**EFFECT OF SMALL CLASS SIZE ON ACADEMIC ACHIEVEMENT OF PUPILS IN MATHEMATICS IN OGBARU LOCAL GOVERNMENT AREA, ANAMBRA STATE**

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**JULY 2018**

**TITLE PAGE**

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**DEPARTMENT OF SCIENCE AND VOCATIONAL EDUCATION, FACULTY OF EDUCATION, GODFREY OKOYE UNIVERSITY,**

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**A RESEARCH WORK SUBMITTED TO THE DEPARTMENT OF SCIENCE AND VOCATIONAL EDUCATION,FACULTY OF EDUCATION, GODFREY OKOYE UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE IN EDUCATION (B.Ed)**

**JULY, 2018**

**CERTIFICATION PAGE**

I Ezievuo Chinwendu Faith a degree student in the department of Science and Vocational education with the registration number: U16/EDU/MAT/003 has satisfaction completed the requirements for this research work "Effect of small class size on academic achievement of pupils in mathematics" for the award of bachelor of Science in Education B.Sc (Ed) (Mathematics Education). The work contained in this project report is original and has not been submitted in part or full for any diploma or degree of this or any other university.

……………………………… .......................

Ezievuo Chinwendu Faith Date

**APPROVAL PAGE**

This project has been read, examined, collected and approved as meeting the requirement for the award of Bachelor of Education (B.Ed) in the department of Science and Vocational Education (Mathematics Education Programme) of Godfrey Okoye University Enugu.

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External Supervisor Signature Date

**DEDICATION**

This project work is dedicated to the Almighty God for his love, favour, mercy, grace, guidance and protection throughout my academic journey.

**ACKNOWLEDGEMENT**

I wish to express my immense gratitude to God almighty, for his love, mercy favour, grace, guidance and protection throughout my academic journey.My appreciation goes to my amiable supervisor and Head of department Professor UcheAgwagah for her great efforts, contibutions and direction throughout the period of this work, may God bless you abundantly Prof. I recognize the efforts of my honourable lecturers Professor ochor, Mr/Mrs Ezugorie, Mr benson, Mr. Anaeche, Dr. Ugwunnadi, Dr. Anabanti, Dr Agbebako, for been there for me at all times.

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I must extend a handshake to my dear friends and colleagues Nnadika Peace, Lemchi Chiamaka, Johnson Amarachi, Nzekwe Ujunwa, Chukwu Augustine,Nnaji Harrison and the entire graduating students of Godfrey Okoye University most especially faculty of Education.

Finally, to others too numerous to mention, may God bless you, and I love you.

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**Abstract**

The topic of the study is effects of small class size on academic achievement of pupils in mathematics in Ogbaru local government area of Anambra state. The purpose of the study was to find out the effect of small class size on academic achievement of pupils in mathematics in primary schools. The study adopted a quasi-experimental research design, specifically the non-equivalent control group design. The population of the study consisted of primary schools pupils in all the nineteen (19) private primary schools in Ogbaru. The total population was 3490 pupils. A purposive sampling technique was used to select an intact class of small and large class of primary four (4) pupils. A sample size of 65 was used. The study was guided by two(2) research questions and two(2) research hypotheses were tested at 0.05 level of significance using Analysis of covariance (ANCOVA). The data were collected using fraction achievement test. The Instrument was found to be reliable by the reliability coefficient of 0.8 using Kuder-Richardson formula method (K-R 20). Validation of the instrument was made by experts in mathematics education and measurement and evaluation. Face validation of the instrument was done as well as content validation through construction of a test blue print. The result indicated that there is a significant difference in the achievement of pupils taught mathematics in small class and those taught in large class The study also showed that there is no significant difference between the mathematics achievement of male and female pupils taught mathematics in small class size. Hence, the study recommend that educators should develop great interest in finding ways of improving pupils reasoning in mathematics and this could be achieved through reduction of class size which makes it easier for the teacher to have more one on one interaction with the pupils.

**CHAPTER ONE**

**INTRODUCTION**

**Background of the Study**

Education is the key factor to industrial and technological development of any country in the world. Knowledge holds key to the attainment of the millennium development goals, which include, food security, eradication of child mortality, and reduction of the spread of HIV and AIDS, among others. Husen (2000) stated that education is widely regarded as a basic human right, a key to enlightenment, and a great tool for human and society development. For any Nation to achieve her aims and objectives in education there must be good, dedicated and committed teachers. The teachers must possess characteristics that will enhance effective teaching and learning.

Therefore, teachers play a major role in the educational sector and their role is a major determinant of educational attainment of any students. However, for anyone to qualify to be a teacher, the person must obtain degree or National Certificate in Education during the course of study. The pre –service teacher will be exposed to both pedagogy and content knowledge in the field of study; psychology and philosophy courses in preparation for the teaching assignment.

To be prepared to teach mathematics adequately, teachers must have a comprehensive understanding of technology pedagogical content knowledge (TPCK)” (Niess, 2005). Shulman (1987) defined content knowledge as the knowledge about the subject (such as knowledge of mathematics and mathematical representations), while knowledge of students, knowledge of teaching, and knowledge of educational contexts characterize pedagogical content knowledge. The sum and intersection of technological knowledge, pedagogical knowledge, and content knowledge serve as a framework for effective mathematics teaching and learning. As mathematics teachers think about teaching with technology, they should concurrently consider how to teach mathematical concepts in such a way that students can experiment with ideas, make conjectures, test hypotheses, and form generalizations.

For more than two thousand years, Mathematics has been a part of the human search for understanding the world. Mathematical discoveries have come both from the attempt to describe the natural world and from the desire to arrive at a form of inescapable truth from careful reasoning. These remain fruitful and important motivations for mathematical thinking, but in the last century, mathematics has been successfully applied to many other aspects of the human life.

Today, mathematics as a mode of thought and expression is more valuable than ever before. It is absolutely an essential subject in the world today. It is a compulsory subject in both Primary and post primary schools in Nigeria. The study of mathematics is taken serious amongst students and school authorities of various institutions of learning. For instance, students generally cannot gain admission into any course of study in higher institutions without a pass or credit in mathematics.

Mathematics is the study of topics such as quantity (numbers), structure, space, and change (Encyclopedia Britannica, 2010). It is the science that studies and explains numbers, quantities, shapes and the relationship between them (Merriam Webster Dictionary 2015). It is alsothe systematic treatment of magnitude, relationships between figures and forms, and the relations between quantities expressed symbolically (Dictionary.com 2016). Mathematics is very useful in the society, more so in the present science and technology age. A sound science curriculum cannot be spoken of realistically without considering the important role of mathematics (Nneji, 2011). Agwagah (2001) stated that mathematics is a scientific tool in realizing the nation's scientific and technological aspirations.

Mathematics is the mother of all sciences. No wonder Mathematics is a compulsory subject at primary and secondary school levels, though, not all the students are expected to become mathematicians but because Mathematics cuts across all the areas of human life even at the domestic level. For a person to function very well within the immediate environment, the knowledge of Mathematics is very necessary.

Adesina (2000) defined mathematics as the science that draws necessary conclusions and also the manipulation of the meaningless symbols of a first order language according to explicit, syntactical rules. Anibueze (2015) stated that, mathematics plays important roles in three areas which are mathematics as a core skill for life ,as a key to economic prosperity and mathematics education.

Mathematics is the queen of science and a tool for scientific and technological development, an indispensible tool for effective use of electronic resources for national development. It is also a way to communicate ideas. More than anything, it is a way of reasoning that is unique to human beings. Mathematics is identified as a specialised language in which knowledge of the physical world has been recorded; a language in which idea originating in the minds of scientists can be encoded, transmitted to others and decoded with a much exact method and much less error (Oyedeji, 1999). Olutosin (2007) described mathematics as an instrument to ease or facilitate the learning of other subjects and that, the importance of Mathematics permeates all aspects of human endeavor. Mathematics ideas have helped make possible the revolution in electronics, which has transformed the world the way we think and live today.

Mathematics being an abstract subject which needs to be concretized, does not require much population during the cause of teaching for effective learning to take place.

As school population increases, class sizes also increase, the performances of students become an issue. According to Dror (2010), class size has become a phenomenon often mentioned in the educational literature as an influence on pupil’s feelings and achievement, on administration, quality and school budgets. Dror noted that class size is almost an administrative decision over which teachers have little or no control. Most researchers start from the assumption that size of the class would prove a significant determinant of the degree of success of students. In fact, with the exception of a few, many studies have reported that under ideal situation, class size in itself appears to be an important factor. Class size refers to an educational tool that can be used to describe the average number of students per class in a school (Adeyemi, 2008). It also refers to the number of students a teacher faces during a given period of instruction.

The relationship between class size and academic performance has been a perplexing one for educators. Studies have found that the physical environment, class overcrowding and teaching methods are all variables that affect students achievement (Molnar, Smith, Zahorik, Ehrle, Halbach, Kuehl 2000). Other factors that could affect students achievement are school population and class size (Gentry, 2000, and Swift, 2000). The issue of poor academic performance of students in Nigeria has been of much concern to all and sundry. The problems are so much that it has led to the decline in standard of education. In order to better understand the skill levels of students, it might be necessary to evaluate factors affecting their performance. These factors can include; school structure and organization, teachers quality, curriculum and teaching philosophies (Driscoill, Halcoussis and Sony, 2003) and class size (Gentry,2000; Swift, 2000).

According to Michael (2010) and Lori (2016), each class has its own advantages and disadvantages. Lori (2016), maintained that students in large classes are independent, develop more ideas, have better social opportunities, develop competitive spirit and discussion activity whereas for students in the smaller classes, teachers have more of an opportunity to get to know students on a personal level, helping them to tailor their teaching strategies to meet individual learning needs.

It is noted that discussion time becomes fragmented among students in large classes and instructors may rely on passive lecturing, assign less written homework or fewer problem sets, and may not require written papers. Instructors may find it difficult to know each student personally and tailor pedagogy to individual student needs in a large class. According to (Adeyemi 2013)overcrowded classrooms have increased the possibilities for mass failure and make studentslose interest in school. This is because large class sizes do not allow individual students to get attention from teachers which invariably lead to low reading scores, frustration and poor academic performance.

Small class size helps students to be able to forge better relationships with classmates and teachers. Increasing class size negatively affects students academic achievement that teachers change pedagogical practices in smaller classrooms and their relationship with students was much closer.

In smaller classes, teachers had a better understanding of their students and could customize lessons to individual needs much more than in larger classes. Teachers adopt more group work to take advantage of the smaller classroom and also engage more students by varying types of coursework. These changes create a greater sense of unity and belonging in the classroom hence, it leads to increase in student achievement. Englehart (2007) discovered that students were able to transition from one task to another quicker in the small class and spent a greater amount of time engaged in the material presented. In the small class, the atmosphere is much more conversational and familial. This helps to facilitate their learning by opening lines of communication between teachers and students. Thus, smaller class size seems to be beneficial to student achievement. It (smaller class sizes) leads to a decrease in classroom management issues which would be particularly beneficial to lower achieving students. It fosters more intrapersonal relationships with students. Teachers spend moretime for the review of material if needed, and have fewer discipline problems in smaller

Classes.

Blatchford, Bassett, and Brown (2011) noted that student engagement increased in smaller classrooms as well as their interaction with teachers hence lower achievers were off-task much more.

Din (1999) found that students in smaller classes tended to help the teacher with classroommanagement, had more positive student-teacher interactions, and received more individualized help from teachers. Fan (2012) found that smaller classes gave students more access tocomputers and additional space, and teachers were able to spend less time on classroommanagement, which in turn led to greater student achievement. Konstantopoulos and Sun(2014) found that teacher effects (teaching skills and practices) had a larger impact on student achievement in smaller classrooms than regular size classrooms. Smaller class sizes also give teachers an opportunity to increase parental involvement and improve teacher curriculum planning and development. Researchers found that smaller classes gave teachers moreopportunities to reach out to parents and include them in the educational process. And teachers who used smaller classes to differentiate and individualize their curriculums showed significantgains in student achievement. Rodriguez and Elbaum (2014) analyzed that teachers with smaller class sizes had more time to interact with parents and to develop more personal bonds.

Isocrates (392 B.C.) opened an academy of rhetoric in Athens to train Athenian generals and statesmen, and insisted on enrolling not more than six or eight students in the school at a time. Power (1966) explained that Isocrates admitted "only a few students to the classes because of the extraordinary concern for care." Quintilian (1875) a rhetorician writing in the Roman Empire around 100 CE, cited the practices in Isocrates' school as evidence that a caring education required small class sizes. Quintilian argued in Institutes of Oratory, as Power summarized the book's thesis, that "care had nothing whatever to do with discipline: It meant simply that only a few students at a time could be taught effectively. However, since there is no concensus on the effect of class size on academic achievement. it becomes imperative to examine the effect of class size on pupils achievement in Mathematics.

Moreover, gender is another factor that could affect students’ achievement in mathematics. The widespread belief that males outperform females in mathematics is apparently a myth. A meta-analysis (Hyde, Fennema, and Lamon 1990) showed that boys tend to do better in mathematics tests that involve problem solving, at least by the time they reach high school. Girls, however, do better in computation and there is no gender difference in understanding concepts. According to Kimball (1989), girls tend to earn better grades in mathematics than boys. Gender differences in mathematics performance that favour males are usually attributed to gender socialization (Boswell 1980; Brush 1980; Eccles and Jacobs 1986; Linn and Peterson 1986; Parsons, Adler and Kaczala and Meece1982; Sherman 1979, 1980; Sherman and Fennema 1997; Stallings 1979). Basically, the argument is that girls are thought to have low aptitude for mathematics and that they will not need skills in advanced mathematics as adults (Chipman and Thomas 1985). These socialization practices cause girls to lose interest in mathematics and to lack confidence in their mathematical ability. As a result, they avoid mathematics courses in high school. This situation puts them at even a greater disadvantage because the most accurate predictor of performance on tests in mathematics is the number of mathematics courses taken (Jones 1984). Girls also may experience math anxiety (fear of mathematics) because of the messages they receive, which can interfere with learning and test performance (Meece, Wigfield and Eccles 1990; Tobias 1987).

Gherasim, Butnaru and Mairean (2013) found gender effects in such variables as achievement goals, classroom environments and achievement in mathematics among young adolescents showing that girls obtained higher grades in mathematics than boys. Girls reported higher classroom support, lower performance-avoidance goals (Shim, Ryan and Anderson, 2008) and more mastery of the learning materials (Perkun, Elliot and Maier, 2006). Another aspect, students' attitude, was studied by Jones and Young (1995), who found that boys had more favorable attitudes towards mathematics and science than girls. Emotions towards mathematics were studied by Frenzel, Pekrun and Goetz (2007) who found that girls experienced less enjoyment and pride than boys. Boys on the other hand , experienced less anxiety and less hopelessness towards mathematics than girls. They also found that girls felt slightly more shame than boys.

**Statement of the Problem**

The ever-growing world population and the craze for education mean that classes will continue to grow. A common feature in institutions of learning is the large number of students taught by a single teacher. With such a high teacher-student ratio, the teacher has no option but to adopt self-help measures, which are in no way ideal or adequate for appropriate learning. A critical issue that becomes a focus in the recent development is the issue of the ability of the regular classroom lessons to meet the learning requirements of the pupils in mathematics subject. It is now thought that complementing the classroom lessons with a small number of pupils may help in guiding them towards better performance. Inspite of the importance of Mathematics, there is a general low-level of pupils performance in Mathematics in examination, therefore the class-size couldbe the cause of this low performance.

**Purpose of the Study**

The purpose of this study was to find out the effect of small class size on academic achievement of pupils in mathematics in Primary schools. Specifically, the study sought to find out

1. The mean scores of the pupils taught mathematics in small class and those taught in large class.

2. The mean scores of male and female pupils taught mathematics in small class.

**Scope of the study**

This study is restricted to primary four pupils in private owned primary schools in Ogbaru Local Government Area in Anambra State in teaching and learning of fractions in Numbers and numeration in Mathematics.

**Significance of the study**

A study such as this will be significant in many ways to the pupils, teachers, educational administration, and government.

There is going to be a great improvement on the part of the pupils who learn because the teacher will know them, their skills, passion, strength and learning styles and more likely offer individual attention and guidance to them.

They are going to be exposed to more one on one interaction with the teacher, thereby enhancing their strengths and improving their weaknesses. They will have the opportunity to speak up and be heard among their peers which will help them to build self confidence and public speaking skills.

Teachers will be in the better position to justify the performance of each child which will guide their subsequent steps and strategies towards enhancing better teaching with regards to the pupil’s performance.

They are going to be prevented from becoming overwhelmed and overworked, which leads to higher teacher satisfaction rates. This is because small class size consists of small number of pupils which the teacher will have limited time to spend with.

This study will be of great value to schools and educational administrators in their educational planning and reformations by knowing the number of pupils that should be taught in a particular class by a teacher.

Finally, the study will be very important as it might create jobs for unemployed Mathematics teachers. The government might realize the needs for more hands with regards to recruitment of many Mathematics experts who would be deployed in schools.

**Research questions**

The following Research questions are formulated to guide the study

1. What are the mean scores of the pupils taught Mathematics in small class and those taught in large class?

2. What are the mean scores of the male and female pupils taught mathematics in small class.

**Research hypothesis**

The following hypotheses are tested at 0.05 level of significance.

Ho1: There is no significant difference in the mean scores of pupils taught Mathematics in small class and those taught in large class.

Ho2: There is no significant difference in the mean scores of male and female pupils taught Mathematics in small class.

**CHAPTER TWO**

**REVIEW OF RELATED LITERATURE**

This chapter will be discussed under the following headings:

Conceptual Framework

Theoretical Framework

Empirical Studies

Summary of Reviewof Related Literature

**Conceptual Frame work**

Concept of Class size

Concept of Small class size

Concept of Mathematics

Concept of Fraction

Concept of academic achievement

Gender

**Concept of class size**

Class size refers to the number of students in a given course or classroom, specifically either: the number of students being taught by individual teachers in a course or classroom or the average number of students being taught by teachers in a school, district, or educational system . The term may also extend to the number of students participating in learning experiences that may not take place in a traditional classroom setting, or it may also refer to the total number of students in a particular grade level or “class” in a school (although this usage is less common in public education). Locastro (1989) reported that in Japan, the average largest class size is 45 and the normal 38, while small class sizes range from 19 to 24. Class size is a term that describes students' population per class and teacher- students’ ratio in an ideal, moderate or out of place classroom situation. Hoffman (2003) described it as the number of students per teacher in the teaching-learning process in a classroom. Kedney (2005) submitted that class size can be used to measure the performance of the education system.

**Concept of small class size**

Small class size will be defined as classes with approximately 15 students, while large or regular class will be defined as classrooms with approximately 24 or more students (Harris and Plank, 2000). Locastro (1989) asserted that small class size falls between 4 and 7.In recent decades, a variety of reform efforts have been focused on decreasing class sizes, or the average class sizes in an education system, as a strategy for improving school and student performance. After research studies found that smaller class sizes could have positive effects on student learning and academic achievement, many initiatives—both at the level of state and federal policy, and in individual schools and districts—sought to lower student-teacher ratios. The basic rationale is that if teachers have fewer students, they can devote more time and attention to each student, including more time diagnosing specific learning needs, critiquing work products, and giving students one-on-one instruction and academic support. For example, a teacher that has 15 students in a class when compared with the one that has 50 students in a class, it is clear that there will be increase in the teaching workload. If a teacher with 15 students in a class spends only 10 minutes reading, analyzing, and responding to a writing assignment (a short amount of time), the teacher will have to devote 150 minutes to the process for the whole class or about 2 and half hours. But for a teacher with 50 students, the time required would be 500 minutes or about 8 hours. This example illustrates, at a certain point that class size, for purely logistical reasons, will affect the instructional options available to teachers, since the demands of lesson preparation, teaching duties, and assignment grading can quickly become unmanageable as class sizes increase. And the more students that teachers have, the more likely it is that they will have to rely on instructional methods that require less time to complete, such as grading short-answer worksheets or scoring multiple-choice tests

An alternative way to reduce, or effectively reduce, class size is to use a variety of instructional- and school-configuration strategies broadly known as “small learning communities.” While many different school designs and teaching methods are used to create small learning communities within new or existing schools, the general goal is to increase the amount of one-on-one attention, personalized instruction, or academic support for students. In small learning communities, students are paired with teachers, counselors, and support specialists who, over time, get to know the students and their specific learning needs well, enabling them to educate the students more effectively. Even though the average student-teacher ratio in a school may or may not change in small-learning-community settings, students will be grouped and supported in ways that can potentially reproduce the benefits of smaller class sizes. It is important to note, however, that smaller learning communities, and related strategies such as advisories or teaming, may take a wide variety of configurations from school to school, and they may be more effective or less effective depending on the quality of their design and execution.

In recent decades, there has been much debate about class size and whether simply reducing student-teacher ratios will lead to improved student learning and academic achievement particularly on a large scale, such as in a state’s public-education system. While reducing class sizes, and the attendant professional burdens placed on teachers, seems to be a logical way to improve the amount of instructional time and attention given to each student, research studies have found mixed results: some indicated that smaller class sizes produce educational benefits for students, but others suggested that strong teaching is the main factor, and that simply hiring more teachers who may not necessarily be more experienced and skilled teachers will simply increase educational costs without producing the desired results.

In the ongoing debate about class size, costs tend to play a significant role. For example, critics of lower student-teacher ratios may argue that an effective teacher can teach a larger class of students better than an ineffective teacher can teach a smaller class, and therefore the benefits do not justify the increased costs. Proponents may counter that both effective and less-effective teachers will be more effective in smaller classes.Results showed that as class sizes become smaller, there were more times when students were the focus of a teacher’s attention, and more times when they were engaged.

**Importance of Small class size**

In a 10-student class, it stands to reason that each student will have three times more individual face time with their teacher. This type of educating is critical, both for development of skills and for inspiring students. With more one-on-one time with their teacher, students are certain to have a greater sense that their teacher cares for them, and when students feel like someone they look up to cares about their work, they excel (Bored Teachers.com 2018).

Also,in a 30-student class, it becomes much easier for the quiet kids, or the unmotivated kids, to hide in a clique of friends or the back of the class. With fewer students, the teacher is more capable of ensuring everyone participates and engages the material. This ensures students can’t fake it, thus must keep up, while teachers can prevent declining engagement and scores (Bored Teachers.com 2018).

In large classes, teachers can struggle to identify where problems might be arising, and then because their time is so valuable, they further struggle to adequately address these issues. When a teacher has 30 essays to grade, less time is spent on each one and flaws are glazed over in writing skills that could be fixed with minimal instruction. Within these kinds of spaces, where teachers are spending too little time watching for and addressing individual issues, students begin to slip through the cracks (Bored Teachers.com 2018).

A smaller class will ultimately make a more cohesive unit than a larger one. A class of 30+ students allows for the formation of cliques even within the class, as well as ensures not all students need to engage each other - students can often stick to who they are comfortable with. However, in a smaller classroom setting, students will have the opportunity to interact with and form relationships with all of their classmates, ensuring that the class is more supportive of each other (Bored Teachers.com 2018).

Related to the increased amount of individual time spent is the quality of relationships teachers are able to build with each student. In smaller classes, teachers better know the strengths, weaknesses, and needs of each pupil. With this increased level of attention, teachers can more successfully relate and instruct, thus becoming more than a simple instructor, but a genuine role model.

When students have a strong relationship with their teacher and know they are responsible for their work and level of participation, they are bound to be more engaged with the curriculum. This has two roots: first, students are in an environment where engagement and quality work is simply expected of everyone, it becomes something of a cultural norm; second, when students have strong relationships with teachers, when they care what their teacher thinks of their performance, they are certain to produce better work (Bored Teachers.com 2018).

With a small group, teacher attention is more focused, students are more inclined to engage and be enthusiastic towards the material, and when this happens, work gets done faster. When work is done faster, classes can cover more ground, explore more topics, and more completely experience the curriculum and ideas presented. And when all the work is done, everyone has time for more fun in class, thus improving class culture and cohesion (Bored Teachers.com 2018).

In a 10-student class, there will simply be less noise - it’s a matter of physics. Furthermore, it will be easier to avoid letting the group get out of hand, and as mentioned earlier , it is vastly easier to identify issues as they arise, thus ensuring a tranquil learning environment. And with a peaceful class, all of the other benefits presented above are amplified (Bored Teachers.com 2018).

The above reasons are a list of the pedagogical benefits of smaller class sizes, but in aggregate they make for better, more productive, and easier-to-manage environments for the teachers. When teachers are given the space to be productive in a positive and peaceful class, they are simply happier and better at their jobs. The “grind” becomes less of one, teachers last longer in the field, and there is ultimately a net benefit for the field of education when teachers are happier.

**Concept of Mathematics**

Mathematics is the science that deals with the logic of shape, quantity and arrangement (Elaine 2013). Mathematics is all around us, in everything we do. It is the building block for everything in our daily lives including mobile devices, architecture (ancient and modern), art, money, engineering and even sports. Since the beginning of the recorded history, mathematics discovery has been at forefront of every civilized society, and in use in even the most primitive of cultures. The needs of mathematics arose based on the wants of the society. The more complex a society, the more complex the mathematical needs. Primitive tribes needed little more than the ability to count, but also relied on mathematics to calculate the position of the sun and the physics of hunting.

As civilizations developed, mathematicians began to work with geometry, which computes areas and volumes to make angular measurements and has many practical applications. Geometry is used in everything from home construction to fashion and interior design (Elaine 2013). Geometry went hand in hand with algebra. Algebra offered civilizations a way to divide inheritances and allocate resources. Mathematicians in ancient times also began to look at number theory. With origins in the construction of shape, number theory looks at figurative numbers, the characterization of number theorems.

Mathematics encompasses a growing variety and depth of subjects over history and comprehension requires a system to categorize and organize the many subjects into more general areas of mathematics (Wikipedia 2016). A number of different classification schemes have arisen, and though they share some similarities, there are differences due in part to the different purposes they serve.

A traditional division of mathematics is into pure mathematics; mathematics studied for its intrinsic interest and applied mathematics, mathematics which can be directly applied to real world problems. Mathematicians have always worked with logic and symbols. The study of structure begins with numbers. Within the world of mathematics, analysis is the branch that focuses on change. Number theory is traditionally concerned with the properties of integers. It can be divided into elementary number theory, analytic number theory, algebraic number theory and so on.

Mathematics is the underlying rule behind everything that we interact with in our environment. It is a highly interconnected subject that involves understanding and reasoning about concepts and relationship between them. As research demonstrate that virtually all young children have the capability to learn and become competent in mathematics, young people need time and multiple experiences in order to develop the mathematical confidence to tackle unfamiliar tasks.

**Concept of Fraction**

Fraction is gotten from the Latin world” fractus” which means to break. It represents a part of a whole or, more generally, any number of equal parts (Encyclopedia of mathematics 2014).A fraction is a number we need for measuring. For counting, we have the natural numbers: 1, 2, 3, 4. But when we measure something, such as a length, it will not always be a whole number. Therefore we need numbers that are less than 1, numbers that are the parts of 1: half of 1, a third, a fourth, a fifth, a millionth. A number written with a numerator and a denominator, in which both are natural numbers. A fraction describes how many parts of a certain size there are, for example, one-half, eight-fifths, three-quarters. A common or simple fraction (example, 17/3) consists of an integer numerator displayed above a line (or before a slash), and a non-zero integer denominator, displayed below (or after) that line. Numerators and denominators are also used in fractions that are not common, including compound fractions, complex fractions, and mixed numerals.

Every fraction is constructed in this way from number 1, which is the source of every number of arithmetic. The whole numbers are the multiples of 1. The fractions are its parts: its halves, thirds, fourths, fifths, and so on. Since the numerator and denominator are natural numbers, the numerator has a ratio to the denominator (3 is three tenths of 10) And the fraction itself has that same ratio to 1 (3/10 is three tenths of 1).

Fractional symbols therefore indicate a ratio. The fraction indicates the ratio of 1 to 2. 1 is half of 2. Any number that can be written as a fraction is therefore called a rational number. Now in everyday speech, a fraction means a part of a whole, as in the phrase "a fraction of the students." But students are discrete not continuous, and in mathematics a fraction is a number we need to measure what is continuous. A mathematical fraction is not simply a part of any whole. It is a part of the unit of measure.

An improper fraction is a fraction greater than or equal to one (1). An improper fraction is recognized when the numerator is greater than or equal to the denominator. In fact, when the numerator is equal to the denominator, then the fraction is equal to 1. To change an improper fraction to a mixed number or a whole number, divide the numerator by the denominator, write the quotient , and write the remainder as the numerator of the fraction; do not change the denominator. When we change an improper fraction to a mixed number, we say that we are extracting or taking out the whole number. The numerator represents a number of equal parts, and the denominator indicates how many of those parts make up a unit or a whole. The denominator cannot be zero because zero parts can never make up a whole. For example, in the fraction 3/4, the numerator, 3, tells us that the fraction represents 3 equal parts, and the denominator, 4, tells us that 4 parts make up a whole. The picture to the right illustrates or 3 ⁄ 4 of a cake.

A common fraction is a numeral which represents a rational number. That same number can also be represented as a decimal, a percent, or with a negative exponent. For example, 0.01, 1%, and 10−2 all equal the fraction 1/100. An integer such as the number 7 can be thought of as having an implicit denominator of one: 7 equals 7/1.

In mathematics the set of all numbers that can be expressed in the form a/b, where a and b are integers and b is not zero, is called the set of rational numbers and is represented by the symbol Q , which stands for quotient . The test for a number being a rational number is that it can be written in that form ( as a common fraction). However, the word fraction is also used to describe mathematical expressions that are not rational numbers.

Informally, the numerator and denominator may be distinguished by placement alone but in formal contexts they are always separated by afraction bar. The fraction bar may be horizontal (as in 1/3), oblique (as in 1/5), or diagonal (as in 1 ⁄ 9). The denominators of English fractions are generally expressed as ordinal numbers, in the plural if the numerator is not one. (For example, 2 ⁄ 5 and 3 ⁄ 5 are both read as a number of "fifths".) Exceptions include the denominator 2, which is always read "half" or "halves", the denominator 4, which may be alternatively expressed as "quarter"/"quarters" or as "fourth"/"fourths", and the denominator 100, which may be alternatively expressed as "hundredth"/"hundredths" or " percent ". When the denominator is 1, it may be expressed in terms of "wholes" but is more commonly ignored, with the numerator read out as a whole number.

**Forms of fractions**

Simple, common, or vulgar fractions

A simple fraction (also known as a common fraction or vulgar fraction) is a rational number written as a/ b where a and b are both integers. As with other fractions, the denominator (b) cannot be zero. Simple fractions can be positive or negative, proper, or improper etc. Compound fractions, complex fractions, mixed numerals, and decimals are not simple fractions, though, unless irrational, they can be evaluated to a simple fraction.

A unit fraction is a common fraction with a numerator of 1. Unit fractions can also be expressed using negative exponents, as in 2 −1, which represents 1/2, and 2 −2, which represents 1/(2 2 ) or 1/4.

A dyadic fraction is a common fraction in which the denominator is a power of two.

Proper and improper fractions

Common fractions can be classified as either proper or improper. When the numerator and the denominator are both positive, the fraction is called proper if the numerator is less than the denominator, and improper otherwise. In general, a common fraction is said to be a proper fraction if the absolute value of the fraction is strictly less than one that is, if the fraction is greater than −1 and less than 1.

Reciprocals and the invisible denominator

The reciprocal of a fraction is another fraction with the numerator and denominator exchanged. The product of a fraction and its reciprocal is 1; hence the reciprocal is the multiplicative inverse of a fraction. The reciprocal of a proper fraction is improper, and the reciprocal of an improper fraction not equal to 1, that is, numerator and denominator are not equal, is a proper fraction.

When the numerator and denominator of a fraction are equal, for example, its value is 1, and the fraction therefore is improper, Its reciprocal also has the value 1, and is improper, too. Any integer can be written as a fraction with the number one as denominator. For example, 17 can be written as , where 1 is sometimes referred to as the invisible denominator . Therefore, every fraction or integer, except for zero, has a reciprocal.

Ratios

A ratio is a relationship between two or more numbers that can be sometimes expressed as a fraction. Typically, a number of items are grouped and compared in a ratio, specifying numerically the relationship between each group. Ratios are expressed as "group 1 to group 2 ... to group n". For example, if a car lot had 12 vehicles, of which 2 are white, 6 are red, and 4 are yellow, then the ratio of red to white to yellow cars is 6 to 2 to 4. The ratio of yellow cars to white cars is 4 to 2 and may be expressed as 4:2 or 2:1. A ratio is often converted to a fraction when it is expressed as a ratio to the whole. In the above example, the ratio of yellow cars to all the cars on the lot is 4:12 or 1:3. We can convert these ratios to a fraction and say that 4/12 of the cars or ⅓ of the cars in the lot are yellow. Therefore, if a person randomly chose one car on the lot, then there is a one in three chances or probability that it would be yellow.

Decimal fractions and percentages

A decimal fraction is a fraction whose denominator is not given explicitly, but is understood to be an integer power of ten. Decimal fractions are commonly expressed using decimal notation in which the implied denominator is determined by the number of digits to the right of a decimal separator. Thus for 0.75 the numerator is 75 and the implied denominator is 10 to the second power, viz. 100, because there are two digits to the right of the decimal separator. In decimal numbers greater than 1 (such as 3.75), the fractional part of the number is expressed by the digits to the right of the decimal (with a value of 0.75 in this case). 3.75 can be written either as an improper fraction, 375/100, or as a mixed number.

Decimal fractions can also be expressed using scientific notation with negative exponents, such as 6.023 × 10 −7, which represents 0.0000006023. The 10−7 represents a denominator of 107. Dividing by 107 moves the decimal point 7 places to the left.

Decimal fractions with infinitely many digits to the right of the decimal separator represent aninfinite series. For example, ⅓ = 0.333... represents the infinite series 3/10 + 3/100 + 3/1000 + ... . Another kind of fraction is the percentage (Latin per centum meaning "per hundred", represented by the symbol %), in which the implied denominator is always 100. Thus, 51% means 51/100. Percentages greater than 100 or less than zero are treated in the same way, e.g. 311% equals 311/100, and −27% equals −27/100.

Whether common fractions or decimal fractions are used is often a matter of taste and context. Common fractions are used most often when the denominator is relatively small. By mental calculation, it is easier to multiply 16 by 3/16 than to do the same calculation using the fraction's decimal equivalent (0.1875). And it is more accurate to multiply 15 by 1/3, for example, than it is to multiply 15 by any decimal approximation of one third. Monetary values are commonly expressed as decimal fractions with denominator 100, i.e., with two decimals, for example $3.75. However, as noted above, in pre-decimal British currency, shillings and pence were often given the form (but not the meaning) of a fraction, as, for example 3/6 (read "three and six") meaning 3 shillings and 6 pence, and having no relationship to the fraction 3/6.

Mixed numbers

A mixed numeral (also called a mixed fraction or mixed number) is a traditional denotation of the sum of a non-zero integer and a proper fraction (having the same sign). It is used primarily in measurement; inches, for example. Scientific measurements almost invariably use decimal notation rather than mixed numbers. The sum is implied without the use of a visible operator such as the appropriate "+". For example, in referring to two entire cakes and three quarters of another cake, the numerals denoting the integer part and the fractional part of the cakes are written next to each other.

An improper fraction can be converted to a mixed number as follows:

1. Divide the numerator by the denominator. For example, divide 11 by 4. 11 ÷ 4 = 2 with remainder 3.

2. The quotient (without the remainder) becomes the whole number part of the mixed number. The remainder becomes the numerator of the fractional part. In the example, 2 is the whole number part and 3 is the numerator of the fractional part.

3. The new denominator is the same as the denominator of the improper fraction. In the example, they are both 4.

Complex and Compound fractions

“Complex” and “compound" tend to be used in their every day meaning of "consisting of parts".

Complex fractions

In a complex fraction, either the numerator, or the denominator, or both, is a fraction or a mixed number, corresponding to division of fractions. If, in a complex fraction, there is no unique way to tell which fraction lines takes precedence, then this expression is improperly formed, because of ambiguity. So 5/10/20/40 is not a valid mathematical expression, because of multiple possible interpretations.

Compound fractions

A compound fraction is a fraction of a fraction, or any number of fractions connected with corresponding to multiplication of fractions.

Equivalent fractions

Multiplying the numerator and denominator of a fraction by the same (non-zero) number results in a fraction that is equivalent to the original fraction. This is true because for any non-zero number, the fraction might be equal. Therefore, multiplying by two is equivalent to multiplying by one, and any number multiplied by one has the same value as the original number.

Dividing the numerator and denominator of a fraction by the same non-zero number will also yield an equivalent fraction. This is called reducing or simplifying the fraction. A simple fraction in which the numerator and denominator are co prime (that is, the only positive integer that goes into both the numerator and denominator evenly is 1) is said to be irreducible, in lowest terms, or in simplest terms. A common fraction can be reduced to lowest terms by dividing both the numerator and denominator by their greatest common divisor. For example, as the greatest common divisor of 63 and 462 is 21, the fraction can be reduced to lowest terms by dividing the numerator and denominator by 21. The Euclidean algorithm gives a method for finding the greatest common divisor of any two positive integers.

Comparing fractions

Comparing fractions with the same positive denominator yields the same result as comparing the numerators, because 3 > 2, and the equal denominators are positive. If the equal denominators are negative, then the opposite result of comparing the numerators holds for the fractions. If two positive fractions have the same numerator, then the fraction with the smaller denominator is the larger number. When a whole is divided into equal pieces, if fewer equal pieces are needed to make up the whole, then each piece must be larger. When two positive fractions have the same numerator, they represent the same number of parts, but in the fraction with the smaller denominator, the parts are larger. One way to compare fractions with different numerators and denominators is to find a common denominator.

Because every negative number, including negative fractions, is less than zero, and every positive number, including positive fractions, is greater than zero, it follows that any negative fraction is less than any positive fraction. This allows comparison of all possible fractions.

Addition

The first rule of addition is that only like quantities can be added; for example, various quantities of quarters. Unlike quantities, such as adding thirds to quarters, must first be converted to like quantities. To add fractions containing unlike quantities (e.g. quarters and thirds), it is necessary to convert all amounts to like quantities. It is easy to work out the chosen type of fraction to convert to; simply multiply together the two denominators (bottom number) of each fraction. In case of an integer number apply the invisible denominator

Subtraction

The process for subtracting fractions is, in essence, the same as that of adding them: find a common denominator, and change each fraction to an equivalent fraction with the chosen common denominator. The resulting fraction will have that denominator, and its numerator will be the result of subtracting the numerators of the original fractions.

Multiplication

Multiplying a fraction by another fraction

To multiply fractions, multiply the numerators and multiply the denominators. Thus, consider one third of one quarter. Using the example of a cake, if three small slices of equal size make up a quarter, and four quarters make up a whole, twelve of these small, equal slices make up a whole. Therefore, a third of a quarter is a twelfth. Now consider the numerators. The first fraction, two thirds, is twice as large as one third. Since one third of a quarter is one twelfth, two thirds of a quarter is two twelfth. The second fraction, three quarters, is three times as large as one quarter, so two thirds of three quarters is three times as large as two thirds of one quarter. Thus two thirds times three quarters is six twelfths. A short cut for multiplying fractions is called "cancellation". Effectively the answer is reduced to lowest terms during multiplication. For example; A two is a common factor in both the numerator of the left fraction and the denominator of the right and is divided out of both. Three is a common factor of the left denominator and right numerator and is divided out of both.

Multiplying a fraction by a whole number

Since a whole number can be rewritten as itself divided by 1, normal fraction multiplication rules can still apply. This method works because the fraction 6/1 means six equal parts, each one of which is a whole.

Multiplying mixed numbers

When multiplying mixed numbers, it is considered preferable to convert the mixed number into an improper fraction.

Division

To divide a fraction by a whole number, one may either divide the numerator by the number, if it goes evenly into the numerator, or multiply the denominator by the number.

Converting between decimals and fractions

To change a common fraction to a decimal, do a long division of the decimal representations of the numerator by the denominator (divide the denominator into the numerator), and round the answer to the desired accuracy. To change a decimal to a fraction, write in the denominator as followed by as many zeroes as there are digits to the right of the decimal point, and write in the numerator all the digits of the original decimal, just omitting the decimal point.

Fractions in abstract mathematics

In addition to being of great practical importance, fractions are also studied by mathematicians, who check that the rules for fractions are consistent and reliable . Mathematicians define a fraction as an ordered pair of integers and for which the operations addition, subtraction , multiplication and division are defined. In case of fractions of integers the fractions with coprime are often taken as uniquely determined representatives for their equivalent fractions, which are considered to be the same rational number. This way the fractions of integers make up the field of the rational numbers.

Algebraic fractions

An algebraic fraction is the indicated quotient of two algebraic expressions. As with fractions of integers, the denominator of an algebraic fraction cannot be zero. Algebraic fractions are subject to the same field properties as arithmetic fractions.If the numerator and the denominator are Polynomials, the algebraic fraction is called a rational fraction (or rational expression). An irrational fraction is one that is not rational, for example, one that contains the variable under a fractional exponent or root.

The terminology used to describe algebraic fractions is similar to that used for ordinary fractions. For example, an algebraic fraction is in lowest term if the only factors common to the numerator and the denominator are 1 and −1. An algebraic fraction whose numerator or denominator, or both, contain a fraction, is called a complex fraction .The field of rational numbers is the field of fractions of the integers, while the integers themselves are not a field but rather anintegral domain . Similarly, the rational expressions are the field of fractions ofpolynomials . There are different integral domains of polynomials, depending on the integral domain the coefficients of the polynomials are from (e.g. from integers, real numbers , complex numbers , etc).

The term partial fraction is used when decomposing rational expressions into sums. The goal is to write the rational expression as the sum of other rational expressions with denominators of lesser degree. For example, the rational expression can be rewritten as the sum of two fractions. This is useful in many areas such as integral calculus and differential equations.

Radical expressions

A fraction may also contain radicals in the numerator and/or the denominator. If the denominator contains radicals, it can be helpful to rationalize it (compare Simplified form of a radical expression), especially if further operations, such as adding or comparing that fraction to another, are to be carried out. It is also more convenient if division is to be done manually. When the denominator is a monomial square root, it can be rationalized by multiplying both the top and the bottom of the fraction by the denominator. The process of rationalization of binomial denominators involves multiplying the top and the bottom of a fraction by the conjugate of the denominator so that the denominator becomes a rational number.

In summary, fractions that are less than 1 are called proper fractions, while fractions greater than or equal to 1 are improper. The proper fractions are the parts of 1. Improper fractions are equivalent to mixed numbers or whole numbers. In English, the names of the proper fractions are the same as the names of the parts, and therefore a fraction and a ratio have become confused. "One quarter" is the name of a part, or a ratio, which is a relationship between two numbers. 5 people are one quarter of 20 people -and that statement is not a measurement, we are not invoking any fraction. The fraction we call "one-quarter," on the other hand, is one quarter of a continuous unit of measure.

**Concept of Gender**

Gender is the range of characteristics pertaining to and differentiating between masculinity and femininity (Wikipedia 2018). According to World Health Organization (2016), gender refers to the socially constructed characteristics of women and men such as norms, roles and relationships of and between groups of men and women. It varies from society to society and can be changed. While most people are born either male or female, they are taught appropriate norms and behaviours including how they should interact with others of the same or opposite sex within households, communities and work places. When individuals or groups do not "fit" established gender norms, they often face stigma, discriminatory practices or social exclusion- all of which adversely affect health. It is important to be sensitive to different identities that do not necessarily fit into binary male or female sex categories. Gender norms, roles and relations influence people's susceptibility to different health conditions and diseases and affect their enjoyment of good mental, physical health and well being. They also have a bearing on people's access to and uptake of health services and on the health outcomes they experience throughout the life course.

Ganley and Lubienski (2016) asserted that at both elementary and secondary levels, boys and girls score similarly on many state tests, and girls get relatively good grades in math classes. However, some gender differences in math attitudes and skills appear during elementary school, and ultimately, boys are much more likely than girls to pursue careers in some key math-intensive fields, such as engineering and computer science. In recent years, concerns about boys and reading have taken some attention away from girls and math, as girls have higher reading achievement than boys in early elementary school. However, it is important to consider that research shows that reading gender gaps narrow during the elementary grades, whereas gender gaps in math grow during early elementary school.

Gherasim, Butnaru and Mairean (2013), found gender effects in such variables as achievement goals, classroom environments and achievement in mathematics among young adolescents showing that girls obtained higher grades in mathematics than boys. Girls reported a higher classroom support, lower performance avoidance goals (Shim, Ryan and Anderson 20088) and more mastery of the learning materials (Perkun, Elliot and Maier, 2006). Jones and Young (1995) found that boys had more favorable attitudes towards mathematics and science than girls. Frenzelm Pekurun and Goetz (2007) found out that girls experienced less enjoyment and pride than boys. Boys on the other hand experienced less anxiety and less hopelessness towards mathematics than girls. They also found that girls felt slightly more shame than boys.

In general, gender differences in math performance are small, which is important to keep in mind. Gender differences on math tests tend to be more pronounced when the content of the assessment is less related to the material that is taught in school. In addition, researchers consistently find that gender gaps are larger among higher-performing students, which may partially explain the gender gaps in mathematics related careers, as these are often pursued by the highest-performing students.

A number of different potential explanations exist for the small gender differences that persist and why larger gaps exist in mathematics related career choices. Below,the research on some of the factors that have been found to contribute to gender differences in mathematics and mathematics related career choices are summarized.

Research consistently shows that, even from a fairly young age, girls are less confident and more anxious about mathematics than boys. Moreover, these differences in confidence and anxiety are larger than actual gender differences in mathematics achievement. These attitudes are important predictors of mathematics performance and mathematics related career choices. Men and women also tend to prioritize different values when selecting a profession. For example, women tend to care more about working with people, and men tend to be more interested in working with things, and research shows that this difference relates to gender gaps in selection of math-related careers (Ganley and Lubienski 2016).

Some researchers have found that boys tend to use more novel problem-solving strategies, whereas girls are more likely to follow school-taught procedures. In general, girls more often follow teacher-given rules in the classroom, and it could be that this “good girl” tendency inhibits their mathematics explorations and development of bold problem-solving skills. Such differences may contribute to gender gaps in mathematics achievement as content becomes more complex and problem-solving situations call for more than learned procedures (Ganley and Lubienski 2016).

Boys tend to be stronger in the ability to mentally represent and manipulate objects in space, and these skills predict better mathematics performance and STEM career choices. Fortunately, some researchers have found that spatial skills can be improved through training, and one study even found that the gender gap in spatial skills was eliminated with training (Ganley and Lubienski 2016).

Recently, researchers found that girls’ mathematics achievement is lower if they have a female teacher who is anxious about mathematics. This may be because these girls are picking up on gender stereotypes. In addition, some of theresearchers suggest that when boys and girls have the same mathematics performance and behaviors in mathematics class, teachers perceive that the boys are better at mathematics, and that this “differential rating” of boys and girls contributes to gender gaps in mathematics performance. This is not to suggest that teachers are to blame for gender differences in mathematics performance. Teachers’ views simply reflect those of society as a whole. Research has been mixed about whether today's children hold gender stereotypes about mathematics. Children often report being aware of gender stereotypes about mathematics, but they less often indicate that they believe those stereotypes (Ganley and Lubienski 2016).

Although girls outperform boys in academic achievement, in general, boys still have an advantage in other fields. One possible explanation for the female disadvantage in mathematics and their under representation in technical professions is culturally embedded beliefs about female inferiority and male superiority in mathematics and related disciplines. On one hand, these beliefs can lead to different subject specific investment strategies of female and male students. On the other hand, the presence of negative stereotypes about girls' lower competencies in mathematics in classrooms can hamper girls' performance through stereotype threat by their peers' expectation. Accordingly, not only the own beliefs are relevant but also the attitudes of classmates that can reinforce behaviour patterns of adolescents conforming the prevailing gender norms (Oxford Academic 2017).

**Concept of academic achievement**

Achievement is something accomplished, especially by superior ability, special effort, great courage etc; a great or heroic deed. It is the act of learning; attainment or accomplishment (Dictionary.com, LLC, 2018).

Academic achievement has become an educational touchstone since the passage of the federal No Child left Behind Act in 2001, requiring all educators including school counselors- to formally define how their jobs and programmes impact students' academic growth and contribute to overall school success (School-counselors.org 2018). The definition of academic achievement, however, varies among educators, policymakers and other educational stakeholders.

According to (Steinmayr, Meibner, Weidinger, Wirthwein 2014), Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college, and university. School systems mostly define cognitive goals that either apply across multiple subject areas (e.g., critical thinking) or include the acquisition of knowledge and understanding in a specific intellectual domain (e.g., numeracy, literacy, science, history). Therefore, academic achievement should be considered to be a multifaceted construct that comprises different domains of learning. Because the field of academic achievement is very wide-ranging and covers a broad variety of educational outcomes, the definition of academic achievement depends on what the indicators used to measure it. Among the many criteria that indicate academic achievement, there are very general indicators such as procedural and declarative knowledge acquired in an educational system, more curricular-based criteria such as grades or performance on an educational achievement test, and cumulative indicators of academic achievement such as educational degrees and certificates. All criteria have in common that they represent intellectual endeavors and thus, more or less, mirror the intellectual capacity of a person. In developed societies, academic achievement plays an important role in every person’s life. Academic achievement as measured by the GPA (grade point average) or by standardized assessments designed for selection purpose such as the SAT (Scholastic Assessment Test) determines whether a student will have the opportunity to continue his or her education (e.g., to attend a university). Therefore, academic achievement defines whether one can take part in higher education, and based on the educational degrees one attains, influences one’s vocational career after education. Besides the relevance for an individual, academic achievement is of utmost importance for the wealth of a nation and its prosperity. The strong association between a society’s level of academic achievement and positive socioeconomic development is one reason for conducting international studies on academic achievement, such as PISA (Programme for International Student Assessment), administered by the OECD (Organization for Economic Co-operation and Development). The results of these studies provide information about different indicators of a nation’s academic achievement; such information is used to analyze the strengths and weaknesses of a nation’s educational system and to guide educational policy decisions. Given the individual and societal importance of academic achievement, it is not surprising that academic achievement is the research focus of many scientists; for example, in psychology or educational disciplines.

The exploration of academic achievement has led to numerous empirical studies and fundamental progress such as the development of the first intelligence test by Binet and Simon. However, as academic achievement is a broad topic, several textbooks have focused mainly on selected aspects of academic achievement, such as enhancing academic achievement or specific predictors of academic achievement. Spinath 2012 emphasizes the importance of academic achievement with regard to different perspectives (such as for individuals and societies, as well as psychological and educational research). Hattie 2009, provides an overview of the empirical findings on academic achievement by distinguishing between individual, home, and scholastic determinants of academic achievement according to theoretical assumptions. However,Spinath 2012 points out that it is more appropriate to speak of “predictors” instead of determinants of academic achievement because the mostly cross-sectional nature of the underlying research does not allow causal conclusions to be drawn. Large-scale scholastic achievement assessments such as PISA (OECD 2010) provide an overview of the current state of research on academic achievement, as these studies have investigated established predictors of academic achievement on an international level. Furthermore, these studies, for the first time, have enabled nations to compare their educational systems with other nations and to evaluate them on this basis. However, it should be mentioned critically that this approach may, to some degree, overestimate the practical significance of differences between the countries. Moreover, the studies have increased the amount of attention paid to the role of family background and the educational system in the development of individual performance. The quality of teaching, in particular, has been emphasized as a predictor of student achievement.

Student achievement measures the amount of academic content a student learns in a determined amount of time. Each grade level has learning goals or instructional standards that educators are required to teach. There are many variables that can impact successful student achievement, but the most critical are classroom instructions and learning disabilities. It is important to remember that all students do not learn the same way or at the same rate. Students are like leaves on a tree; there are no two exactly the same. Just as a leaf comes in unique colors, shapes and sizes, each student has their own unique learning style (Study.com 2018).

**Theoretical Framework**

The theory for the work will be based on Lev Vygotsky's Social development theory.

Lev Semyonovich Vygotsky was a soviet psychologist who is best known for his social cultural theory and also a prolific writer. Vygotsky was born on November 17, 1896 in Orsha, a city in the western region of the Russian Empire. Vygotsky's interests were quite diverse but often centered on issues of child development and education. Vygotsky's theory stress the fundamental role of social interaction on the development of a child as he believed strongly that community plays a central role in the process of making meaning.

Vygotsky(1978) argued, "learning is a necessary and universal aspect of the process of developing culturally organized, specifically human psychological function". in other words, social learning tends to precede (come before) development. Vygotsky(1978) believed that social interaction plays a critical role in children’s' learning . Through social interactions, children go through a continuous process of learning. Vygotsky (1978) also believed that adults in a society foster children's development in an intentional and systematic manner by engaging them in challenging and meaningful activities. To Vygotsky, adults convey to children the way their culture interprets and responds to the world through both formal and informal conversations and education. As children develop, they gradually internalize processes they use in social contexts and begin to use them independently. This internalization process allows children to transform ideas and processes to make them uniquely their own.

Vygotsky (1978) also introduced the idea that children can perform more challenging tasks when assisted by more advanced and competent individuals. Vygotsky identified two levels of development: actual development, which is the upper limit of tasks a child can perform with the assistance of a more competent individual. According to Vygotsky,in order to get a true assessment of a child's actual and potential development, the capabilities of the child should be assessed both when the child is performing the activity alone and with a more competent individual.

However, according to Vygotsky (1978), parents and teachers can foster learning by providing educational opportunities that lie within a child's zone of proximal development (ZPD). ZDP is the range of tasks that a child can perform with the help and guidance of others but cannot yet perform independently according to Vygotsky . Kids can also learn a great deal from their interactions with peers, classmates and friends, so teachers can foster this process by pairing less skilled children with more knowledgeable classmates.

The theory discusses how social interactions play a role in children's development, considering the teacher or parent as adult who interacts with children and show the meanings they attach to objects, events and experiences, however; small class size creates room for more one on one interaction of children with the teacher, which helps the teacher to monitor the social behavior of the children individually, knowing the individual differences, weakness and strength of each child. This results to a strong relationship between the children and the teacher and a more positive environment due to the children developing better relationships with each other; higher achieving ones encouraging and assisting their peers. This leads to the production of a better work, in other words, higher academic achievement is attained.

**Empirical Studies**

Idris (2017) carried out a research on the influence of class size on the academic performance of low ability level senior secondary school III (SS III) students in Mathematics in Zaria. The study used ex-post facto design and sample consisted of one hundred and fifty (150) low ability level SS III students whose scores ranged from 0-49 as recommended by Telca using their mock examination results as index of categorization. These students were selected by purposive sampling technique from two randomly selected senior secondary schools in Zaria education zone, Kaduna state. One hypothesis was formulated to direct the study. Students' mathematics score from their SS III mock examination were collected from examination and record office in the examined schools. Data collectedwere analyzed using t-test statistics. The result indicated that there is a significant difference in the mean performance score in mathematics between low ability level students taught by teacher in small class size and those in large class size. Based on the research findings, it is concluded that low ability level students in small class size perform better than those in large class size in the senior secondary school mathematics. It is therefore recommended that the full implementation of the Nigeria national policy on teacher-students ratio of 1: 40 should be encouraged for desired learning outcomes particularly as it affects mathematics. This research work relates to the present researcher's work as it indicates that students perform better when taught in a small class size than large class not withstanding their low ability level, however, pupils can also perform better when taught in a small class.

Anibueze, Ayogu and Abugu (2017), carried out a research on the effect of class size and school location on senior secondary school students' achievement in Mathematics for technological development. The study was guided by three (3) research questions and three (3) research hypotheses were tested at 0.05 levels of significance using the students’t-test. The study was an inferential survey design, which sampled 933 Senior Secondary School 3 (SSS 3) students in Enugu Education zone of Enugu state. The 2016 West African Senior Secondary School Certificate Examination (WASSSCE) mathematics objective paper formed the instrument used for data collection. The instrument was found to be reliable by the reliability coefficient of 0.8 using the Kuder-Richardson formula method (K-R 20). The researchers did not consider it necessary to determine the validity of 2016 West African Senior Secondary School Certificate Examination (WASSSCE) mathematics objective paper, since that the instrument is a standardized test whose validity had already been established by the West African Examination Council (WAEC). The study discovered that students in large classes perform better than the students in small classes, there was no significant difference between the mean achievement scores of senior secondary rural and urban school students in senior secondary certificate mathematics examination and there was no significant difference between the mean achievement scores of senior secondary male and female students in mathematics. Hence, the study recommended that the school authorities, government and heads of school management boards should improve the class size arrangement. Secondly, mathematics teachers and other educational stakeholders should encourage both male and female students to work harder in Mathematics. They should ensure that there is no gender discrimination in Mathematics lesson class or department. Finally, Ministry of Education should provide adequate and appropriate resource materials to the schools both in rural and urban areasevenly in order to enhance students' Mathematics achievement since rural and urban students taught do not differ in their mean achievement scores. The study relates to the present work as the researcher is trying to findout if small class size has any effect on pupils achievement in mathematics since students in large class can perform better than those in small class.

Adigun, Onihunwa, Irunokhai, Sada and Adesina (2015) embarked on a research on effect of Gender on Students’ Academic Performance in Computer Studies in Secondary Schools in New Bussa, Borgu Local Government of Niger State. The research studied the relationship between student’s gender and academic performance in computer science. The research design for the study was the expo-facto design since there was no special treatment given to the subjects and there is no control group

Questionnaire which consist of 30 multiple-choice itemsdrawn from Senior School Certificate Examination past questions as set by the West Africa Examination Councilin 2014 multiple choice past question was used as the research instrument. The questionnaire wasadministered to 275 students from both private and public schools in the study area. The students’ responseswere marked and scored, afterward analysed using independent t-test. The results of the study showed that eventhough the male students had slightly better performance compared to the female students, it was not significant. The better performance was found to be pronounced in the private school which was shown to possess the bestmale brains found in the study area. Based on the findings of this study, recommendations were made. Parentsare encouraged to provide the right education they can afford for their children irrespective of gender. Also, thereshould be a deliberate Federal Government policy to encourage absorbance of female students into further studyin computer science. Furthermore, it was recommended that stake holders in the education industry should makeuse of these findings and try to research into ways of making gender sensitive policies.

**Summary of Literature Review**

Teaching and learning of Mathematics is at the heart of Education. Learning Mathematics aims to link school to everyday life, Provide skill acquisition, Prepare students for the work force and foster mathematical thinking (Ontario Ministry of Education 2005). Mathematics involves learning to problem-solve, investigate, present and communicate mathematical concepts and ideas and making connections to everyday life.

Although some researchers have found that there are no significant differences in male-female mathematics performance at any level, it has been the general belief in most parts of the country that male students tends to perform better compared to the female students in mathematical related or technology based subjects (Atovigba 2012).

As academic achievement represents performance outcomes that indicates the extent to which a person has accomplished specific goals that were the focus of activities in instructional environment specifically in school, college and university,small class provides a supportive and engaging classroom environment which is very important and helps to develop students' mathematical understanding and confidence.Pritchard (1999) stated that smaller classes results in a more positive environment due to students developing better relationships with each other. In smaller classes, teachers better know the strengths, weaknesses and needs of each pupil. And with this increased level of attention, teachers can more successfully relate and instruct, thus becoming more than a simple instructor, but a genuine role model.

**CHAPTER THREE**

**RESEARCH METHOD**

**Research Design**

The design adopted for this research was quasi experimental research design, specifically the non equivalent control group design. A non equivalent group design is a between subjects design in which participants have not been randomly assigned to conditions. The reason for the choice of the design was because the pupils are not randomly assigned to classes by the researcher, and this means there could be important differences between them.

**Area of the study**

The research was conducted in Ogbaru local government area of Anambra state. The reason for the choice of area was because most children in the area are performing badly in mathematics and many schools are overcrowded, therefore, the researcher wants to find out if reducing the class size will help in the improvement of pupils achievement.

**Population of the study**

The population of this study consisted of all the primary school pupils in all the nineteen (19) private primary schools in ogbaru local government area. The total population was 3490 pupils.

**Sample and Sampling Technique**

The sample for the study consisted of sixty five (65) pupils. Purposive sampling procedure was used. The researcher purposely selected an intact class of small number of pupils and large number of pupils in primary four (4). The small class consisted of fifteen (15) pupils while the large class consisted of fifty (50) pupils.

**Instrument for data collection**

The instrument used for the collection of data was Fraction achievement Test (FAT). FAT is the achievement test that measures the competence of the pupils including knowledge and skills in solving problems involving fraction. The FAT consist of twenty (20) questions on proper and improper fraction, equivalent fraction, mixed fraction, ordering of fraction, decimal fraction, addition and subtraction of fraction and fraction in its lowest term.

**Validation of the instrument**

Method of validity employed was face validity. The test was presented to two (2) experts in mathematics education and one (1) in measurement and evaluation. The test was corrected and the corrections were effected. The test was also subjected to content validation through construction of a test blue print.

**Reliability of the instrument**

The researcher used Kuder-Richardson formula 20 to establish the internal consistency reliability of the instrument.

**Experimental procedure**

The researcher administered the first test to the two groups respectively before teaching. Then, the researcher collected their test after writing and started teaching. After having three (3) lessons respectively with each group, the researcher administered another test to each of the groups.

**Control of Extraneous variables**

Extraneous variable such as the pupils faking of their attitude on seeing the researcher was controlled as the researcher was introduced as their new teacher. Also the initial differences in the group which might be as a result of the biasness of the control group feeling that the experimental group is more intelligent than them was controlled using analysis of co-variance. This because analysis of co-variance is a statistical tool in measuring differences in group mean.

**Method of data collection**

The instrument was administered to the pupils by the researcher before and after teaching. So, the method of data collection was through administering of test to the pupils.

**Method of data analysis**

The research questions were answered using mean and standard deviation and the hypotheses were tested using the analysis of co-variance (ANCOVA).

**CHAPTER FOUR**

**ANALYSIS OF DATA AND RESULT**

Research Question one

What are the mean scores of the pupils taught Mathematics in small class and those taught in large class.

Table 1

Pre-test

|  |  |  |  |
| --- | --- | --- | --- |
| Types of group | Mean x | Standard deviation | N |
| Experimental group | 14.9 | 2.88 | 15 |
| Control group | 7.34 | 3.98 | 50 |

Table 2

Post-test

|  |  |  |  |
| --- | --- | --- | --- |
| Types of group | Mean x | Standard deviation | N |
| Experimental group | 18.93 | 1.23 | 15 |
| Control group | 12.02 | 3.18 | 50 |

**Research question two**

What are the mean scores of male and female pupils taught mathematics in small class.

Table 3

Pre-test

|  |  |  |  |
| --- | --- | --- | --- |
| Gender | Mean x | Standard deviation | N |
| Male | 14.4 | 3.01 | 5 |
| Female | 15.2 | 2.79 | 10 |

Table 4

Post-test

|  |  |  |  |
| --- | --- | --- | --- |
| Gender | Mean x | Standard deviation | N |
| Male | 14.4 | 3.01 | 5 |
| Female | 15.2 | 2.79 | 10 |

**Analysis of Research Hypothesis**

Hypothesis one

There is no significant difference in the mean scores of pupils taught mathematics in small class and those taught in large class

Table 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Types of group | Mean x | Standard deviation | T cal | t-tab | L/S | Df | Dec |
| Experimental group | 33.83 | 4.11 | 5.63 | 2.0 | 0.05 | 63 | R |
| Control group | 19.06 | 7.16 |  |  |  |  |  |

The researcher rejects the null hypothesis and claim that there is a significant difference in the mean scores of pupils taught mathematics in small class and those taught in large class.

Hypothesis two

There is no significant difference in the mean scores of male and female pupils taught mathematics in small class.

Table 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Gender | Mean x | Standard deviation | T cal | T-tab | L/S | Df | Dec |
| Male | 33 | 4.35 | 4.14 | 2.0 | 0.05 | 13 | R |
| Female | 34.3 | 3.93 |  |  |  |  |  |

The researcher rejects the null hypothesis and conclude that there is a significance difference in the mean scores of male and female pupils taught mathematics in small class.

**CHAPTER FIVE**

**DISCUSSIONS, CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS AND SUMMARY OF THE STUDY**

This chapter deals with discussions of results, conclusions, implications, recommendations and summary

**Discussions of Results**

From the findings made in research question one, the researcher observed that in the pre test, the experimental group had a mean score of 14.9 and a standard deviation of 2.88 while the control group had a mean score of 7.34 and a standard deviation of 3.98. In the post test, the experimental group had a mean score of 18.93 and a standard deviation of 1.23 while the control group had a mean score of 12.02 and a standard deviation of 3.18.

From the findings made in research question two, the researcher observed that in the pre test, the male pupils has a mean score of 14.4 and a standard deviation of 3.01 whereas the female pupils had a mean score of 15.2 and a standard deviation of 2.79. In the post test, the male pupils had a mean score of 18.6 and a standard deviation of 1.34 while the female pupils had a mean score of 19.1 and a standard deviation of 1.14.

In the analysis of the research hypothesis one, the researcher observed that there is a significant difference in the mean scores of pupils taught mathematics in small class and those taught in large class.

In the analysis of the research hypothesis two, the researcher observed that there is a significant difference in the mean scores of male and female pupils taught mathematics in small class.

**Conclusions**

From the results obtained from the data analysis, the researcher has drawn the following conclusions;

That small class size gives room for a greater academic achievement far muchbetter than large class size. It encourages active participation of the pupils and helps in enhancing their strengths and improving their weaknesses.

Also female students however can as well perform better than the male students in mathematics because many researchers has found out that male students always perform better than the female students.

**Educational Implications**

It is recognized that small class size gives room for a greater academic achievement far muchbetter than large class size, It encourages active participation of the pupils and helps in enhancing their strengths and improving their weaknesses,so there is a need that pupil are taught mathematics in small class .

There is a need for female students to improve and perform better since female students however can as well perform better than the male students in mathematics because many researchers have found out that male students always perform better than the female students.

**Recommendation**

From the findings and implications of the study, the researcher recommended that educators should develop great interest in finding ways of improving pupils reasoning in mathematics and this could be achieved through reduction of class size which makes it easier for the teacher to have more one on one interaction with the pupils. However, it ensures active participation and engagement and work gets done faster.

**Limitations of the study**

The study was limited by class size because not all the primary schools in the area has an intact small classsize and this made the researcher to carry out the research in those primary schools that has an intact class of small size. Also, because it is uncommon to find a public school with a small number of pupils in a class, the research was carried out in private schools. There was a limited time frame for the study.

**Suggestions for further study**

Based on the limitations and findings of this study, the researcher makes these suggestions for further research:

The extent small class size improves academic achievement.

The impact of using audio-visual aids in teaching students with respect to a small class size.

**Summary**

The purpose of this study is to find out the effect of small class size on academic achievement of pupils in mathematics. The research was a quasi experimental research specifically the non equivalent control group design. The data were analyzed using mean and standard deviation in answering the research questions and analysis of co-variance in testing the hypotheses. The finding was that small class size has a positive effect on the academic achievement of pupils, however, there will be a great improvement in mathematics performance and less phobia in the subject if the educational administrators will adopt the measure of assigning a small number of pupils to a particular class.

School ­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class: Primary four (4)

Gender: Male Female

Subject: Mathematics Time: 1 Hour: 30 mins

**TEST**

Instruction: Answer all questions and kindly tick one answer for each question from the options lettered A- D

Using the first number as the denominator, what is the correct name of the fraction in nos.1 -3?

1. 5, 3 (a) proper fraction (b) improper fraction (c) mixed fraction (d) normal fraction.
2. 15, 4 (a) proper fraction (b) improper fraction (c) mixed fraction (d) ordinary fraction
3. 6,9 (a) proper fraction (b) improper fraction (c) equivalent fraction (d) mixed fraction

**Write as an improper fraction**

1. 2 ½ (a) 5/2 (b) 3/2 (c) 21/2 (d) 23/2
2. 5 7/12 (a) 12/12 (b) 67/12 (c) 57/12 (d) 7/12

**Give your answer as a mixed fraction**

1. 29/3 (a) 9 2/3 (b) 3 9/2 (c)2 9/3 (d) 2 1/7
2. 37/10 (a) 3 7/10 (b) 6 7/5 (c) 10 3/7 (d) 2 4/5

**Reduce to its lowest term**

1. 8/24 (a) 1/3 (b) 2/6 (c) 14/12 (d) 8/12
2. 12/20 (a) 6/4 (b) 4/8 (d) 3/5
3. 8/12 (a) 2/3 (b) 4/6 (c) ¾ (d) 3/2

**Find the equivalent fraction of the following**

1. 1/2 (a) 2/6 (b) 5/10 (c) 20/30 (d) 11/15
2. 1/6 (a)
3. 2/3 (a) ¾ (b) 1/10 (c) 12/13 (d) 4/6

Replace by <, > or =

1. 1/24 1/12
2. 3/12 1/4
3. 1/8 + 1/4 (a) 1/8 (b) 1/4 (c) 3/8 (d) 2/6
4. 3 ¾ -1 ½ (a) 3 ¾ (b) 11/4 (c) 2 ¼ (d) 2 ¾

Write as a decimal

1. 1 3/10 (a) 0.03 (b) 1.3 (c) 1.23 (d) 0.1
2. 7/10 (a) 0.7 (b) 1.70 (c) 10.7 (d) 0.007
3. 1.6 + 6.25 – T = 5.47 what is T? (a) 1.26 (b) 13.32 (c) 7.85 (d) 2.38

Good luck!