen as the interaction between the teacher and the learners to acquire the described mathematical knowledge, skills, ideas necessary for becoming functional members of the society.

Mathematics teaching today primarily takes place within a professional framework. However, teaching mathematics is a complex and demanding process. Even though being professional is a condition for its success, it is not sufficient. The complexity is successfully resolved by relating mathematics to other sciences. That way we get a

process which has to take place harmoniously within several frameworks. The main frameworks are language frameworks, professional frameworks, methodology frameworks, scientific frameworks, pedagogical frameworks and psychological frameworks. From the comparison mentioned we can easily conclude that scientific methods are important for modern mathematics teaching. That is why they are the subject of research in modern mathematics teaching methodology. Through the selection of appropriate problems and through the application of that method a creative teacher can prepare students for work which is very similar to research work, work of a scientist. Plenty of mathematics teaching content can undergo such application thus meeting the science principle in its extent (Odili, 2006).

2.4.1 Problems of Teaching Mathematics in Secondary Schools

Despite the effort of the government on the development of mathematics teaching and provision of opportunities for the improvement of teaching, there are still problems in mathematics teaching and learning. Odili (2006) outlined some of these problems as follows:

(1) Lack of curriculum integration.

(2) Shortage of mathematics teachers.

(3) Lack of instructional materials.

(4) unqualified teachers (non-professional)

(5) Poor government policy.

(6) Poor classroom organization by teachers.

(7) Lack of equipped mathematics laboratory for practical.

(8) Over population of students which may impedes effective demonstration during practical.

(9) Teachers impatience and un-preparedness.

(10) Poor remuneration of teachers.

(11) poor teaching Methods

Looking at the numerous achievements recorded in mathematics education in Nigeria in the 21st century, there are more challenges ahead of mathematics teaching. There have been efforts in mathematics curriculum development to correct these problems, but there appears to be more challenges in mathematics teaching and learning (Tali, *et al.*, 2011). These numerous problems in teaching mathematics affects students performance in examinations, thus, the researcher decided to investigate some of these problems in other to enhance the students performance and teachers teaching skills in mathematics.

2.5 History of the Study of Creativity

Historically, the study of creativity was shrouded in several romantic myth. The first approach to the study of creativity was based on divine inspiration. The creative person was seen as empty vessel, that a divine being God would inspire. The individuals would then pour out the inspired ideas forming another worldly product, (Sternberg and Lubart in Ortese, 2009). Another approach linked creativity with the concept of a genius. It was seen as a rare mysterious phenomenon occurring only in people who were geniuses. These were believe to be people who have rare extraordinary personality characteristics

that enable them to be creative. Thus , only these could be creative (Weisberg in Ortese, 2009). Creativity was also linked with insanity (neuroticism). That is, it was considered that only those who were insane could be creative. Thus creativity was linked with one mental disorder (neurosis) or the other. However, the study of British geniuses in 1904 found only a small portion of the subjects with neurotic or psychotic disorders or tendencies. Another approach linked creativity to those who have high intelligence quotient (IQ). However Terman's study of 300 eminent personalities such as artists, scientists, and engineers, proved that just a few of them had high IQ of 17-200. The average was 135, some had low 100-110 .The above mystical approaches and romantic myths made people to believe that creativity is something that does not lend itself to scientific approach of study (Ortese, 2009).

However, according to Animashaun (2002), conscious consideration of the field of creativity began in the late 19th century, when the creative aspects of mind and of will engaged the attention of all the major philosophers and psychologist of the people and early 20th century, such as Sigmund Freud, Alfred Binet, and Carl Jung. Creativity was seen as a process from then on. Wallas in Ortese (2009) proposed four main stages of creativity process: preparation, incubation, illumination and verification. This prepared the stages for later process models of creativity to emerge. Yet, by 1950, only 186 out of 121,000 entries of psychological abstracts in U.S.A. dealt with creativity imaginations. Against this background, J.P. Guilford, the then president of the American Psychological Association (APA), strongly challenged psychologists to pay attention to what he found to be a neglect, but extremely important attribute, creativity. From then on, a systematic research effort was turned to the study of creativity, leading to series of paradigms,

techniques, tools and test of creativity. For instance, studies at the university of California of high creative contemporary writers, architect, artists, mathematicians, and scientists by the use of intensive methods of personality assessment, contributed important impetus to the study of personality and creativity. These research works were funded mostly by foundations such as Carnegie, Ford, Rockefeller, and Richardson (Ortese, 2009). Also, the US office of education gave significant support to research on creativity in education (Barron and Harington in Ortese, 2009). The creativity attributes (fluency, novelty, flexibility, and originality) that Guilford identified formed the bases of new creativity tests on creativity assessment. For instance Torrance's Test of Creativity Thinking (TTCT) as well as Akinboye's Ibadan Creativity Assessment Scale (ICAS) measure: Originality, Flexibility, Fluency and creativity motivation (Ortese, 2009).

2.51 Background of Creativity in Education

The application of the concept of creativity in educational started in England, According to Craft (2001) there have been two recent periods in which creativity has been recognized as a desirable aim for inclusion in the curriculum, particularly in primary education. The first was in the 1960s with the publication of the Plowden Report and the second during the late 1990s. The first period linked creativity to a particular, child-centered, discovery-based pedagogical approach and to the arts. But it was this 'free' approach to creativity which formed part of the critique of child-centered education practices by the Black Paper writers and which, arguably, laid the way for the introduction of a subject-content-based national curriculum at the end of the 1980s. In addition, some thought that many schools were implementing the Plowden ideas incompetently Alexander in Craft (2001).

However, since the mid 1990s, there has been a growing recognition from policy-makers and commentators alike that learner creativity is an extremely important aim for education. The economic imperative to foster creativity in business has helped to raise the profile and credentials of creativity in education more generally. During the recent review of the National Curriculum (Curriculum 2000), the Secretary of State for Education and Employment set up a number of advisory groups to provide input into the debate. One of these groups was the National Advisory Group for Creative and Cultural Education (NACCCE), which submitted its final report in 1999. The report contained a wide range of recommendations, which called for further work and investigations into creativity and cultural education (Craft,2001).

2.5.2 Creativity in Mathematics

Creativity can be seen as the ability of man to establish new relationships to change reality. So, mathematical creativity can be seen as the mental activity in the area of mathematics education which is directed towards establishing new relationships – which go beyond those given – in a non-routine mathematical situation. Teaching creatively means teaching with variations and innovations. A creative lesson in mathematics is interesting, challenging unconventional, productive and motivating. There are variation in teaching techniques and materials, instructional activities, and assessment. There are innovations in designing teaching aids, selecting activities and evaluation. Teachers can employ approaches that facilitates students' participation and active interaction. Creative mathematics teaching allows flexibility in adopting various pedagogical approaches that are suitable for students level of understanding and that are appropriate for the nature of the content. Flexible teaching shift between students centred approach and the teacher-

students interactive approach. The students-centred approach emphasis students ability to discover and construct new knowledge. Active participation of students is encouraged. activities are designed to explore students' competencies in various domains. Students learn to evaluate their performances and the achievements of their peer. They are giving opportunity to voice opinions and present ideas. The teacher-student approach emphasis guiding learners to optimal performance and development. They are active interactions between teachers and students. The teacher-students interactive approach highlights teachers' assistance, guidance and hint, whereas the students-centred approach emphasis the discovery of knowledge by individual students. The two approaches consider learning in various contexts and recognize interpersonal interaction (Eid, 2000).)

Levi (2007) explored the concept of creativity in mathematics in the context of multiple solutions task, in this, flexibility refers to number of different solutions generated by a solver. Novelty refers to the conventionality (relative to a specific curriculum) of suggested solutions, fluency refers to pace of solving procedures and switches between difference solutions. According to Levi, there are many open questions about the development of creativity which arise in at least two contexts of creativity in mathematics;

Fostering students creativity: it has become place for educators to accept that the goal of mathematics education is more than the mastery of a body of algorithms and methods. Mathematics is an idea training ground for the development of logical reasoning on students. It is less widely accepted in the field that mathematics is also a training ground for creativity. Some questions associated with the notion of creativity in mathematics might be :

1. Can creativity be actively fostered in the classroom ?
2. What classroom techniques lead students to exercise their minds creatively ?
3. What areas of mathematics lend themselves most to students' independent exploration ?
4. What must teachers know or do, in order to support students in developing their creativity in mathematics ?

These are questions that can be asked with regards to students and classrooms on any ability level and any age level.

Fostering creativity in teaching: a second context in which we may discuss the phenomenon is in the context of teaching. The act of teaching may itself be ordinary or creative, standard, or novel. A teacher may simply follow the textbook. A more creative teacher might give her own examples that illustrate the point in the textbook. A more creative teacher might invent his own explanations or activities to convey a concept or method and there are certain levels of creativity above this one. Questions about creativity in teaching might be the same as those about creativity among students but additional issues come up in this wider context:

1. How does creative teaching interact with the need to be standardized, to measure, to be held accountable ?
2. How do we manage teachers or schools to allow for creativity to emerge ?
3. What are the role of creative teachers in the classroom ? in the school ? in the profession?

2.5.3 Components of Creativity in Teaching Mathematics

Creative teaching is comprises of various components given by different authors . according to Tan(1998) there are at least six components of creativity in mathematics. the first component is refers to basic pedagogical skills such as lesson planning,

communication, classroom management and evaluation. The second component is directed to the domain of specific expertise, creative techniques and knowledge of developmental processes. The third component is related to the competence in selecting appropriate assessment modes. The forth component refers to the teachers and students motivation. Intrinsic motivation is an indispensable component (Amabile in Tan, 1998) as it is generates an on-going commitment. The fifth and sixth components are related to the learning climate and the school environment: educational policies influence school learning climates.

If creative and critical thinking is one of the educational concerns, teachers and principals may pay more attention to developing students' problem solving skills and creative competence. They are like to adopt an unconventional approach to teaching. If examination results constitutes the hallmark of education, schools are likely to be one of the major learning activities. Creative teachers are able to co-ordinate the various pedagogical components. Fundament components are such as the teachers' content knowledge, creative techniques, assessment modes, and individual needs. Teachers understanding of mathematical concepts should be enriched with the knowledge of child and adolescence psychology. Teachers should be aware of developmental processes of various ages groups. They should investigate how students understand mathematical concepts. If teachers understand students' cognitive and behaviors, they are like select appropriate teaching materials and design suitable teaching aids. Teachers should acquire various creative techniques. They should know conditions that stimulate creativity, the brainstorming techniques, for instance allow students to generate ideas in a non-threatening environment. Problem solving enable the students to use information

available to search for possible solutions. Creative techniques are modified according to students' need and psychological development Tan, A.G.(1998).

According Guilford and Torrance in Lev-Zamir and Leikin (2011), the general literature on human creativity refers fluency, flexibility, originality, and elaboration as main components of creativity in each and every field of human activity, including learning and teaching mathematics. According to Akiboye in Ortese (2009) creativity components refers to originality, flexibility, fluency and motivation in all the field on human activity including teaching of mathematics.

2.5.4 An Overview Of Creative Mathematics Lesson

A creative mathematics lesson maintain students learning interests, stimulates students thinking and encourages students to discover new knowledge. Individuals need of the students are considered. It is indispensable to arouse students interest in mathematics at younger age Smith in Levi (2007). Motivation is one of the prerequisite conditions for continuous learning and self-education. Mathematics can be an interesting subject, if teachers can associate this subject with student pleasant learning experiences. Learning mathematics does not confine to memorizing formulae. In a survey, primary pupils were asked to list activities of mathematics lessons that brought forth fun. A group of 33 primary two pupils (average ages 8.6 years) reported that they enjoy activities related to learning fractions (60.6%), using abacus (48.5%), and mental sums (9.1%). The comment of a primary two girl (8.4 years old) is "I like abacus it is fun and interesting. We have to use the right fingering or else we will have to start all over again. I like abacus very much". Teachers employed the abacus as a pedagogical instruction, allowing pupils to learn new concepts with concrete objects. Reasons of two primary pupils who liked

fractions are cited, “I like fractions because I cut things in to two quarters and half” (male, 8.3 years old). “I like fractions because I made a whole, half and quarter” (female,8.6 years old) playing brings joy and fun. Quizzes , games and puzzles with rewards were favourable activity of the group of 63 primary five pupils (average age 11.1 years). These activities provide them the opportunities to share, to discover, and to interact with peer. Learning that brings pleasant experiences is likely to generate satisfaction. When a lesson is interesting and enjoyable, it is likely that pupils would develop positive attitudes toward learning. An activity that is not fun but ineffective is an undesirable pedagogical activity. A creative pedagogical activity should observe guide lines for an effective instructional activity (Levi, 2007)

2.5.5 Creative Ways to Teach Mathematics

There are many so many creative ways that a creative teacher can adopt the in the classroom to teach and foster creativity like the ten creative ways Adapted from the Building Blocks project's *DLM* Early Childhood Express Mathematics by (Clements & Sarama, 2003). Here are some activities for your classroom to add a bit of sparkle and creativity. As learners work, ask critical questions such as "Did you try this?" "What would have happened if?" "Do you think you could?" to enhance learner's understanding of mathematical ideas and vocabulary ;

1. **Use technology.** Try digital cameras to record children's mathematical work, in their play and in planned activities, and then use the photographs to aid discussions and reflections with children, curriculum planning, and communication with parents. Use computers wisely to mathematise situations and provide individualized instruction

2. **Use dramatizations** . Invite children pretend to be in a ball (sphere) or box (rectangular prism), feeling the faces, edges, and corners and to dramatize simple arithmetic problems such as: Three frogs jumped in the pond, then one more, how many are there in all?

3. **Use children's bodies.** Suggest that children show how many feet, mouths, and so on they have. When asked to show their "three arms," they respond loudly in protest, and then tell the adult how many they do have and show ("prove") it. Then invite children to show numbers with fingers, starting with the familiar, "How old are you?"

4. **Use children's play.** Engage children in block play that allows them to do mathematics in numerous ways, including sorting, seriating, creating symmetric designs and buildings, making patterns, and so forth. Then introduce a game of Dinosaur Shop. Suggest that children pretend to buy and sell toy dinosaurs or other small objects, learning counting, arithmetic, and money concepts.

5. **Use children's toys.** Encourage children to use "scenes" and toys to act out situations such as three cars on the road, or, later in the year, two monkeys in the trees and two on the ground.

6. **Use children's stories.** Share books with children that address mathematics but are also good stories. Later, help children to see mathematics in any book.
7. **Use children's natural creativity.** Children's ideas about mathematics should be discussed with all children. Here's a "mathematical conversation" between two boys, each 6 years of age: "Think of the biggest number you can. Now add five. Then, imagine if you had that many cupcakes. " Wow, that's five more than the biggest number you could come up with!"

8. **Use children's problem-solving abilities.** Ask children to describe how they would figure out problems such as getting just enough scissors for their table or how many snacks they would need if a guest were joining the group. Encourage them to use their own fingers or be manipulative or whatever else might be handy for problem-solving.

9. **Use a variety of strategies**. Bring mathematics everywhere you go in your classroom, from counting children at morning meeting to setting the table, to asking children to clean up a given number or shape of items. Also, use a research-based curriculum to incorporate a sequenced series of learning activities into your program.

10. **Use assessments to measure children's mathematics learning.** Use observations, discussions with children, and small-group activities to learn about children's mathematical thinking and to make informed decisions about what each child might be able to learn from future experiences. Also try computer assessments. Use programs that assess children automatically.

2.5.6 Review of Previous Studies on Teaching Creativity in Mathematics

In mathematics education, Lev-Zamir & Leikin (2011) carried an exploratory study on teachers conception of creativity in teaching mathematics using a qualitative research paradigm. Through observation of lessons and individual, semi-structured interviews with the teachers, analyses teachers' conceptions of creativity in teaching mathematics focusing on three components of creativity flexibility, originality, and elaboration. The report showed that the activities described by some teachers as examples of creativity in teaching mathematics would not have been recognized as such by them without the teachers' explanation. The findings from their work which were regarded as creative

teaching techniques on the flexibility, originality were used in developing the instrument for this research. In their work they didn't consider fluency and motivation as a component of creativity, that is they did not completely use Akinboye's Ibadan Creativity Assessment Scale (ICAS). Therefore this research work is built on findings of Lev-Zamir & Leikin exploratory research work. Fluency and motivation component of creativity is included in this work as a survey research carried out as an assessment of teachers' creativity in teaching mathematics in senior secondary schools.

Whitelaw (2006) evaluated Teachers' Creativity on creative components, such as elaboration, originality, fluency, flexibility, and resistance to premature closure but did not include motivation in his work.

Another evaluative study conducted by Whitelaw (2006) on Teachers' Creativity, on the use of the Heuristic Diagnostic Teaching Process and Student Mathematics Performance indicated that teachers need professional development in identifying creative characteristics of their students.

Also a research conducted by Yashin-Shaw (2001) on a cognitive model for understanding creative thinking, revealed that creative solutions evolved through the iterative and interactive deployment of cognitive components and not in a linear or cyclical way as proposed by a number of other models explaining creative thinking. Cognitive categories and procedures were deployed with varying frequencies at different times during the problem-solving process according to task demands. However, no category of thinking had exclusive association with any particular stage of the process. Rather, solutions were 'built up' as a result of cognitive activity switching among the

categories of executive control, generation, exploration and evaluation and their characteristic procedures.

Pelfrey (2011) also conducted a research on classroom behaviours in elementary school teachers on the activities identified as fostering creativity at Northern Kentucky University and revealed that teachers should also encourage collaboration, a risk-free environment, and use inquiry to facilitate learning, connect learning to students' lives, tie the arts into everyday learning for all students, and accept more than one right answer during instruction. Likewise other researchers, Pelfrey did not carry out research using creativity components of originality, fluency, flexibility, and motivation of Akinboye's Ibadan Creativity Assessment Scale (ICAS). Nevertheless, all these researchers are foreign ones. In the light of the above statement, this research assessed teachers' creativity in teaching mathematics in senior secondary schools in Keffi LGA of Nasarawa State as a basis to enhance students' performance in mathematics and Nigeria at large.

2.5.7 Creative Teaching Methods (indirect methods)

Creative teaching is the teacher's ability to foster not just knowledge (content) in learners but also attitudes and cognitive skills (higher-order skills or divergent thinking) necessary for their creative and innovative performance in real life. Teaching content (knowledge) is a simple activity of the subject teacher, for skills fostering is just an added responsibility but a specialized teaching skill. This explains why Tucker in Gable (2002), insists that creative teaching requires that the teacher must be a creative person, before he/she can teach creatively. According to Gable (2002) creative teaching involves

teachers ability to the following in the normal subject teaching in the class in order to do encourage creativity in students through the following methods:

1. Recognize and value creative traits in students.
2. Provide stimulating environment that will engage learners' senses.
3. Encourage manipulation of ideas and objects.
4. Encourage divergent thinking.
5. Encourage problem-solving-approach.
6. Encourage idea generation activity, debates and brainstorming.
7. Encourage exploration, manipulation and experimentation skills.
8. Reward creative thinking, work, interests and efforts.
9. Evaluate students' creative work constructively.
10. Provide choices (materials) for students to select based on their interest and abilities.
11. Entertain and respect questions, suggestions, opposing or unusual view of the students.
12. Encourage curiosity, persistence and open mindedness.
13. Provide active and quit periods for reflections.
14. Teach how to test new ideas.
15. Create active classroom atmosphere

2.6 Assessment and creativity

According to Ortese (2009) there is very little record and assessing creativity in the literature although in the field of psychometrics, creativity tests were historically used, for example those developed by Akinboye in Ortese (2009) Akinboye's Ibadan Creativity Assessment Scale (ICAS) measured ideative originality, ideative flexibility, ideative fluency and motivation.

Adedipe in Ortese (2009) gave on unanimous criteria to be used to assess creativity as follows.

Novelty : the production must be new and uncommon

Original : it must be an original work of the creator without duplicating another person's earlier work.

Flexibility : the product must be seen to be easily applicable to other situations, problems or environment too.

Fluency : many ideas, concepts, interests are catered for in the new product.

Torrance in Ortese (2009) described four components by which individual creativity could be assessed:

- ✓ fluency: the ability to produce a large number of ideas
- ✓ flexibility: the ability to produce a large variety of ideas
- ✓ elaboration: the ability to develop, embellish, or fill out an idea
- ✓ originality: the ability to produce ideas that are unusual, statistically infrequent, not banal or obvious.

2.7 Hemispheric Theory of Creativity and Mathematics

From the field of psychology, understanding and explanations of the phenomenon called creativity differs among psychologists. Similarly, a number of theories or psychological approaches guide the study and understanding of creativity. Each theory has its different views of human nature, growth and development. Each has different constructs and relationship to explain creativity. Still, each has something to offer those involved in developing others' creativity. This theory centers on the portion of the human brain in to two different but complementary aspects, the left and right cerebral hemispheres as the basis for creativity act. Within the frame work of hemispheric theory, each half of human brain is said to be responsible for a distinct mode of thought, the left cerebral hemisphere is specialized for thought processes such as verbal, sequential, logical, language , reasoning, and analytical Bogen in Ortese (2009), whereas the right cerebral hemisphere is specialized for thought patterns and which emphasis perception, synthesis, spiritual, lyrical, sensuous activity and the holistic rearrangement of ideas .

The left hemisphere is sometimes referred to as "linear side" because the thought modalities tend to be serially linked together in ordered linear patterns. The right side which is non-linear side consists of a more unordered organic thought modality. Linear thinking is sequential, additive, precise and reductionist and mostly applicable to situations which required order and system. Creative people use the RIGHT side of their brains more than the LEFT (Owolabi in Ortese, 2009).

The figure 2.1 shows the Hemispheric Theory of Creativity, right brain verses left brain

2. 8 Gender difference in Teaching Mathematics

There is indeed no doubt that in any society in the world, men and women, boys and girls, are assigned different roles as dictated by the culture of the people. This therefore, shows that to a greater extent, the differences in the behaviours of males and females are mainly socially determined rather than biologically or genetically influenced (Iwendi and Oyedum,2012). Archibong in Iwendi and Oyedum (2012) sees gander as rather being socially oriented and therefore dynamic. Thus, this has led many researchers to examine gender differences right from time measures of intellectual ability were first developed (Abiam and Odok in Iwendi and Oyedum, 2012).

The woman has lived in the shadow of her male counterpart and this has over centuries created a psychological complex in the minds of the society which thinks the female gender is made to play a second fiddle. Unfortunately, the school which is supposed to be an agent of socialisation and orientation has not been able to do much in this respect but,

rather has widened the gap that existed in the intellectual ability of males and females (Iwendi and Oyedum, 2012) . School which is supposed to be a mini-society imbibes the culture of the large society and therefore, relegates female to the background (Iwendi and Oyedum, 2012).

Nevertheless, a lot of interest has generated on the study of gender in Nigeria and worldwide as pointed out by Boloji in Yusuf (2003). Other studies like Fennema and Carpenter in Yusuf (2003) have Observed no significant difference or approximately equal teaching ability between male and female teachers. For the above reasons the researcher have been prompted to examine critically the issues of gender differences in teaching and learning mathematics to know the impart made by male and female teachers to student on the bases of gender. Callahan and Clement in Iwendi and Oyedum (2012) pointed out that girls perform in mathematics the same with boys in the elementary schools but decreases in the middle school. Also Hanna in Iwendi and Oyedum (2012) found out that, in some countries, girls were more successful than boys while in other countries the opposite was true. Therefore, She opposed the theories that attempted to explain boys superiority in mathematics on the basis of biological differences. According to Meyer and Koehler in Iwendi and Oyedum (2012) it is so reasonable to believe that lesser confidence or anxiety on the part of females is an important variable which helps to explain sex- related differences in the study of mathematics. For the above reasons the researcher considered the gender as a variable in this study.

2.8.1 Professionalism as a Problem of Teaching Mathematics

According to Yusuf (2003) majority of the related researches have attributed the poor performance of students in mathematics to acute shortage of qualified and competent

mathematics teachers. Kelejarye in Yusuf (2003) observed that, post-primary institutions in Nigeria are starved with mathematics teachers. Very few graduates specialising in mathematics are produced every year by the universities. Consequently, majority of the schools continue to rely heavily on teachers who lack sufficient understanding of mathematics to be able to ensure high students performance.

Fakuade in Yusuf (2003) educational authorities at National, State and local level, have not paid adequate attention to the training of teachers in science and mathematics. In the same vein, most of the teachers who are now ask to teach mathematics in secondary schools are not qualified to handle the subject, as they lack the necessary professional training required of a teacher. There are two equally important aspect of any profession, significant knowledge and effective technique. One cannot be efficiently professional if there is any distinct weakness in either aspect. A truly functional programme of professional preparation must, therefore, place emphases on the acquisition of knowledge significant to the chosen profession and also on the acquaintance with and use of the efficient techniques of that profession (Fakuade in Yusuf, 2003). This is true of the nature of mathematics teaching in secondary schools in Nigeria today. The majority of mathematics teachers are ill-prepared and non-professional. Several researches confirmed that one of the major problems that demand the attention of curriculum reforms specialist is that, a large majority of science and mathematics teachers in Nigerian secondary schools are unqualified. The effect of this on school system can be very enormous and even disastrous academically (Yusuf, 2003). This research produced a result that will help to make new policies by the government on the issues of unqualified teachers (non-professional teachers).

2.8.2 Influence of Teachers' Experience in Teaching Mathematics

There are many factors that influence teachers ability to teach and foster creativity effectively in the classroom and impact effective mathematics concepts to the students. There are numerous factors and activities that account for teachers' creativity in teaching mathematics. The excellence of teaching mathematics depend on many factors among which are the teacher, course content, motivation and the teaching experience. The teaching experience is the major factors among the factors which account much on the teachers' creativity in teaching mathematics (Nelson in Akintoye and Aregbede, 2012). Car in Akintoye and Aregbede (2012) examine the effects of teachers characteristics such as teachers teaching experience and concluded that teachers education, certification and teaching experience are not strong predictor of teachers' effectiveness.

Aaroson, Barrow and Sander (2007) noted that ninety percent of variance in teachers influence on students learning was not explained by characteristics such as teaching experience. Also Johnson in Omer (2011) caution that lack of teaching experience is not necessarily an indication of a teachers' ability in teaching mathematics. Whereas as Adeyemi (2007) examined teachers' teaching experience on students learning outcomes in secondary schools and revealed that teachers' teaching experience was significant with learning outcomes as measured by their performance in SSCE, schools with five years and above teaching experience achieved better results than schools having more teachers with less than five years teaching experience. Therefore, relevance of teaching experience by mathematics teachers in teaching and learning cannot be over emphasized.

2.9 Summary

The review of the related literature has been shown that research analysis on creativity in teaching mathematics is clearly overlooked and neglected in mathematics education research, and that research on creativity is still secondary to research on mathematical thinking, learning, and teaching. Few empirical works had been conducted on teachers' creativity in teaching mathematics. The as aspect of the major concern as found from the review were exploratory studies on the creativity assessment scale of originality, flexibility and elaboration. Teachers conceptions of creativity regarding those components showed that their conceptions were narrow and associated with particular teachers' actions. Which shows that their knowledge about creativity is insufficient for a discussion of the subject.

From the review of the literature, a wide gap was identified, motivation and fluency components of teaching creativity were not considered in their studies. Therefore, this study would assess teachers' creativity in teaching mathematics with inclusion of motivation and fluency components of creativity in addition to originality and flexibility in Keffi local government area of Nasasrawa State.

The essence is to provide an empirical data on teachers' creativity in teaching mathematics. To added more to literatures on practical teaching in mathematics and also added research analysis on creativity in teaching mathematics to mathematics education research. This will help teachers, students and educational administrators to be expose to other practical ways of teaching and learning mathematics.

CHAPTER THREE

METHODOLOGY

This chapter is concerned with the description of methodology the researcher adapted to arrive at the answers to the research questions. This describes the research design of the study, the area of the study, population, sample and sampling technique, instruments, validity and reliability of the instruments, the method of data collection and method of analysis.

3.1 Research Design

The descriptive survey design was adapted in this research. This is because, it is directed towards determining the nature of a situation as it exists at the time of the research. According to Leady in Haruna (2009) descriptive survey method is the type of the design that investigates a phenomenon and reports on it as it is, allowing for the use of adequate and appropriate sample which results in the value judgment. Descriptive research of the survey type is often used in this type of research, as it describes, interprets and is concerned with the conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident or trends that are developing.

3.2 Population

The population for this research was made up of all senior secondary two (SS2) students and all the mathematics teachers in the six (6) public senior secondary schools owned by the Nasarawa State Ministry of education in Keffi local government area of Nasarawa state. There were thirteen (13) mathematics teachers and one thousand two hundred and forty-five (1245) students in the senior secondary two (SS2) in Keffi local government

area. Therefore, the total population for the study was one thousand two hundred and fifty-eight (1258) subjects, 625 male and 633 female (staff disposition list, Area Inspectorate Office Keffi, Ministry of Education Nasarawa State, 2013).

3.3 Sample and Sampling Techniques

The sample for this study was five senior secondary schools purposively selected in Keffi local government area of Nasarawa State. Next, two (2) mathematics teachers (1 male and 1female) and twenty (20) Senior Secondary two (SS2) students (10 males and 10 females) were selected for the study through stratified random sampling techniques from each of the schools. Gender was considered in the selection for both teachers and students in all the selected schools. Then a sample of ten (10) mathematics teachers and one hundred (100) SS 2 students were used for this research work. Total sample size was therefore one hundred and ten (110) subjects.

3.4 Research Instrument

In order to generate data for this study, two instruments were developed and used by the researcher. Namely, Teachers' Questionnaire On Teaching Creativity in Mathematics and Students' Questionnaire On Teaching Creativity in Mathematics in senior secondary schools in Keffi Local Government Area of Nasarawa State. The two questionnaires were designed to measure the same variables. The questionnaires for both mathematics teachers and students were in two sections; section A was on personal data, while section B was on the rating scale of four points in the increasing order of magnitude of Never (1), Rarely (2), Sometimes (3), Often (4). The total score on the scale gave the index of creativity. The questionnaires were designed in five categories of which each of the components of creativity, reflecting assessment scale; fluency, flexibility, originality and motivation. A

certain number of question items on the questionnaires measured application of a particular component of creativity in teaching mathematics by the teachers, question 1 – 3 covers flexibility, 4 – 8 covers originality, 9 – 13 represents fluency, while 14 – 20 represents motivation components of creativity.

3.4.1 Validity of the Instrument

The instrument were validated by four experts for the content and face validity. These experts includes the researcher's supervisor, one mathematics lecturer in the department of Science Education Federal University of Technology Minna, one mathematics teacher and an expert of Measurement and Evaluation, in the Department of Educational Foundations, Nasarawa State University Keffi. They critically scrutinised all the questions on each of the questionnaires and all the necessary corrections recommended by each of experts were harmonised and effected. Therefore, the instruments were considered to be valid.

3.4.2 Reliability of the Instrument

The pilot study was conducted prior to the administration of the questionnaire. The instruments were tested using test-re-test method to determine the reliability of the instrument. The instruments were first administered to five (5) mathematics teachers and ten (10) students. After two weeks interval the same instruments were re-administered to the same group. Data collected were used to calculate the reliability coefficient (r) of the instrument using Pearson's product moment correlation and reliability coefficient of r = 0.87 for teacher's questionnaire and r = 0.74 for student's questionnaire. This implies that the instruments were found to be consistent. This group of teachers and student were excluded from main study.

3.4.3 Administration of Instrument

The instruments were administered personally by the researcher and collected after completion on the spot to reduce instrument mortality. The questionnaire were administered to Two (2) mathematics teachers and twenty (20) SS2 students in each school which gave a total number of ten (10) questionnaires for mathematics teachers and one hundred (100) for students. Ten (10) copies of questionnaires administered to the teachers were completely collected without missing any one and the one hundred (100) copies of questionnaires administered to students were also collected back without shortage.

3.5 Method of Data Analysis

The data collected were analyzed using mean ($\bar{X}$), standard deviation (SD) and t-test. The mean ($\bar{X}$) and standard deviation were used to answer research questions. Since two groups were involved, the mean and standard deviation of each questionnaire item in each group was interpreted in relation to the midpoint of the rating scale (2.50) for research question one and two, to determine the acceptance therefore, a mean score of 2.5 was chosen as a decision point between used and unused. Consequently, any response with a mean score of 2.50 and above was considered as a creativity characteristics that is used, while responses with a mean of 2.49 and below was regarded as a creativity characteristics that is not used by teachers in teaching mathematics. The hypotheses were tested using the t-test at 0.05 level of significance.

CHAPTER FOUR
PRESENTATION OF RESULTS

Introduction

This chapter focuses on the presentation and analysis of data collected for the purpose of this study. The analysis of data for the study and the results of the analysis are presented in order to answer research questions and test the hypotheses.

4.1 Presentation of results and Analysis

4.1.1 Data analysis based on the Research questions

Research Question One:

To what extent do mathematics teachers use creativity in teaching mathematics ?

The answer to research question one is presented in table 4.1

Table 4.1: The Mean and Standard Deviation of teachers on the extent to which mathematics teachers use creativity in teaching mathematics

	Teachers	
Variables	$\bar{X}_1$	**SD**
Fluency	3.04	0.49
Originality	3.68	0.60
Flexibility	3.67	0.63
Motivation	3.43	0.96

Criterion mean = 2.50

X_1 - Mean response of teachers

Table 4.2: The Mean and Standard Deviation of students on the extent to which mathematics teachers used creativity in teaching mathematics

Variables	Students $\bar{X}_2$	SD
Fluency	2.72	0.75
Originality	3.06	0.80
Flexibility	3.21	0.96
Motivation	3.04	0.96

X_2 - Mean response of students

SD - Standard Deviation

The table 4.1 and 4.2 show the mean and standard deviation on the creativity assessment scale; fluency, originality, flexibility, and Motivation of teachers and students respectively; the teachers have the mean of 3.04, 3.68, 3.67, and 3.43 with standard deviation of 0.49, 0.60, 0.63, and 0.96 respectively. While students mean were 2.72, 3.06, 3.21 and 3.04 with standard deviation of 0.75, 0.80, .096, and 0.96 respectively. Based on the Criterion mean point of 2.50, the respondent's rating for all the creativity assessment scale of fluency, originality, flexibility, and Motivation for both teachers and students show mean scores above the criterion mean of 2.50 . This indicated the use of all the creativity assessment by mathematics teachers in teaching mathematics, since all the mean rating by the respondents are above the criterion mean. The extent to which the

mathematics teachers used creativity in teaching of mathematics based on the table 4.1 is that, creativity assessment scale of originality, flexibility, and Motivation has higher mean scores of 3 points and above for both teachers and students except, fluency which shows 3.04 for teachers and 2.72 for students. Students rating is very close to the criterion mean which shows that fluency is rarely used by mathematics teachers whereas, teachers mean shows that, they used fluency sometimes but the difference in both teachers and students mean is much. It signified that mathematics teachers rarely use fluency in teaching mathematics in their schools.

Research Question Two:

Is there any difference between teachers and students mean scores on the use of creativity in teaching mathematics ?

Table 4.3: The Mean and Standard Deviation of teachers on the use of creativity in teaching mathematics

S/No	Statement	$\bar{X}_1$	SD
1	I know and love mathematics and want to teach it	4.00	0.75
2	I do use different methods and procedures in solving mathematics questions to arrive at the same answer with the students	3.50	0.78
3	I do define the purpose of a lesson but when a student ask a question that must be addressed immediately, I do change planning and share it with every student in the class	3.50	0.72
4	I do develop something new that is beyond what is written in the books to enhance students performance in the class	3.50	0.52
5	I do look for ideas that are suitable for me and interesting for students to implement in my class	3.60	0.83
6	I don't miss any opportunity to solve mathematics i different ways	3.90	1.01
7	I do invent my own teaching aids and activities to convey mathematical concepts to students	3.50	0.86
8	I use to give different examples in addition to those given in the textbook for students	3.90	0.79
9	I do use audio-visual and computer aided programs in teaching mathematics	1.60	0.93
10	I do give mathematics examples that illustrate the same examples in the textbook	3.10	1.21
11	I do teach mathematical concepts and relate them to real life situations	3.70	0.92
12	I also teach mathematics topics that are connected in the sequence, pre-requisite to one another	3.60	0.78
13	I do solve a similar mathematics questions repeatedly to enhance students understanding in lessons	3.20	0.95
14	When I discover mathematics weakness in a particular student after an assessment, I incorporate this information into the next instruction	2.90	0.97
15	I do give my students take home assignment after every lesson, marks and give feedback to them	3.80	0.79
16	I also give class work to students during lessons and mark	3.70	0.90
17	I do organize practical lessons in mathematics for student to enhance their understanding	2.80	1.19
18	I do begin my teaching of mathematics from the simplest activities to the complex	3.70	0.96
19	I do start my teaching with already known activity and connect it to a new topic	4.00	0.87
20	I do admit possible solution (give solution) to a question and therefore guide students to arrive at it	3.10	1.03

Table 4.4: The Mean and Standard Deviation of students on the use of creativity in teaching mathematics Students

S/No	Statement	$\bar{X}_2$	SD
1	My teacher know and love mathematics and want to teach it	3.60	0.00
2	My teacher do use different methods and procedures in solving mathematics questions to arrive at the same answer with the students	2,96	0.80
3	My teacher do define the purpose of a lesson but when a student ask a question that must be addressed immediately, I do change planning and share it with every student in the class	3.07	0.67
4	My teacher use to develop something new that is beyond what is written in the books to enhance students performance in the class	3.01	1.17
5	My teacher do look for ideas that are suitable for me and interesting for students to implement in my class	3.13	0.06
6	My teacher doesn't miss any opportunity to solve mathematics i different ways	3.13	0.83
7	My teacher do invent my own teaching aids and activities to convey mathematical concepts to students	2.68	0.66
8	My teacher use to give different examples in addition to those given in the textbook for students	3.35	0.30
9	My teacher uses audio-visual and computer aided programs in teaching mathematics	1.44	0.87
10	My teacher do give mathematics examples that illustrate the same examples in the textbook	2.88	0.77
11	My teacher do teach mathematical concepts and relate them to real life situations	2.95	0.46
12	My teacher do teach mathematics topics that are connected in the sequence, pre-requisite to one another	3.13	0.49
13	I do solve a similar mathematics questions repeatedly to enhance students understanding in lessons	3.21	0.54
14	When my teacher discover mathematics weakness in a particular student after an assessment, I incorporate this informa-tion into the next instruction	3.01	1.04
15	My teacher do give us take home assignment after every lesson, marks and give feedback to them	3.20	0.40
16	My teacher also give class work to students during lessons and mark	3.28	0.63
17	My teacher do organize practical lessons in mathematics for student to enhance their understanding	2.26	1.04
18	My teacher do begin my teaching of mathematics from the simplest activities to the complex	3.27	0.46
19	My teacher do start my teaching with already known activity and connect it to a new topic	3.20	0.00
20	My teacher do admit possible solution (give solution) to a question and therefore guide students to arrive at it	3.09	1.18

Criterion mean = 2.50

X_1 - Mean response of teachers

X_2 - Mean response of students

SD - Standard Deviation

The data presented on table 4.3 and 4.4 shows the mean and standard deviation for both teachers and students respectively. Mathematics teachers had mean scores ranging from 2.90 – 4.00 and standard deviation ranging from 0.52 - 1.21 respectively and students had the mean scores ranging from 2.95 – 3.60 with standard deviation of ranging from 0.00 – 1.18 respectively. The table also revealed that 18 out of 20 items on the table had their mean scores above the criterion mean score of 2.50, this signifies that those characteristics on item 1,2,3,4,5,8,10,11,12,13,14,15,.16,18,19,and 20 on the table are the activities that are performed by mathematics teachers. Also the mean value for item 9 for teachers and students is 1.60 and 1.44 respectively which are not the same and below the criterion mean point of 2.50 indicating that, this characteristics is not used by mathematics teachers in teaching mathematics. However, item 17 had the mean response of 2.80 for teachers which is above the criterion mean of 2.50 and 2.26 mean response for students which is below the criterion mean value of 2.50.This indicates, that there is difference in the mean response of teachers and students on question 17 item. The findings on this table therefore shows that, there is no difference in the mean response of teachers and students on 19 out of 20 items, which signifies that, the assessment of teachers and students on the use of creativity in teaching mathematics is reliable for 19 items but there is difference on the mean response of item 17. The teachers agreed that, they do organize practical lessons in mathematics for student to enhance their

performance in mathematics, whereas the students disagree with their teachers based on their mean responses. The results on the table also shows that, mathematics teachers rarely used audio-visual and computer-assisted instruction in teaching mathematics in their schools.

Research Question Three:

What is the difference between the mean score of male and female teachers' use of creativity in teaching mathematics?

Table 4.5: The Mean and Standard Deviation of male and female teachers' use of creativity in teaching mathematics

Gender	**N**	$\bar{X}$	SD
Male	5	69.00	5.90
Female	5	67.60	4.88

$\bar{X}$ - Mean response of teachers

SD - Standard Deviation

Table 4.5 shows the results of mean and standard deviation comparison of male mathematics teachers and female teachers' use of creativity in teaching mathematics. The mean response for male teachers is 69.00 with standard deviation of 5.90 and female teachers mean of 67.60 with standard deviation of 4.88. The table results revealed that there is difference in the mean response of male and female teachers, the mean response of male teachers is higher than that of female teachers just by 1.4. This indicates that, there is a little difference in the mean comparison of male and female teachers scores on the use of creativity in teaching mathematics.

Research Question Four :

What is the difference in the mean score of teachers on the use of creativity in teaching mathematics on the basis of experience ?

Table 4.6: The Mean and Standard deviation of teachers on the use of creativity in teaching mathematics on the basis of experience ?

Experience	**N**	$\bar{X}$	**SD**
1 – 10 years	5	65.40	4.41
11 – 20 years and above	5	71.20	4.83

$\bar{X}$ - Mean response of teachers

SD - Standard Deviation

Table 4.6 shows analysis of mean responses of teachers' use of creativity in teaching mathematics in terms of years of experience. It shows that, teachers with teaching experience of 1 – 10 years had mean a score of 65.40 with standard deviation of 4.41 and teachers with teaching experience 11 – 20 years and above had mean of 71.20 with standard deviation of 4.83. This indicates that the mean score of teachers with teaching experience 11 – 20 years and above is higher than those with teaching experience 1 – 10 years by 5.80. Therefore, there is difference of 5.80 in their mean scores on use of creativity in teaching mathematics on the basis of experience. Thus, those with teaching experience of 11 – 20 years and above have higher teaching creativity in teaching mathematics than teachers with 1 – 10 years experience.

Research Question Five :

What will be the difference in teachers' creativity between professional and non-professional teachers in teaching mathematics?

Table 4.7: The Mean and Standard deviation of teachers' creativity between professional and non-professional teachers in teaching mathematics?

Variable	N	$\bar{X}$	SD
Professional	8	69.38	2.83
non-professional	2	64.00	0.50

$\bar{X}$ - Mean response of teachers

SD - Standard Deviation

The results presented on table 4.7 show that, professional teachers obtained a mean score of 69.38 with Standard deviation of 2.83 and non-professional teachers obtained a mean score of 64.00 with Standard deviation of 0.50 . The mean score for professional teachers is higher than non-professional teachers by 5.38, this indicates the difference in teachers' creativity between professional and non-professional teacher in teaching mathematics, hence the mean score of professional teachers is higher than that of non-professional teachers, professional teachers has higher teaching creativity in mathematics than non-professional teachers.

4.1.2 Hypotheses Testing

The following null hypotheses were tested at 0.05 level of significance.

HO_1 : There is no significant difference between the mean responses of male and female teachers' use of creativity in teaching mathematics.

The t-test was used to test the hypothesis

Table 4.8: The Mean, Standard Deviation and t-test of male and female teachers on use of creativity in teaching mathematics.

Variables	**N**	$\bar{X}$	**SD**	**df**	**t-value cal**	**t-value critical**
Male	5	69.00	5.90	8	0.41^{NS}	2.31
Female	5	67.60	4.88			

NS = Not significant at 0.05 level

Table 4.8 shows the t-test analysis of teachers use of creativity in teaching mathematics. The male teachers' mean score was 69.00 and standard deviation of 5.90 whereas as female teachers have a mean score of 67.60 with standard deviation of 4.88. When the values were subjected to t-test analysis, the t-calculated value of 0.41 with df = 108 was lower than the critical value of 1.96 at 0.05 level of significance. Therefore, the null hypothesis which says that there is no significant difference in the mean responses between male and female teachers' use of creativity in teaching mathematics was retained

HO_2: There is no significant difference between the mean responses of teachers' use of creativity in teaching mathematics on the basis of experience.

This hypothesis was also tested using t-test

Table 4.9: The Mean, Standard Deviation and t-test mean of teachers on use of creativity in teaching mathematics on basis of experience

Variables	N	$\bar{X}$	SD	df	t-value cal	t-value critical
1 – 10 years	5	65.45	4.41	8	1.99^{NS}	2.31
11 – 2o above	5	71.20	4.83			

NS = Not significant at 0.05 level

The data presented on in table 4.9 revealed that teachers with teaching experience of 1 – 10 years has the mean score of 65.45 with standard deviation of 4.41 while teachers with teaching experience of 11 – 20 and above have the mean score of 71.20 with standard deviation of 4.83. Therefore, the t-calculated value is 1.99 with df = 8 less than the t-critical value of 2.31. Therefore, the null hypothesis which states that there is no significant difference between the mean responses of teachers' use of creativity in teaching mathematics on the basis of experience is retained.

HO_3: There is no significant difference between the mean responses of professional and non-professional teachers on use of creativity in teaching mathematics

The t-test was used to test the hypothesis

Table 4.10: The Mean, Standard Deviation and t-test of professional and non-professional teachers use of creativity in teaching mathematics.

Variable	**N**	$\bar{X}$	**SD**	**df**	**t-value cal**	**t-value critical**
Professional	8	69.38	2.83	8	5.08*	2.31
Non-profes-sional	2	64.00	0.50			

* = significant at 0.05 level

From table 4.10, the mean score of professional teachers is 69.38 with standard deviation of 2.83 while the mean score of professional teachers is 64.00 with standard deviation of 0.50. The data on this table also revealed that, the t- calculated value is 5.08 with df = 8 greater than the t-critical value of 2.31 at 0.05 level of significance. Therefore, the null hypothesis was rejected. Since, there is significant difference between the mean responses of professional and non-professional teachers on use of creativity in teaching mathematics.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter contains the conclusions, recommendations and suggestions based on the findings of the study.

5.1 Discussion of Results

Research question one is on the extent to which mathematics teachers used creativity in teaching mathematics. The findings shows that mathematics teachers used creativity in teaching mathematics, both the teachers and students agreed that, the creativity assessment scale of fluency, originality, flexibility and motivation were used in teaching mathematics by mathematics teachers. A close look at the findings revealed that, mathematics teachers used originality and flexibility in teaching to foster creativity more than fluency and motivation. This means that, the originality and flexibility components were often used by teachers since their mean scores are far above the criterion mean but that of fluency and motivation were closer to the criterion mean. This implies that, fluency component of creativity assessment scale which relates to the continuity of ideas, flow of associations, and use of basic and universal knowledge, and motivation need to be improve upon by mathematics teachers in teaching of mathematics.

Also, research question two focused on the difference between students and teachers' mean scores on the use of creativity in teaching mathematics. The findings shows that both teachers and students mean scores on 18 items out 20 were not the same but all above criterion mean score which signified that both agreed on the use of creativity in

teaching mathematics. The result also indicated that, there is contradiction between teachers and students on question 17 to which teachers agreed that, they do organize practical lessons in mathematics for students to enhance their performance in mathematics whereas the students disagreed, that their teachers don't organize practical lessons in mathematics for them. This means that obviously, mathematics teachers rarely organize practical lessons in mathematics. The implication is that, mathematics laboratories are not in use or not established in secondary schools in Keffi local government area, even if they are available, they are not utilized by the mathematics teachers. This is against creative teaching methods to aid retention by Alcon, *et al*, in Anikweze (2010) the power of instructional materials, especially the ones that students can manipulate, declared that people generally remember 10% of what they read, 20% of what they heard, 30% of what they see, 50% of what they heard and see 70% of what they say and 90% of what they say as they do a thing.

Finally, findings also revealed that both teachers and students agreed on item 9, that there rarely use audio-visual and computer assisted instruction in teaching mathematics in their schools. This has a greater disadvantage to teachers and students. Ayodele in Haruna (2009), said that some students learn best through hearing, and others learn best through sight, most would learn best when sight and hearing are involved. Mkpa in Haruna (2009), agreeing with this said that the more the number of senses involved in the instructional process the more enduring the leaning that results. Also Okpala in Haruna (2009) said that the combination of visual and sound is likely to make a deeper impression on the student than could normally be achieved by conventional textbook teaching or chalk-and-talk method.

The significance of computer cannot be overemphasis in education. Computer has been generally accepted as a modern instrument that enables teachers to select teaching methods that will increase students' interest (motivation). Humphreys (2004) compared the face-to-face methods of teaching and computer-based instruction and reported that students who learnt with computer scored higher than students in traditional methods. This is supported by Martin (2005) who revealed that on average, students taught using computer based instruction scored higher than students without computer. The students also learnt more in less time. The non-use of computer-based instruction in teaching mathematics as one of the findings of this study could be as a result of computer illiteracy by mathematics teachers. This is in line with Olobamise (2003) who noted that the problem of information technology illiteracy was a serious one among teachers in the country as it cuts across the schools. He said that many teachers in the country do not have basic computer skills and noted that the problem was a hindrance to efforts at achieving the use of computer for educational purses the schools.

Research question three is on the difference between the mean score of male and female teachers' use of creativity. The finding revealed that there is difference in teachers' use of creativity in teaching mathematics between male and female teachers. Male teachers had higher teaching creativity in teaching mathematics than female teachers. This finding is similar to Okonruwa (1999) who found out that teachers' had a significant effect on the achievement mean score of students in sciences. Male teachers were more effective than their female counterparts. This submission could be the adoption of creative teaching methods by male science teachers.

The analysis on research question four revealed data on the teachers' use of creativity in teaching mathematics in terms of years of experience. The finding shows that there is difference on use of creativity in teaching mathematics on the basis of experience. Those with higher range of teaching experience had higher teaching creativity in mathematics. This finding shows that experienced mathematics teachers are more knowledgeable on the basic concepts and how to inculcate them to students. This finding is the same with that of Akintoye and Aregbede (2012) that experienced physics teachers are more knowledgeable on the basic physics concepts and the use of instructional materials. Okoruwa (1999) further found out that teachers' teaching experience had significant impact on science .

Research question five is on teachers' creativity between professional and non-professional teachers on teaching mathematics. The finding revealed that there is difference in teachers creativity between professional and non-professional teachers. Professional teachers had higher teaching creativity in mathematics than non-professional teachers. The professionalism in teaching and learning processes cannot be overemphasized. This is supported by Tahir (2003) who noted that poor teaching process exhibited by non-professional teachers is among the many problems of educational development in Nigeria. Yusuf (2003) also added that one of the major problems that demands the attention of curriculum reform specialists is that, a large majority of science and mathematics teachers in Nigerian secondary schools are unqualified. The effect of this on school system can be very enormous and even disastrous academically. It has been revealed in this research that professional teachers had higher creativity than non-professional teachers and this has a negative impact on the teaching of mathematics and

students' performance. This could be regarded as one of the major causes of poor performance of students in mathematics as discovered by this study.

Research hypothesis one compared the mean responses of male and female teachers' on the use of creativity in teaching mathematics. This hypothesis tested the same variables with research question three which revealed that there is difference between male and female teachers teaching creativity in mathematics. But this hypothesis therefore, found out that the difference is not significant between male and female teachers use of creativity in teaching mathematics as there is no significant difference in the mean responses between male and female teachers' use of creativity in teaching mathematics.

Research hypothesis two compared t-test mean score between the mean responses of teachers on the use of creativity in teaching mathematics on basis of experience. The result shows that there is no significant difference on the mean responses of teachers experience and use of creativity in teaching mathematics. Research question 4 measured the same variables and shows that there is difference between teachers use of creativity in teaching mathematics measured in years of teaching experience. Those highly experienced had higher mean responses on the use of creativity in teaching mathematics than those with less years of experience. The difference is not significant as it confirmed by this hypothesis. Thus there is no significant difference in the mean responses of teachers experience and use of creativity in teaching mathematics.

Research hypothesis three tested data on difference between the mean responses of professional and non-professional teachers on the use of creativity in teaching mathematics. The result revealed that there is significant difference between the professional and non-professional teachers' use of creativity in teaching mathematics.

Since, there is significant difference in the mean responses of teachers' use of creativity in teaching mathematics between professional and non-professional teachers, this hypothesis is similar to research question five which revealed that there is difference between professional and non-professional teachers' creativity. Professional teachers had higher teaching creativity in mathematics than non-professional teacher, but the hypothesis shows an insignificant difference.

5.2 Summary

This study assessed teachers' creativity in teaching mathematics in senior secondary schools using Akinboye's Ibadan Creativity Assessment Scale (ICAS) of originality, flexibility, fluency, and motivation. For the purpose of investigation. Five research questions and three hypothesis were formulated based on the variables to guide and direct the study. The descriptive survey design was adopted using a structured questionnaires. The population of the study comprises of 1258 teachers and student in senior secondary two (2) in Keffi LGA of Nasarawa State. A sample size of 110 respondents of teachers and students were drawn from the population using a simple random sampling procedure. A structured questionnaire instrument containing 20 items was administered to teachers and students. The mean and standard deviation were used in answering research questions while the four hypothesis were tested using t-test at 0.05 level of significant. Based on the analysis of the data collected, the following are the major findings of the study.

Creativity assessment scale of originality, flexibility, fluency, and motivation were used in teaching mathematics by mathematics teachers, though it was observed that teachers

used originality, flexibility, fluency and motivation in teaching to foster creativity and enhance performance. There is no proper utilization of fluency and motivation components since mathematics teachers don't organize practical lessons for student in mathematics to enhance their performance, mathematics teachers don't use audio-visual and computer-aided instruction in teaching mathematics in their schools even as computer has been generally accepted as a modern instrument that enables teachers to select teaching methods that will increase students' interest and motivation thereby enhance performance. This could be as a result of computer illiteracy by mathematics teachers and non availability of computer in schools. Male mathematics teachers used creativity in teaching mathematics more than their female counterparts in their schools. Mathematics teachers with higher range of teaching experience in years have higher teaching creativity in mathematics than those with less years of experience. These findings show that, experienced mathematics teachers are more knowledgeable on the basic concepts and how to inculcate them into their students. Professional mathematics teachers have higher creativity in teaching mathematics than the non-professional mathematics teachers.

5.3 Implication of the Results

The above findings have several implications for educational administrators and teachers in finding ways to enhance instructional delivery in schools to enhance students learning and performance in examinations. Since the knowledge of mathematics is increasingly important for individuals' anest for a career and higher education. Almost all the careers required a background in mathematics. The results, suggestions and recommendations of this study will be an answer to the recent demand in research on creativity. Ada in Ortese

(2009) observed that today we are in the 21st century where knowledge and creativity dictate the pace of development. As a result, Akinboye (2001:3) affirms that for the first time in history knowledge is critically considered as the primary source of economic productivity, an era of creativity, innovations and knowledge utilization has emerged. Therefore, any organization that plans to experience peak performance and harvest excellent results must learn to utilize creativity. The implication of this findings is in line with the above statement. For educational organization to experience peak performance and harvest excellent results in mathematics, mathematics teachers must be creative in their teaching of mathematics. The starting point for fostering creativity in Nigeria is through curriculum. This findings revealed information for curriculum planners and developers, on the areas to include in the thinking curriculum. It has been argued that by fostering pupils' creativity in the classroom, they will be helped to identify and establish a framework for their lives. The development of creative skills and attitudes across the curriculum may enable them to 'route-find' a range of contexts in their lives. The findings is also useful to creativity counsellors in mathematics, teachers, educational administrators in supervision and inspection services as well as allocation of classes to teachers. It exposes teachers and students to some learning and teaching techniques that are regarded to be creative strategies through study frame work and literature reviews.

5.4 Conclusions

As a result of the above findings, the following conclusions have been drawn;

Mathematics teachers use originality and flexibility components of creativity than fluency and motivation components. This implies that students' continuity of ideas, flow of associations, and use of basic and universal Knowledge is not adequately given by their

teachers in teaching mathematics. No proper utilisation of motivation component of creativity since; Teachers of mathematics don't organize practical lessons in mathematics for students which shows that the use of mathematics laboratories are neglected. Adegboye and Odili in Yusuf (2003) state that, mathematics laboratory is a necessity and not a luxury and that every school should have mathematics laboratory to make mathematics teaching creative and learning exciting, interesting and meaningful to students. This has been identified by this study as one of the major causes of massive failure in mathematics. Mathematics teachers don't use audio-visual and computer-aided instruction in teaching mathematics in their schools even as computer has been generally accepted as a modern instrument that enables teachers to select teaching methods that will increase students' interest and motivation. These are recorded by this study as causes of hindrance to excellent performance in mathematics. Mathematics teachers don't organized practical lessons for student in mathematics to enhance their understanding It was also discovered that most of the mathematics teachers in Keffi LGA were not professional mathematics teachers.

5.5 Limitations of the Study

This research work intended to use SS3 students as part of the respondents in this research during data collection but SS3 students were not in school during the time of data collection because it was after SSCE. This study also intended to use at least twenty (20) mathematics teachers (10 male and 10 female) as respondents but only thirteen (13) mathematics teachers were found in the five senior secondary schools in Keffi local government area.

5.6 Recommendations

Based on this research work, the following recommendations are made:

1. Mathematics teachers should endeavour to relate mathematics concepts to real life situations by proper utilization of creativity components especially fluency which fosters continuity of ideas, flow of associations, and use of basic and universal Knowledge in mathematics.
2. Establishment of mathematics laboratories should be made compulsory in all secondary schools for student's practical as it is a requirement for physics and chemistry and be included in curriculum.
3. Curriculum planners should inculcate the use of audio-visuals and computer assisted instruction by mathematics teachers in teaching mathematics and should ensure that, there is proper integration of the curriculum in all secondary schools in Nigeria.
4. Teacher educators should design an integrated curriculum that emphasizes creative teaching. Creative techniques should be taught as integrated components of core and elective modules, but not as separate components.
5. Non professional teachers should not be allow to teach mathematics in secondary schools. They have a low creativity skills in teaching the course, but only professional teachers should be given the opportunity.
6. The use of audio-visuals, and CAI for teaching mathematics should be encouraged and made compulsory for teachers in mathematics in secondary schools.
7. Adequate funds should be provided towards procurement of computers and mathematics laboratories equipment in secondary schools .

8. Regular check on the apparatus in the laboratory and their applications should be done same as chemistry and physics by authorized bodies.
9. Experienced teacher should always be considered to teach mathematics at foundation and certification classes during allocation of classes to teachers.

5.7 Contributions to Knowledge

This study has therefore made the followings contribution to knowledge;

- There should be provision for practical teaching in mathematics in secondary schools through audiovisuals, computer and other teaching creativity components.
- This study added more to literatures on practical teaching in mathematics.
- This study also added research analysis on creativity in teaching mathematics to mathematics education research.
- Compulsory establishment of mathematics laboratories in secondary schools is recommended in this study.

3.8 Suggestion for further Studies

Considering the findings and the recommendation the researcher suggests that, further studies should be carried out in the following areas.

1. Teachers' creativity in teaching mathematics in primary schools since, it is where students foundation in mathematics is supposed to be laid.
2. A research on teachers' creativity using exploratory research method to interview, observe teaching and use of teachers lesson plans.

3. An experimental research on teachers' creativity in teaching mathematics and students performance using creativity teaching characteristics or techniques.

REFERENCES

Adeyemi ,T. O. (2007). Influence of teachers' teaching experience on students' learning outcome in secondary schools in Ondo State, Nigeria. *African Journal of Education Studies in Mathematics and Science,* 5 , 9-19.

Akinboye, J. O. (2001). Era of creativity and knowledge innovation. *Nigeria journal of applied psychology*, 6,1-19.

Akintoye, O.H., and Aregbede, O. S. (2012).Correlation Analysis of Teachers' Characteristics and Instructional Practices for quality Teaching and learning in Lagos Secondary schools, *Journal of science, technology, Mathematics and education* (JOSTMED), 9(1), 240-248.

Anikweze, C. M. (2010). Essentials of instructional technology. Abuja: Gofats ventures limited.

Animashaun, R. A. (2002). *Effectiveness of six reduction of psychological behaviour of convicted adolescent in Nigerian prisons* .A Doctorate dissertation university of Ibadan: unpublished.

Bolden, D. S., Harries A. V., and Newton D.P. (2010). Pre-service primary teachers' conceptions of creativity in mathematics. *Educational Studies in Mathematics* ,73(2), 143-57.

Clement and Sarama (2003). Ten creative ways to teach mathematics. retrieved form http://www.scholastic.com/teacher'/article/ten-creative-ways-teach-mathematics

Craft, A. (2001). *Analysis of research and literature on teaching creativity in education*, the curriculum journal, 10(1), 135-150

Eid, I. (2000). The philosophy of creativity of Mourad Wahba. In Mourad Wahba and Mona Abousenna (Eds.), *Manifesto of Creativity in Education*, 17 -24. Cairo: Kebaa House.(In Arabic).

Even, R., Karsenty, R., and Friedlander, A. (2009). Mathematical creativity and giftedness in teacher professional development. In R. Leikin, A., Berman, and B. Koichu, (Eds.), *Creativity in mathematics and the education of gifted students, (309-24). Rotterdam, the Netherlands: Sense Publishers.*

Federal Republic of Nigeria (FRN, 2004). National policy on education (revised edition). Lagos, Federal ministry of information printing division.

Gable, S. (2002). Creativity in young children. Retrieved from htpp:www.Indian.edu/bobweb/ handout/d3.ttcthtm.

Gimba, R. W., & Angwagah, U. N. V. (2012). Importance of Mathematics to Science and

Technology. *Journal of Science, Technology, Mathematics and education,* 8 (2), 251.

Haruna, J. O. (2009), *Assessing the availability and utilization of instructional Materials and Equipment in Kaduna Polytechnic*. M. Tech. thesis, Federal University of Technology, Minna: Unpublished.

Humphreys, B. R. And Coates d. (2004). No significance Distance between face-to-face and online instruction. Evidence from principles of economic. *Economic of Education Review,* 23(6), 533-546.

Ityavzua, T. M. (2008). *Mathematics laboratories in Secondary Schools in Gboko LGA Benue State; implication for the teaching and learning of mathematics*. B. Sc (Ed) Project Submitted to UAM: unpublished.

Iwendi, B. C., & Oyedum, N. A. (2012), Effects of gender and age on mathematics achievement of secondary school students in Minna metropolis of Niger State. Journal of Science, Technology, Mathematics and Education, 9(1), 215-221.

Lampert, M. (2001). *Teaching problems and the problem of teaching*. New Haven, CT: Yale.

Leikin, R. (2011). The education of mathematically gifted students: On some complexities and questions. *Montana Mathematical Enthusiast Journal,* 8(2), 167-88.

Levi, M. (2007). Multiple solution Task as a Minifying Glass for the Observation of Mathematical Creativity. *In the proceedings of the 31st International Conference of Mathematics Education*. Retrieved from htpp:www.Indian.edu/bobweb/ handout/ d3.ttcthtm.

Lev-Zamir, H., & Leikin, R. (2011). Creative mathematics teaching in the eye of the beholder: focusing on teachers' conceptions, *Research in Mathematics Education,* 13(1), 17-32.

Mann, E. L. (2006). Creativity: The essence of mathematics. *Journal for the Educationof the Gifted,* 30(2), 236-62.

Martin, K. (2005). Effect of Computer Assisted Instruction Packages on the Academic performance of Secondary School Students in physics. *World Journal of education,* 1(1), 95-110.

NECO analysis from 2010-2012 (2012). http://www.thisdayonline.com/nview.php?=154867

Odili, G. A. (2006). *Mathematics in Nigeria Secondary Schools. A Teaching Perspective*. Port Harcourt : Rex – Charles and Patrick Ltd.

Okereke, E. H. (2007). *Fundamentals Of Educational Psychology.* Abuja: Nyanyan Plaza Press.

Okoruwa, T. O. (1999). *The effect of some Teachers' characteristics on the Pupils' Performance in Primary science* , M. Ed Project. University of Ibadan: Unpublished.

Olobamise, B. (2003). The information society and Nigeria. Development Information Education network Nigeria. Retrieved from http://www.Jdaw.com/Nigeria/devnet1.htm1.

Ortese, P. T. (2009). *Psychology Creativity*. Makurdi: Aboki Publishers.

Pelfrey, R. (2011). *classroom behaviors in elementary school teachers identified as fostering Creativity*. A dissertation submitted in partial fulfillment of the requirements for the degree of doctorate of educational leadership to Northern Kentucky University : Proquest LLC. Retrieved from http://www.Indiana.edu/bobweb/handout/d3.ttcthtm

Shriki, A. (2009). Working like real mathematicians: Developing prospective teachers' awareness of mathematical creativity through generating new concepts. *Educational Studies in Mathematics,* 73(2), 159-79.

Shuaibu, F. B. (2012). *Creativity and The Teacher, 3rd edition*. Abuja: star Clear Press Ltd.

Tahir, G. (2003). Poor Supervision of Schools in what and Where. Vanguard: Thursday, January 23,p25.

Tali, D., Mbwas, L. C., Abe, A. S. (2011). The teaching of Mathematics in secondary schools as a tool for self-reliance and rebranding process in Niger. *Educational research and review*, 7(1), 1-4. Retrieved from http://www.academicjournal.org/ERR.

Tan A. G. (1998). Teaching primary mathematics creatively, some insight for educators. The mathematics educators, 3(1), 38-49 .

Uwadiae, I. (2012). Head of National Office of WEAC Key Statistics 2012 examination in Comparison with that of 2011 and 2010. http://www.news2online Nigeria.com/headlines/WEAC-result-for2012

Uwadiae, I. Head of National Office of WEAC May/June results (2009). http://www.thisdayonline.com/nview.php?=154867

Whitelaw, L. A. (2006). *An evaluative study of teacher creativity, use of the heuristic diagnostic teaching process and student mathematics performance*. Ph .D. thesis Submitted to Drexel University: Retrieved from http://www.Indiana.edu/bobweb/handout/d3.ttcthtm

Yashin-Shaw, I. (2001). *A cognitive model for understanding creative thinking*. Ph.D. thesis submitted to Griffith University Retrieved from htpp:www.Indian.edu/bobweb/ handout/d3.ttcthtm

Yusuf, B. L. (2003). *Problems of Teaching mathematics in Senior Secondary Schools in Niger State*. M. Tech. thesis, Federal University of Technology, Minna: Unpublished.

Appendix A

STUDENTS' QUESTIONNAIRE ON TEACHING CREATIVITY IN MATHEMATICS

Dear Student,

The purpose of this questionnaire is to collect information, which will be used to assess teachers creativity in teaching mathematics in senior secondary schools in Keffi local government area of Nasarawa State.

Please , respond to the following statements as honestly as it is applicable. Every response will be treated confidentially.

Thanks for your anticipated cooperation.

Yours Sincerely,

Ityavzua, Terhemen Moses

SECTION A

INSTRUCTION: Fill in the gaps provided with suitable response(s)

1. Sex Male ( ) Female ( ) Tick (√) where applicable
2. Class:……

SECTION B

INSTRUCTION: Please tick in the appropriate box indicating your teachers' attitude to each of the following statements

(1) Never
(2) Rarely
(3) Sometimes
(4) Often

S/No	Statement	4 often	3 Some-times	2 Rarely	1 Never
1	My teacher knows and loves mathematics and like teaching it				
2	My teacher uses different methods and procedures in solving mathematics questions to arrive at the same answer with the students				
3	My teacher do define the purpose of a lesson but when				

	a student asks a question that must be addressed immediately, it is redirected and shared with every student in the class				
4	My teacher use to develop something new that is beyond what is written in the textbooks to enhance students performance in the class				
5	My teacher do look for ideas that are suitable for him and interesting to students to implement it in the class				
6	My teacher doesn't miss any opportunity to solve mathematics in different ways with students				
7	My teacher do invent teaching aids and activities to convey mathematical concepts to students				
8	My teacher use to give different examples in addition to those given in the textbook to students				
9	My teacher do uses audio-visual and computer aided programs in teaching mathematics in the class				
10	My teacher do give mathematics examples that illustrate the same examples in the textbook				
11	My teacher do teach mathematical concepts and relate them to real life situations				
12	My teacher do teach mathematics topics that are connected in the sequence, pre-requisite to one another				
13	My teacher do solve a similar mathematics questions repeatedly to enhance students understanding in the lessons				
14	When my teacher discover mathematics weakness in students after an assessment, this is incorporated into the next instruction				
15	My teacher do give us take home assignment after every lesson, marks and give feedback to students				
16	My teacher also gives class work to students during lessons and marks				
17	My teacher do organize practical lessons in mathematics for students to enhance their understanding				
18	My teacher do begin teaching from the simplest activities to the complex				
19	My teacher do start teaching with already known activity and connects it to a new topic				
20	My teacher do admit possible solution (give solution) to a question and therefore guide students to arrive at it				

TEACHERS' QUESTIONNAIRE ON TEACHING CREATIVITY IN MATHEMATICS

Dear Respondents,

I am a postgraduate student of the university of Technology Minna, currently carrying out a research on the topic; An assessment of teachers Creativity in teaching mathematics in Senior Secondary Schools in Keffi metropolis of Nasarawa State. You have been selected as one of the respondents of this research. I will be grateful if you could spare your time to complete the accompanied questionnaire as honestly as you can. I assure you that any information supplied by you will be treated as strictly confidential and for the purpose of this research only.

Thanks for your anticipated cooperation.

Yours Sincerely,

Ityavzua, Terhemen Moses

SECTION A

INSTRUCTION : Fill in the gap provided with suitable response(s)

1. *Sex: Male ( ) Female ( ) tick (√) where applicable*
2. *Educational qualification(s) :) tick (√) where applicable*

ND ( ), NCE ( ) , HND ( ), PGDE ( ), B. Ed. ( ), B. Sc.(Ed) ( ), B. A. (Ed) ( ),

B. Tech. ( ), B. Eng. ( ), B. Sc. ( ), B. A. ( ), M. Sc ( ), M. Sc. (Ed) ( ), M. A. ( ),

M. A. (Ed)( ), M. Ed. ( ), Others ……..

3. *Area of Specialization :……*
4. *Teaching Experience in years : 1 – 5 ( ), 5– 10 ( ), 11 – 15 ( ), 16 – 20 ( ) ,21 and above ( )*

SECTION B

INSTRUCTION: Please tick in the appropriate box indicating your attitude to each of the following statements

(5) Never
(6) Rarely
(7) Sometimes
(8) Often

S/No	Statement	4 often	3 Some-times	2 Rarely	1 Never
1	I know and love mathematics and want to teach it				
2	I do use different methods and procedures in solving mathematics questions to arrive at the same answer with the students				
3	I do define the purpose of a lesson but when a student ask a question that must be addressed immediately, I do change planning and share it with every student in the class				
4	I do develop something new that is beyond what is written in the books to enhance students performance in the class				
5	I do look for ideas that are suitable for me and interesting for students to implement in my class				
6	I don't miss any opportunity to solve mathematics in different ways				
7	I do invent my own teaching aids and activities to convey mathematical concepts to students				
8	I use to give different examples in addition to those given in the textbook for students				
9	I do use audio-visual and computer aided programs in teaching mathematics				
10	I do give mathematics examples that illustrate the same examples in the textbook				
11	I do teach mathematical concepts and relate them to real life situations				
12	I also teach mathematics topics that are connected in the sequence, pre-requisite to one another				
13	I do solve a similar mathematics questions repeatedly to enhance students understanding in lessons				
14	When I discover mathematics weakness in a particular student after an assessment, I incorporate this information into the next instruction				
15	I do give my students take home assignment after every lesson, marks and give feedback to them				
16	I also give class work to students during lessons and mark				
17	I do organize practical lessons in mathematics for students to enhance their understanding				

18	I do begin my teaching of mathematics from the simplest activities to the complex				
19	I do start my teaching with already known activity and connect it to a new topic				
20	I do admit possible solution (give solution) to a question and therefore guide my students to arrive at it				

Appendix B

table 2.1 WAEC Analysis from 2010-2012 chief Inspector, Area Inspectorate Office, Keffi

WAEC	Total No of Candidate	% passed	% failure
2010	1740	22.50%	77.50%.
2011	1892	23.13%	76.87%
2012	1920	21.80%	78..20%

Source : WAEC Analysis (2012), Area Inspectorate Office, Keffi Nasarawa State

Table 2.2 shows NECO analysis from 2010-2012

NECO	Total No of Candidate	% passed	% failure
2010	1751	22.70%	77.30%
2011	1,124,879	28.40%	71.60%
2012	1,124,879	20%	80.0%

Source : NECO (2012) analysis Area Inspectorate Office, Keffi Nasarawa State