RELATIONSHIP BETWEEN SECONDARY SCHOOL STUDENTS' CONCEPTUAL UNDERSTANDING AND ATTITUDE TOWARDS ALGEBRA

Researcher

Beanish Safa

138-FSS/MSEDU/F12

Supervisor

Dr. Shamsa Aziz

DEPARTMENT OF EDUCATION

FACULTY OF SOCIAL SCIENCES

INTERNATIONAL ISLAMIC UNIVERSITY

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BY

Beanish Safa

138-FSS/MSEDU/F12

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MS Degree in Education.

RESEARCHER'S DECLARATION

I, Beanish Safa

Do hereby solemnly declare that the work presented in this thesis is my own work, was carried out for partial fulfillment of requirement of MS Degree Program from INTERNATIONAL ISLAMIC UNIVERSITY, ISLAMABAD, under the supervision of Dr. Shamsa Aziz.

RESEARCHER: Beanish Safa

Dated: 11-Aug-015

DEDICATION

I dedicated this to my beloved Parents and dearest Brother

CERTIFICATE

It is certified that Ms. Beanish Safa Reg. No. 138-FSS/MSEDU/F12 completed her thesis titled, "Relationship between Secondary School Students' Conceptual Understanding and Attitude towards Algebra". I am satisfied with the quality of student's research work and allow her to submit her thesis for further process as per IIUI rules and regulations

Shamsa

Dr. Shamsa Aziz

Research Supervisor

APPROVEL SHEET

Relationship between Secondary School Students' Conceptual Understanding and Attitude towards Algebra

By

Beanish Safa

This thesis has been accepted by the Department of Education, Faculty of Social Sciences, International Islamic University Islamabad, in partial fulfillment of degree of **MS Education**

Supervisor----------

Dr. Shamsa Aziz

Internal Examiner----------

Dr. Samina Malik

External Examiner----------

Dr. Aslam Asghar

Date

Chairperson,

Department of Education

International Islamic University Islamabad

Dean,

Faculty of Social Sciences

International Islamic University Islamabad

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Beanish Safa

ABSTRACT

This study was conducted to investigate the Relationship between Secondary School Students' Conceptual Understanding and Attitude towards Algebra. The objectives were to explore the conceptual understanding of students in algebra, to measure the attitude of students towards algebra, to find out the relationship between students' conceptual understanding in algebra and their attitude towards algebra, to find out the difference between the mean scores of male and female students' conceptual understanding in algebra and to find out the difference between the mean scores of male and female students' attitude towards algebra. Nine null hypothesis were tested, first seven hypotheses were related to the significant relationship between students' conceptual understanding in algebra and their attitude towards algebra, and the last two were about the significant difference between the mean scores of male and female (students' conceptual understanding in algebra and attitude towards algebra). The quantitative approach was used in this study. The likert scale and a test were used as research instruments. Five hundred secondary school students of Islamabad were taken as the sample of the study. For data analysis Pearson Product Moment Correlation coefficient and t-test were applied through SPSS. It was found that there was a positive weak but non-significant relationship between students' conceptual understanding in algebra and their attitude towards algebra, there was a significant difference between the mean scores of male and female students' conceptual understanding in algebra and also there was a significant difference between the mean scores of male and female students' attitude towards algebra.

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CHAPTER 1

INTRODUCTION

In any society education plays an important role and gives it a way to be a successful one among the societies. It gives an approach to human beings to spend their lives according to the set patterns and rules in a smooth way without any hurdle. In addition, in the case of facing any problem, they can solve it through education. Therefore, in this way human beings have superiority because they have education and are using their wisdom for understanding the things around them.

Education is a very essential thing in the life of humans because it can enable a person to live a better life. Education is a word that came from the Latin word that is "educere" and its meaning is "to guide" and to give directions. It gives a person the light of knowledge. It is a lifelong process because humans are continuously learning from their lives beside the institutional knowledge. It can depart the roadblocks from the way of success (White, 2006).

When the word "education" comes, usually the concept of schools, colleges or universities appear in the mind of people. They think about the environment of classrooms and institutions: as well as "education" is an academic subject. In educational institutions, it is also taught to the students who are interested in the teaching occupation. In this subject, the most concepts are drawn from the subjects which are related with the human beings i.e. sociology, psychology etc(Wood, 2011).

Knowledge and understanding are two different concepts. In the world of subjects, "mathematics" is a subject that needs the conceptual clarity and understanding. It helps

students not only in their school life but also in their daily life. It gives them a way to use their mathematical understanding in solving the problems. Mathematics is a subject that gives the humans an ability to recognize their problems and search for its solution. Therefore, in this way, mathematics is a subject that can play an important role in the well-being of any society.

Mathematics is a self-governing body of knowledge. From the past to present, humans rely on it because they need it in their everyday life's dealings. It is originated from the Greek. A subject thathas a power of human reasoning: that is why in mathematics, the concepts are very essential. It is the subject that has huge knowledge about numbers, theorems, algebra, geometry etc(Kline, 1982). It is an appearance of human mind and thoughtful reason. The basic elements of this subject are:

- Intuition and Logic
- Analysis and manufacture
- Generalization and distinctiveness (Courant&Richard, 1996)

In mathematics, the connection between the questions is very necessary for students.It helps them to understand the connections between the structures of the questions and concepts (Kilpatrick, Valero& Hoyles, 2005). In mathematics, the understanding of concepts is very essential because without understanding, the teacher cannot teach to students and students cannot understand the concepts of mathematics. In mathematics, the understanding has different levels i.e. to understand: which means sometimes 'understand well'. Some researchers attempt to expose the device of mind that can lead, to the better understanding. Some researchers believe that: mental activities can enhance

the ability to understand. Teaching materials for example,mathematics kits etc. can help in conceptual understanding in the mathematical concepts(Sierpinska, 1994).

Understanding is very much related to the attitude of students. If students' understanding is good in mathematics, then their attitude will be positive towards mathematics (Goodykoontz, 2008). For example, if students are doing drills in mathematics and understand the concepts well then it will motivate them. As a result, they can have more positive attitude(Rao, 2003).

Conceptual understanding is very essential in mathematics. Students' attitude depends upontheir understanding. In mathematics some students shows positive attitude and some shows negative attitude towards mathematics. Similarly, the more they understand the concepts, the more they havepositive attitude. Mathematics consistsof algebra, geometryetc. Algebra is a basic concept and has a huge worth in mathematics that is why it is a starting concept in the book of mathematics of 10^{th} class. The researcherexploredthe conceptual understanding of students in algebra and their attitude towards algebra.

1.1 Statement of the Problem

Students 'conceptual understandinghas a great importance in the mathematical concepts because it may have some relationship with their attitude. Algebra is an important component of Mathematics and being considered difficult, therefore, current study intended to explore the relationship of students' attitude towards algebra and theirconceptual understanding in algebra.

1.2 Objectives of the Study

The objectives of the study were to:

1. explore the conceptual understanding of students in Algebra
2. measure the attitude of students towards Algebra
3. find out the relationship between students' conceptual understanding in algebra and their attitude towards algebra.
4. find out the difference between the mean scores of male and female students' conceptual understanding in algebra
5. find out the difference between the mean scores of male and female students' attitude towards algebra.

1.3 Hypotheses

$H_0$1. There is no significant relationship between students' conceptual understanding in algebra and their attitude towards algebra.

$H_0$2. There is no significant relationship between male students' conceptual understanding in algebra and their attitude towards algebra.

H_0 3. There is no significant relationship between female students' conceptual understanding in algebra and their attitude towards algebra.

H_0 4. There is no significant relationship between the conceptual understanding and the attitude towards algebra of the students having positive attitude toward algebra.

H_0 5. There is no significant relationship between the conceptual understanding and the attitude towards algebra of the students having negative attitude towards algebra.

H_0 6. There is no significant relationship between the conceptual understanding and the attitude towards algebra of the students having higher conceptual understanding in algebra.

H_0 7. There is no significant relationship between the conceptual understanding and the attitude towards algebra of the students having lower conceptual understanding in algebra.

H_0 8. There is no significant difference between the mean scores of male and female students' conceptual understanding in algebra.

$H_0$9. There is no significant difference between the mean scores of male and female students' attitude towards algebra.

1.4 Significance of the Study

In all subjects for any concept, the conceptual understanding is an essential thing. The conceptual understanding of any concept gives the opportunity to the learners to use it in a new situation. Conceptual understanding makes the attitude of learner towards any subject or a concept positive or negative. If they have a positive attitude towards a concept then they have a conceptual understanding and vice versa. The present study is essentially significant in the field of mathematics education within the context of attitude towards algebra and conceptual understanding in algebra of students in Pakistan.

This study combined the two different aspects cognitive and affective i.e. students' attitude towards algebra and their conceptual understanding in algebra.

- The present study would be significant for the teachers; in the way, that teacher can teach their students by knowing their attitude towards algebra whether they have positive or negative attitude towards algebra. Moreover, after knowing this they may adopt different ways of teaching for enhancing the conceptual understanding of students in algebra.
- This study would be helpful for the students in the way that they can know about their abilities in algebraic sentences and equations. In addition, they can know that whether they have conceptual understanding of algebraic sentences and equations or not.
- In addition,the study would be beneficial for the curriculum planners, that they can plan mathematics' curriculum by keeping in views the students' attitude towards algebra.

1.5 Delimitation of the Study

The present study wasdelimited to:

- The public sector Secondary Schools of Islamabad.
- The Algebraic sentences and equations from the Algebra portion of 10^{th} grade mathematics' book of Punjab Text book board. (2006)
- The cognitive domain of Bloom's Taxonomy

1.6 Population

The population of the current study was the secondary school students of Islamabad. Total number of secondary level students in the public sector schools was 30003 in which there were 15109 female students and 14894 male students (FDE, 2013).

1.7Sample

According toL.R.Gay (2011), if the population size is too large, then the smaller percentage is required for the representative sample of the population. For instance, if the population is 5,000 or more than it, then the sample would be 400 or 500. Therefore, the sample of this study was 500 students of secondary level from the public sector schools of Islamabad.

1.8 Operational Definitions of Variables

1. Conceptual Understanding

A conceptual understanding is that students have about a concept.Conceptual understanding is about a concept that students can use it in a new situation for instance the concept of algebraic equations and sentences.

2. Attitude

Attitude is about the feelings of someone towards something and these can be positive or negative. It is a response in the result of an action. In this way students' attitude may depends on their conceptual understanding.

CHAPTER 2

REVIEW OF RELATED LITERATURE

For conducting this research study there was a need to find out its significance in the literature from different relevant researches i.e. presented here. This chapter is about the relevant literature that is based on the explanations of the concepts. Therefore, in this research the main concepts were students' attitude towards algebra and their conceptual understanding in algebra.

2.1 Mathematics Education

Mathematics education is about that: how mathematics can be taught. In which students learns that how the human minds deal with the mathematical problems and how they can solve it. It can improve the teaching learning process in teaching of mathematics through different creative activities. Mathematics education is for those students who are interested in the teaching profession in the field of mathematics. In which they learn about different techniques to teach diverse concepts with different and interesting activities. Because most of the students find mathematics as a boring subject that is, why in this subject there are a lot of techniques and methods to teach students.In this way, teachers can developtheir students' interest in mathematics.

In 1900 at Teacher College Columbia University and University of Chicago in the result of work of Young and David Eugene and Smith mathematics education was introduced as a discipline (Davis& Benjamin,1984).

2.2Nature of Mathematics

Today mathematics is a diverse subject. It deals not only with arithmetic and geometry but also with trignometry algebra etc. It deals with the rational analysis. It used to help the people to understand the world and also to support them to deal with the humen behavior.

It is a science of pattren with numbers. It helps to think criticaly and to work with different alternatives. This subject take up a very significant position in the cuuriculum. From I- X. Mathematics gives the oppurtunity to its students to express their views and ideas about arithmetic, equations, quantity and shapes etc. It plays an important role in almost every field for example business, industry etc(Arif, 2011).

In mathematics one thing that need special care and attention i.e. to building of basic concepts stronger enough so that the next steps of the stairs of mathematics,students can esily achieve. Therefore in mathematics the foundation of the basic concepts should be very powerfull and strong. For instance in the concepts of adding fractions students feel some confusion in it and add it wrong so there is a need to clearify the misconception of adding fraction then go for the next step. Because it is a basic skill for algebra and then for calculus(Thurston, 1990).

So it is a very broad and deep subject in its nature and need special attention, techniques, methods and procedures to teach and all these things should be consider while developing its curriculum.

2.3 Curriculum of Mathematics

The word "curriculum" comes from the latin origin and its meaning is "race course" in which race and course means time and path correspondingly. Therefore its means recommended course of study that have to be cover up in a specific period of time (MOE, 2006).

The expression "curriculum" is described differently each time. According to Rehman (2004), Aggarwal (1990) curriculum is basically a map for learning. It is a structure that is scientifically developed for the learners that they can improve their knowledge and understanding. In any scoiety's education system the curriculum is a more powerful tool. For the development of any society and for competing with new modren world it is important to update and restructure the curriculum. So that in this way there is an oppurtunity for generation to cope with the needs of the modren age. So modernization and up to datecurriculum is a very nessessory step because it would improve the quality of education.

Since 1947 the reforms in the mathematics' curricum had been revised. For instance in 1968 in 9^{th} and 10^{th} grade mathematics' text book : the sets were introduced. In 1972-1973 the inductive and deductive approaches had been introduced. But progressive changes occured in 1994 where a new part information handling was introduced with surviving parts like Set, Algebra, Numbers, Trignometry etc. After that the next review for the reforms in the mathematics' curriculum took place in 2000 and in 2002(MOE, 2006).

2.3.1 National Curriculum of Mathematics in Pakistan

National curriculum of mathematics consist of five standerds these yardsticks work as the guiding indicators that at the improvemental level how the abilities are to be achieved in a way to meet the standards. And it is expected from the students of grade I-XII to complete these developmental stages. The five standerds are:

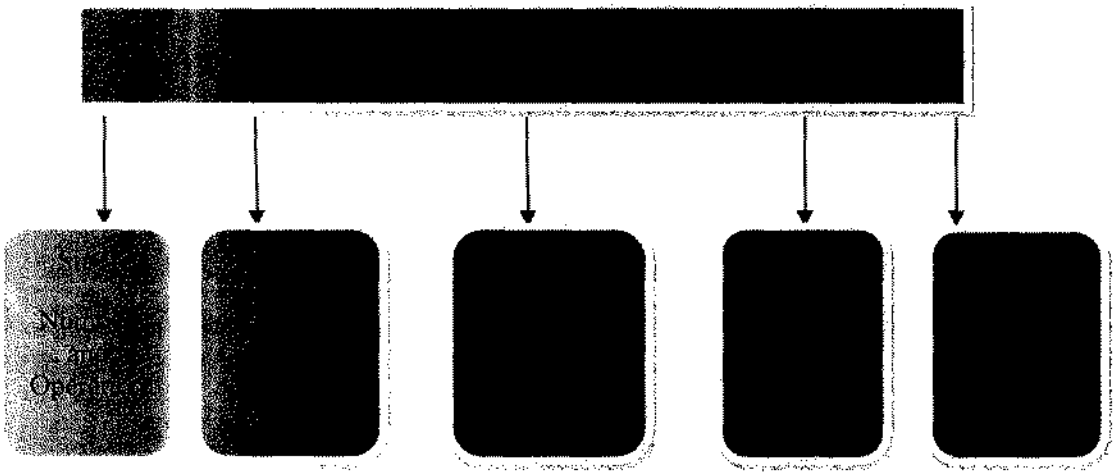

Figure # 2.1: Mathematical Standards

(MOE, 2006)

2.3.2 Benchmarks of standard number 2 in National Curriculum of Mathematicsat secondary Level in Pakisan

Table 2.1

Benchmarks of standard number 2

Standard 2	Benchmarks for Secondary Level
The students will be able to: • Analyze number patterns and interpret mathematical situations by manipulating algebric expressions and relations, • Model and solve contextualized problems • Interpret functions, calculate rate of change of functions, integrate analytically and numerically, determine orthogonal trajections of a family of curves and solve non-linear equations numerically.	• Factorize algebraic expressions. • Apply remainder/ factor theorem to verify that a first degree polynomial is a factor of a given polynomial. • Find HCF and LCM and square root of algebric expressions. • Solve system of two linear equations in two unknowns by elimination, graphical and matrix methods. • Solve linear inequalities with rational coefficients. • Solve equations quadratic and reducible to quadratic. • Analyze attributes of quadratic equations. • Form a quadratic equation from the given roots. • Resolve rational expressions into partial fractions.

(MOE, 2006).

2.4 Comparison of mathematics curriculum of Pakistan for Secondary level with the New York State's Mathematics curriculum for Secondary level

Table 2.2

Secondary level mathematics curriculum's comparison of Pakistan and New York State

Pakistan 9-10	New York 9-10
Matrices and Detreminants • Introduction to Matrices. • Types of Matrices • Addition and Subtraction of Matrices • Multiplication of Matrices • Multiplicative Inverse of a Matrix • Solution of Simultaneous Linear Equation	The Real number system • Extend the prpertise of exponents to rational exponents • Use properties of rational and irrational numbers
Real and Complex Numbers • Real Numbers • Properties of real numbers • Radicals and Radicands • Laws of Exponents/Indices • Complex Numbers • Basic Operations on Complex Number	Quantities • Reason Quantitatively and use units to solve problems
Logarithms • Scientific Notation • Logarithms • Common and Natural Logarithm • Laws of Logarithm • Application of Logarithms	The complex Number System • Perform arithmetic operations with complex numbers • Represent complex numbers and their operations on the complex plane • Use complex numbers in polynomial identities and equations
Algebraic Expressions and Algebraic Formulas • Algebraic Expressions • Algebraic Formulae • Surds and their Application • Rationalization	Vector & Matrix Quantites • Represent and model with vector quantities • Perform operations on Vectors • Perform operations on

	matrices and use matrices in applications
Factorization • Factorization • Remainder Theorem and Factor Theorem • Factorization of cubic polynomial	Seeing Structure in Expressions (Algebra) • Interpret the structure of expression • Write expressions in equivalent forms to solve problems
Algebraic Manipulation • Highest Common Factor and Least common Multiple • Basic Operations on Algebraic Fractions • Square root of Algebraic Expression	Arithmetic with Polynomials & Rational Expressions • Perform arithmetic operations on polynomials. • Understand the relationship between zeros and factors of polynomials • Use polynomila identities to solve problems • Rewrite rational expressions
Linear Equations and Inequalities • Linear Equations • Equation involving Absolute Value • Linear Inequalities • Solving Linear Inequalities	Creating Equations • Create equations that describe numbers or relationships
Quadratic Equations • Quadratic Equations • Solution of Quadratic Equation • Quadratic Formula • Equations Reducible to quadratic form • Radical Equations	Reasoning with Equations & Inequalities • Understand solving equations as a process of reasoning and explain the reasoning • Solve equations and in Equalities in one variable • Solve systems of equations • Represent and solve equations and inequalities graphically
Theory of Quadratic Equations • Nature of the roots of a Quadratic Equation • Cube roots of Unity and their Properties • Roots and Coefficients of Quadratic Equation • Symmetric Functions of Roots of a Quadratic Equation	Interpret Functions • Understand the concept of a function and use funtion notation • Interpret functions that arise in applications in terms of the context • Analyze funtions using different representations

• Formation of Quadratic Equation • Synthetic Devision • Simultaneous Equations	
Variations • Ratio, Proportion and Variations • Theorems on Proportions • Joint Variation • K-Method	Building Functions • Build a function that models a relationship between two quantities • Build new functions from existing functions
Partial Fractions • Proper, Improper and Rational Fraction • Resolution of Fraction into Partial Fraction	Linear, Quadratic & Exponential Models • Construct and compare linear, quadratic and exponential models and solve problems • Interpret expressions for functions in terms of the situation they model
Sets and Functions • Sets and operations on Sets • Binary Realtions • Functions	Trigonometric Functions • Extend the domain of trigonometric functions using the unit circle. • Model periodic phenomena with trigonometric functions • Prove and apply trigonometric identities
Basic Statistics • Frequency Distribution • Commulative Frequency Distribution • Measure of Central Tendency • Measure of dispersion	Congruence (Geometry) • Experiments with transformations in the plane • Understand congruence in terms of rigid motions • Prove geometric theorms • Make geometric constructions
Linear Graphes and their Application • Cartesian Plane and Linear Graphs • Conversion Graphs • Graphic Solution of Equations in two Variables	Similarity, Right Triangles & Trigonometry • Understand similarity in terms of similarity transformations • Prove theorems involving similarity • Define trigonometric ratios

	and solve problems involving right triangels • Apply trigonometry to general triangles
Introduction to Coordinate Geometry • Distance Formula • Collinear Points • Mid-point Formula	Circles • Understand and apply theorems about circles • Find arc and areas of sectors of circles
Introdution to Trigonometry • Measurement of an Angle • Sector of a Circle • Tigonometric Ratios • Trigonometric Identities • Angle of Elevation and Depression	Expressing Geometric propertise with Equations • Translate between the geometric description and the equation for a conic sections • Use coordinates to prove simple geometric theorems algebraically
Congruent Triangles • Congruent Triangles	Geometric Measurement & Dimension • Explains volume formulas and use them to solve problems • Visualize relationships between two-dimensional and three-dimensional objects
Parallelograms and Triangles • Parallelograms and Triangles	Modeling with Geometry • Apply geometric concept in modeling situations
Line Bisectors and Angles Bisectors • Line Bisectors and Angle Bisectors	Interpreting categorical & Quantitative Data (Statistics) • Summarize, represent and interpret data on a single count or measurement variables. • Summarize, represent and interpret data on two categorical and quantitative variables • Interpret linear models

Sides and Angles of a Triangle • Sides and Angles of a Triangle	Making Inferences & justifying Conclusions • Understand and evaluate random processes underlying statistical experiments • Make inferences and justify conclusions from sample surveys, experiments and observational studies
Ratio and Proportion • Ratio and Proportion	Conditional probability & the rules of probability • Understand independence and conditional probability and use them to interpret data • Use the rules of probability to compute probabilities of compound events in a uniform probability model
Pythagoras' Theorem • Pythagoras' Theorem	Using probability to make decisions • Calculate expected values and use them to solve problems • Use probability to evaluate outcomes of decisions
Theorem Related with Area • Theorem Related with Area	
Projection of a Side of a Triangle • Projection of a side of a Triangle	
Chords of a Circle • Chords of a Circle	
Tangent to a Circle • Tangent to a Circle	
Chords and Arcs • Chords and Arcs	
Angle in a Segment of a Circle • Angle in a Segment of a Circle	

Practical Geometry- Triangles • Construction of Triangle • Figures with Equal Areas	
Practical Geometry- Circles • Construction of Circle • Circle attached to Polygons • Tangent to the Circle	

Table # 2.2 shows the comperison of mathematics curriculum for secondary level of one contry i.e. Pakistan and the New York state. In both curriculums algebra has a great importance and students have to be very much clearabout the concepts of algebra (New york state, P-12 & MOE, 2006).

2.5Comparison of mathematics curriculum of Pakistan for Secondary level with the UK's Mathematics curriculum for Secondary level

Table 2.3

Secondary level Mathematics curriculum's comparison of Pakistan and UK

Pakistan **9-10**	**UK** **Key stage 3-4 (9-10)**
Matrices and Detreminants • Introduction to Matrices. • Types of Matrices • Addition and Subtraction of Matrices • Multiplication of Matrices • Multiplicative Inverse of a Matrix • Solution of Simultaneous Linear Equation	Number • Place value for decimals, measures and integers of any size • Order possitive and negative integers, use the symbols • Prime numbers, common factors, common multiplies, highest and lowest common factor, prime factorisation • Use of four operations • Recoganise and use relationshis between operations including invese operations • Use integer powers and associated real roots (square, cube and higher) • Terminating decimals and their corresponding fractions • Infinite nature of the sets of integers, real and rational numbers • Product rule for counting (**stage 4**) • Estimate powers and roots • Calculates with roots and integers and fractionals • Expressions involving squares • Calculate with numbers in standard form • Change recurring decimals in to their corresponding fractions and vice versa • Identify and work with fractions in ratio problems • Apply and interpret limits of

	accuracy when rounding or truncating
Real and Complex Numbers • Real Numbers • Properties of real numbers • Radicals and Radicands • Laws of Exponents/Indices • Complex Numbers Basic Operations on Complex Numbers	Algebra • Use and interpret algebraic notations • Coefficients written as fractions rather than as decimals • Brackets • Substitute numerical values into formulae and expressions, including scientific formulae • Vocabulary of expressions, equations, inequaities, terms and factors • Simplify and manipulating algebric equations • Standard mathematical formulae • Model situations • Linear equations in one variable • Graphs of linear and quadratic functions of one variable, cartesian plane • Mathematical relationship both algebraically and graphically • Interpret gradients and intercepts of graphs of such linear equations numerically, graphically and algebrically • Solutions of simultaneous linear equations • Generate terms of a sequence • Arithmetic sequence and find the nth term • Geometric sequences • Simplify and manipulate algebraic expressions **(stage 4)** • Factorizing quadratic expressions • Simplifying expressions • Difference between an equation and an identity • Interpret simple expressions as functions with inputs and

	outputs • Use kthe form to identify the parallel lines • Identify and interpret roots • Recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions • Sketch translations and reflections of graph of agiven function • Plot and interpret graphs • Calculate or estimate gradients of graphs • Recognise and use the equaton of a circle with center at the origin • Solve quadratic equations • Solve two simultaneous equations in two variables • Find approximiate solutions to equations • Translate simple situations or procedures into algebraic expressions or formulae • Solve linear inequalities • Recoganise and use sequences of triangular, square and cube numbers • Deduce expressions to calculate the nth term of linear sequences.
Logarithms • Scientific Notation • Logarithms • Common and Natural Logarithm • Laws of Logarithm • Application of Logarithms	Ratio, proportion and rates of change • Standard uits [time, length, area, volume/capacity, mass] • Scale factors, scale diagrams and maps • Fraction • Ratio notation • Division of a quantity • Multiplicative relationship between two quantities can be expressed as a ratio or a fraction • Language of ratios, arithmetic of fractions and linear functions • Percentage change, original

	valkue problems and simple interest in financial mathematics • Direct and inverse proportion • Compound units such as speed, unit pricing and density to solve problems • Compare lengths, areas and volumes **(stage 4)** • Convert between related compund units in numerical and algebraic contexts • Interpret equations that describe direct and inverse proporton • Recognise and interpret graphs • Gradients of tangents and chords in numerical, algebraic and graphicla context • Set up, solve and interpret the answers in growth and decay problems including compund interest
Algebraic Expressions and Algebraic Formulas • Algebraic Expressions • Algebraic Formulae • Surds and their Application • Rationalization	Geometry and meausre • Perimeter and area of triangles, parallelograms, trapezia, volume of cuboids and other prisms • Circles, area of circles and composite shapes • Prependiculer bisector, prependiculer distence • Points, lines, parallel lines, prependiculer lines, right angels, reguler polygons, and other polygons • Angels of triangle ABC • Propertise of triangle, quadrilaterals, circles, and other plane figures • Properties of angles, straight line, vertically opposite angles • Drive the properties of reguler polygons • Triangle congruence • Use of pythagoras theorem and

	trigonometric ratios in similer triangles • kInterpret mathematical relationships both algebrically and geometrically • Interpret and use fractional scale factors for enlargements **(stage 4)** • Describe the changes and invarience achieved by combinations of rotations reflections and translations • Identify and apply circle definitions and properties, including center, radius, chords, diameter, circumference, tangent, arc, sector and segment • Apply and prove the standard circle theorems concerning angles, radii tangents and chords, and use them to prove related results • Construct and iterpret plans and elevations of 3D shapes • Interpret and use bearings • Calculate arc lengths, angles and areas of sectors of circles • Calculate surface areas and volumes of spheres, pyramids, cones and composite solids • Apply the concepts of congruence and similarity, including the relationships between lengths in similar figures • Apply pythagoras' theorem and trigonometric ratios to find angles and lenghts in right angled triangles • Know the values of sinθ and cosθ • Know and apply the sine and cosine rule • Describe translations as 2D vectors

	• Use vectors to construct geometric arguments and proofs
Factorization • Factorization • Remainder Theorem and Factor Theorem • Factorization of cubic polynomial	Probability • Analysis of the frequency of outcomes of simple probability • Understand the probabilities of all possible outcomes sum to 1 • Enumerate sets and unions/intersections of sets systematically, using tables, grids and Venn diagrams • Generate theoratical sample spaces for single and combined events • Apply the property that the probabilities of an exhaustive set of mutually exclusive evemts sum to one **(stage 4)** • Use a probability model to predict the outcomes of future experiments • Calculate the probability of independent and dependent combined events • Calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams
Algebraic Manipulation • Highest Common Factor and Least common Multiple • Basic Operations on Algebraic Fractions • Square root of Algebraic Expression	Statistics • Central tendency • Frequency tables, bar charts, pie charts and pictograms • Simple mathematical relationship between two variables • Infer propertise of populations or distributions from a sample **(stage 4)** • Interpret and construct tables and line graphs for time series data • Construct and interpret

	diagrams for grouped and discrete data continuous data • Interpret, analyse and compare the distributions of data sets • Apply statistics to describe a population • Use and interpret scatter graphs of bivariate data
Linear Equations and Inequalities • Linear Equations • Equation involving Absolute Value • Linear Inequalities • Solving Linear Inequalities	
Quadratic Equations • Quadratic Equations • Solution of Quadratic Equation • Quadratic Formula • Equations Reducible to quadratic form • Radical Equations	
Theory of Quadratic Equations • Nature of the roots of a Quadratic Equation • Cube roots of Unity and their Properties • Roots and Coefficients of Quadratic Equation • Symmetric Functions of Roots of a Quadratic Equation • Formation of Quadratic Equation • Synthetic Devision • Simultaneous Equations	
Variations • Ratio, Proportion and Variations • Theorems on Proportions • Joint Variation • K-Method	
Partial Fractions • Proper, Improper and Rational Fraction • Resolution of Fraction into Partial Fraction	

Sets and Functions • Sets and operations on Sets • Binary Realtions • Functions	
Basic Statistics • Frequency Distribution • Commulative Frequency Distribution • Measure of Central Tendency • Measure of dispersion	
Linear Graphes and their Application • Cartesian Plane and Linear Graphs • Conversion Graphs • Graphic Solution of Equations in two Variables	
Introduction to Coordinate Geometry • Distance Formula • Collinear Points • Mid-point Formula	
Introdution to Trigonometry • Measurement of an Angle • Sector of a Circle • Tigonometric Ratios • Trigonometric Identities • Angle of Elevation and Depression	
Congruent Triangles • Congruent Triangles	
Parallelograms and Triangles • Parallelograms and Triangles	
Line Bisectors and Angles Bisectors • Line Bisectors and Angle Bisectors	
Sides and Angles of a Triangle • Sides and Angles of a Triangle	
Ratio and Proportion • Ratio and Proportion	
Pythagoras' Theorem • Pythagoras' Theorem	

Theorem Related with Area • Theorem Related with Area	
Projection of a Side of a Triangle • Projection of a side of a Triangle	
Chords of a Circle • Chords of a Circle	
Tangent to a Circle • Tangent to a Circle	
Chords and Arcs • Chords and Arcs	
Angle in a Segment of a Circle • Angle in a Segment of a Circle	
Practical Geometry- Triangles • Construction of Triangle • Figures with Equal Areas	
Practical Geometry- Circles • Construction of Circle • Circle attached to Polygons • Tangent to the Circle	

Table # 2.3 shows the comparison of mathematics curriculum of two countries i.e. Pakistan and United Kingdom (UK). Both countries have algebra in mathematics curriculum. But the education system is little bit different because in Pakistan the 9^{th} and 10^{th} grades are called secondary level but in the UK education system it is called the Key stage 3 and 4. In the end level of Key Stage 3 the 9^{th} class is started and at the start of the Key Satge 4 the 10^{th} class is started(NCE, 2014 & MOE, 2006).

2.6 Algebra

In the reforms of mathematics education the "algebra" is a central point. Countless mathematics educators suggest that algebra should be introduced at all grades. It is an opening of prospect educational and employment oppurtunities but disappointingly numerous students face difficulities in learning algebra. Therefore it is the responsibility of teachers to facilitate their students to learn the algebraic reasoning (Knuth, Alibali. et.al, 2005).it is an important field of mathematics that state it self with the symbols, words and tables etc. There is a need to understand the algebraic symbols words etc in order to recognize the propertise of the algebraic equations, expressions and so on. Sengul and Erdogan (2014) stated in their research that according to Falkner, Levi Ve Carpenter (1999) and Dede Ve Peker (2007) from different grades students are facing many problems in uderstanding of algebra and these problems are mostly common among students. Further more these problems are usually in the concept of equations, symbols and variables. In these concepts the each next concept is based on the previous one that is why it is very essential to make the concepts of previous the basics then move forword. There fore firstly there is a need to make the concepts clear about the algebraic sentences then equations etc.

2.6.1 Algebraic Sentences

Algebraic sentences is basically a very important and basic concept in the secondary schools' mathematics. Therefore in the mathematics' book of 10th class have a very first concept of algebraic sentences in the first chapter. So the

algebraic sentences are the sentences in which the expressions like 3+4, 3a+8, 5a+7b, x+2y-3z are related with the any of the symbols like <, >, ≤, ≥, ≠, = etc. then it make an algebraic sentence e.g.

3x+5 = 13, 3+6 > 11, 4+5 = 9 etc.

2.6.2 Equations

In mathematics, equations have a very strong place and almost in every chapter contains equations for solving the questions. In this way there is a need to clear the concepts of equations and then move forward. Because after understanding the concepts of equations then there is no difficulty for students to solve further questions. So when algebraic sentences contains the sign of equality "=" between the two algebraic expressions then it is called an equation e.g.

x + 4 = 6, 5y -3 = 6

2.6.3 Conceptual Understanding in Algebra

The word "Algebra" came from the Arabic word Al-Jabar. It is describe by Al-Khwarizmi and its meaning is as remove subtractions. For example:

y2 = 50y-3y2

4y2 = 50y

Currently in many countries a lot of researches are going on algebra for instance, its goal, approaches achievement etc. Mainly in the conceptual understanding of

learning and teaching algebra. Conceptual understanding is basically related with the mind so that concepts need to be clear in algebra (Drijvers, 2011).

Egodawatte (2011) investigated in his research the common mistake and misconceptions in algebra of secondary school students. The findings of this study indicates that most of the errors originated from the misconceptions or not having the conceptual understanding of the concepts of algebra. In algebra mostly students commit errors in the algebraic expressions because of not having conceptual understanding or manipulating them according to the set pattrens and accepted rules. And they also sometimes do not know that where there is a need of putting the sign of equality.

Linsell et.al (2012) conducted a research for designing the teaching approaches that can help out students of 9th and 10th grade students and develop their conceptual understanding in algebra. The findings of the study indicates that the achievement in algebra can be enhanced by focusing the organized perspectives that give teachers the high quality investigative infromation to teachers. Teachers may use the effective teaching approaches e.g.building a toolbox of knowledge and skills that students would use in their daily lives. Students can also learn algebra and make their concepts well if there is appropriate method of teaching and well organised text for algebra. According to windsor & Norton (2008) for quality teaching and learning algebra, the text of algebra should be well organised and standardised. In which the representation of the key concepts should be multiple times so that the students can develop their conceptual understanding of the important basic concepts well.

2.7 Attitude

In daily life people usually use the word "attitude" in their conversation and associate it with someone's behavior towards something or indiviual. In which usually feelings are involved and it can be negative or possitive.

An early theorist of attitude Gordon Allport said about attitude that it is an intellectual and neural state of willingness that is organized through experience and give directions to the indiviuals' behavior towards something or some situation. (Bordens & Horowits, 2013).

Aziz (2004) quoted that Anastasi (1990) describe attitude that it is anapproachability to react positively or negatively towards some object, some situation or some one.It is basically a response in the result of an action. It is associated with the social and emotional responses. It has been described as a psychological build that cannot be observed. Because it involves beliefs, emotions and cognition etc. Pitafi and Farooq (2012) stated that "according to the Encyclopedia of Educational Research , an attitude is a psychological construct, or latent variable, inferred from observable responses to stimuli which are assumed to mediate consistency and coherence ammong those responses".Sarwar (2004) qouted that according to Crow and Crow (1999) a person behaves according to his surrounds and show attitudes according to his individual desires. Attitudes are associated with one persons feelings that he have for the perticuler situation, person, thing or any subject. For exapmle the attitudes of students towards mathematics. This is a very general belief in the researches that attitude consist of three components cognitive, affective and behavioural. These components shows that people's beleifs,

behaviours and emotions towards something or some person. Because attitude is psychological propensity that can evaluate any subject in the way of favour or unfavour (Seker, 2011). According to Aiken (1980) "attitudes may be conceptualized as learned predispositions to respond positively or negatively to certain objects, situations, concepts or persons". As such they possess cognitive (beliefs or knowledge), affective (emotional, motivational) and performance (behaviour or action tendencies) dimensions. (Hannigan, Gill & Leavy, 2013).

2.7.1 Components of Attitude

An attitude is basically the current behavior of a person that is for sure according to the current situation that is made up of its components. Consequently according to Psychologists attitude have three components i.e. affect, cognition and behaviour. And it can rooted by stimuli (different attitude objects, indiviuals, situations etc). Hemsworth & Coleman (2011) quoted that according to Eagly and Chaiken (1993) when a person behaves or shows attitude towards any object then there is an independent involvement of its components.

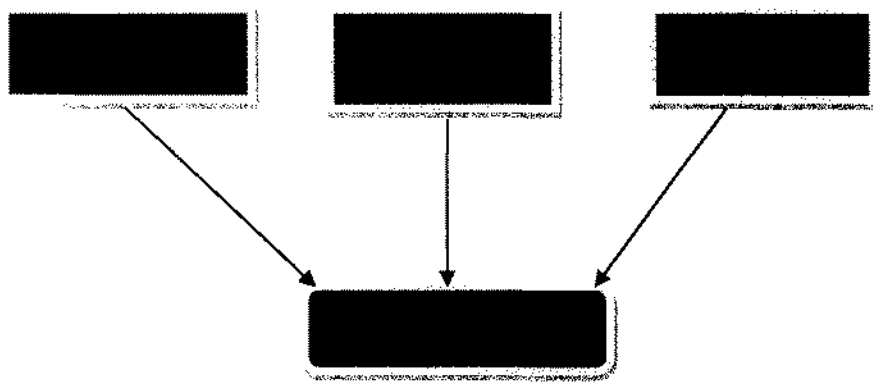

Figure # 2.2: Components of Attitude

(Eiser, 2001)

2.7.1.1 Affective

This component of attitude deals with the emotions and feelings reactions. (Boone & Kurtz, 2010). In which a person have emotional response towards some object or some indiviuals: in which he can like or dislike the things or situations etc. It can indicate the one person's negative or possitive attitude towards some object. (Hemsworth & Coleman, 2011).

2.7.1.2 Cognition

It deals with the knowledge and information about a concept related with an object. (Boone & Kurtz, 2010). These are thoughts that one person have about something or some other persons. It is something that people believe about some objects (Hemsworth & Coleman, 2011).

2.7.1.3 Behavioral

This component deals with that how a person will behave according to the perticuler situation. Because according to the situation a person's attitude can be changed (Boone & Kurtz, 2010).

These three components have too much influence on a person's attitude. And through this anyone can evaluate a person's attitude either it is possitive or negative.

2.8 Measurement of Attitude

It is not possible to measure the attitudes directly. But in the questionnair consist of chain of statements those are representing an attittude. Then the respondents give their responses on the statements. In the questionnairs the statemnets are made up of three

components of attitude i.e belief of any person about an object (cognition) what he/she feel about it and what tendency he/she has to behave towards an object (Hemsworth & Coleman, 2011). In the measuring techniques of attitude the questionnairs or attitude scales are also included. The attittude scales are consisted of number of negative and possitive statements in which respondents selects their level of agreement and disagreement (Aziz,2004).

There are different ways to get informations about a person's attitude that can be questionnairs, observations, interviews etc. through which rsearchers can get data regarding attitudes of people towards something.Attittude can be measured through direct observation of behaviours. In this concern there is a lot of researches have been conducted by using the observation as a research tool.Lewis and Aiken (1970)quoted that according to Corcoran and Gibb (1961) there are several methodsto measuring the attitude towards mathematics those are : interviews, questionnairs, attitude scales, observational methods, content analysis and sentence completion etc.

Al-Nofaie (2010) have conducted a research to examin the attitude of Saudi teachers and stduents towards use Arabic as a facilitating tool in English classes. In the sample of this research study there were 30 students and three teachers. For this purpose the researcher have used three research tools i.e. observation, interviews and questionnairs. So generaly the students and teachers had possitive attitude towards using arabic in casses.

Behavioural attitudes can be measure through observation but if there is a large sample size then it can be difficult and time consuming for the collection of data by using

observation. So at this stage when there is a large sample size then questionnaire or sclae can be used for the measurement of attitude towards some object.

2.8.1 Questionnaire

In social science it is an important tool that can provide valuable information or data about a perticuler topic of interest. A questionnair is basically a tool for collecting information regarding some topic of interest for research purpose. It is consist on several realted questions that is in more clear form.

The language of this tool should be very simple, clear and understandable: it is also depends on the level of respondents. In the questionnaire there is no need to use the difficult words, abbreviation or technical words. Because it can make the respondents feel down. The questions in the questionnairs should be specific wih the topic and with the respondents. Because the designing of the questionnair should be according to the age and level of qualification of the respondents.Lietz (2010) has explained in his research's findings that in the questionnaire designs the words, question's length and answer's alternatives have impact on the responses of the respondents . In the questionnair or in a scale there can be two types of questions one is: open ended questions and second one is close ended questions.

In the open ended questions respondents give their own answers and in close ended questions respondents choose one choice from the given options(Taylor-Powell, 1998).

2.8.2 Types of questionnaires

The research tools in the research studies depends on the research type. According to the reseachobjectives the researchers use the questionnaires. Because any study is run by its objectives. So Cohen, Manion and Morrison (2007) have explained the types of quetionnaire:

- Structured
- Semi-structured
- Unstructured

Structured questionnaires have more precised and defined questions or statements. In the research studies if the population and sample is larger then the questionnaire will be more structured and in the closed form.

Semi-structured questionnaires have some predefined closed-ended questions and some are open-ended questions in which respondents are free to give their answer about the question. It is the most elastic tool for taking the responses of the respondents.

Unstructured questionnaire where the respondents have choice to write what they want related to the topic. It is usuelly used when there is a less number of population and sample.

Accordingly it is all depends on the type of research that for which purpose the questionnaires are going to be used e.g. measurment of attitude through questionnaires. The attitude can be measured by administering the the scale or questionnaire.

Questionnaires or scales can be consisted of possitive or negative statements related with the topic of research study.

2.8.3 Measurement of attitude through questionnaire

There is lot of researches are conducted in which researchers have used questionnnairs as their research tool for measuring the subject's atitude towards different objects. Adams, Dollard, Hollins and Petkov (2005) researched on the measurement of student's attitude towards rural practice and life. In which researchers have used pre and post questionnnaire and found it a reliable tool for the measurement of attitude towards rural practice and life.

Gujar, Naeemullah and Tabassum (2013) conducted a research on the attitude of teachers and students towards computer. Researchers have used questionnair for measuring attitude towards computer. The questionnaire consisted of forty statements that's is based on five dimensions i.e. "fear of using computer, problem solving by computer, computer knowledge, using computer and learning computer". According to the study results on the all proportions of the scale the male and female students have the same attitde towards computers.

Pierce, Stacey and Barkatsas (2007) investegated student's attitude towards learning mathematics with the help of technology. In which mahematics and technology attitude scale (MTAS) is used as a research tool. This scale further have sub-sclaes that is measuring mathematics confidence, confidence with technology, attitude to learning mathematics with technology. Thorugh this questionnair teachers can take useful information for teaching their students.

Similery Wong & Chen (2012) inquired nature of an attitude toward learning mathematics. In which researchers have used a questionnaire consist of 57-items in which 24 items covers these six dimensions: checking solutions, use of IT in mathematics learning, enjoyement, confidence, multiple solutions and usefulness of mathematics. The data for this research have been collected in two years i.e. in 2010 and 2011.

2.9Attitude towards mathematics

Attitude is a word that is used by people in their daily lives. This term comes from the psychology that explains one's likes, or dislike towards something. From the 20thcentury, it is an intellectual and neural state of punctuality thatcan be organized through experiences. Any individual gives a response to the objects and situations. It is closely connected to the one person's belief (Sweeting, 2011).

Jazdzewski (2011) conducted a research on the attitude about mathematics of boys and girls based on their socio- economic status and found that for attitude the status can play a role.

Similarly, lot of previous researches conducted on the attitude of students towards mathematics and still this topic is a boiling issue in the area of mathematics education. Researches illustrate that lot of work has done on the attitude, achievement, family backgrounds etc. but still there is a need to work on it. A positive attitude towards any subject is very important because it can increase the ability to select as the career subject or profession(Haladyna & Shaughnessy, 1983).

Suydam (1984) stated that with the passege of time students are enrolled in the uper classes their attitude become negative towards mathematics.

Collis (1987) and Armstrong & Price (1982) clarifiedabout attitude that it is a behavior, according to the insights of the students and their achievement. In classroom the teaching learning proces in mathematics subject paly a very significant role for attitude of students. Because its affect the understanding of students. Its also very necessary that the method of teaching should be appropriate: in which way the teacher is teaching and how students taking it. And if the students are taking it in a good way and understand it then they have a possitive attitude toward mathematics. It is the reason that can effect the secondary school's students(Shah, Farooq & Ullah, 2008).

Students show their attitude towards mathematics differently according to their gender. Research studies showed that female students showed negative attitude towards mathematics as compared to the male students. Majority of sudents take this subject as a dry and boring subject and choose another subject as their major career subject quickly after their matriculation: mainly the female students. Majority of female students consider themselves weak in this subject because they think that for mathematics the natural talent is required and male students have it(Khaliq &Rodrigues, 2102). Khan (2011) reported in his study that male students have more possitive attitude towards mathematics as compare to the female students. Because in this subject the female students have negative attitude towards mathematics.Awofala, Arigbabu & Awofala (2013) conducted their sudy for investigating the effect of framing and team assisted indiviualised instructional strategies on the attitudes toward mathematics. In which the gender wise attiude towards mathmatics was also examined. Study showed that male students have more possitive attitude towards mathematics than the female students.

Vandecandelaere, Speybroeck, Vanlaar, Fraine and Damme (2012) investigated the association between the attitude of students towards mathematics and with the four dimensions of learning enviornment that to which extentent the teacher motivates to exercise the learning efforts, activates towards self-regulated learning, gives feedback and coaches, structure and steers. In the end the findings of this study indicates that the learning enviornment plays a significant role in the enjoyment of mathematics.

Sirmaci (2010) investigated the relationship of 9th grade students' attitude towards mathematics with their learning styles. The findings of this study showed the significat possitive relationship between ninth year students' attitude towards mathematics with their learning styles.

In mathematics understanding of concepts are very important and it is related with the cognitive domain. Because generally in mathematics education, attitude, emotions and beliefs are the major factors of affective domain. That is why many researchers had explored the relationship between cognitive and affective domain. Similarly knowledge and thinking all are related with the mind(Kishor, 1997).

2.10Concept Formation and Conceptual Understanding

The word concept can defined as it is a representation of a symbol or a group of symbols that views for a large gorup of objects that all have common characteristics. For example in educational settings "school" is a concept in which students, teachers, classrooms etc are the common characteristics.

The term concept formation and the concept learning have the same meaning and basically it is a complex process of problem solving. Mostly psychological researchers

are interested in the understanding of that how the human beings understand the things and make concepts etc. In the cognitive psychology the term "concept formation or concept learning" is very much related with the acquisition of concepts, building of concepts , usage of concepts etc(Roeckelein, 1998). It is good that to make the concepts clear at early stages(Robbins, 2001).

In the cognitive psychology most of the researches are on the understanding of adults, matured persons etc and being studied and in the experimentallab it is a work of very short time frame.

In the cognitive psychology there are two overlapping concepts. The first is related with the concept learning from samples and orderingor texonomy. In this method of cognition the categories are made either natural or artifcial. And it has a strong quantitative thing in it. It is consist of time, measurement, accuracy etc. The second is related with the strong emphasis on the concept formation from the observations that make it most complex and in a real context(Wrobel, 1994).

2.11 Bloom's Taxonomy: The Cognitive Domain

There is a texonomy of cognitive behavior that is called Bloom's Taxonomy. It has a great influence on education. It describes the inside's intellectualprocess that is an obligatory from students (Miller, Williams& Haladyna, 1978). It is designed by Benjamin Bloom and colleagues in 1956 that is a pyramid of intellectual skill of the Cognitive domain. In these days most of the schools are focusing on the development of higer order thinking skills rather than recall knowledge level study. In the cognitive domain there are six levels that is started from the the basic level to the advance level. It helps instructors that they plan such types of questions that promote the higher thinking level (Price

&Nelson, 2011). It is for specifically for the practical demonstartions. In which teachers try to enhance the students's intellects and increase the clarity of concepts (Tomei, 2005).

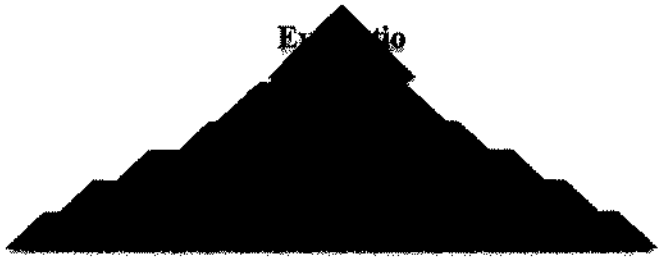

Figure # 2.3: Cognitive Domain

(Wong, 2012)&(Webb, 2007)

2.11.1 Knowledge

In the cognitive domain it is lower level of learning in which students just recall the information about the perticuler objects or theories etc. it is related with that all related knowledge should be in the mind ofstudents. For example the knowledge can be about classifications, procedures, theories, categories etc (O'Connor, 2006).

2.11.2 Comprehension

This is the ability in which students used to remember, establish and rearrange the information. Students must know that how they can arrange the information according to their understanding(Harmon & Jones, 2005).

2.11.3 Application

In this level there is a need of in depth understanding of concepts. In which students used to apply the learned knowledge into the new situations. For instance method, formulas and theories etc (O'Connor, 2006).

2.11.4 Analysis

This level is more intellectual than others. In this level there is a need to break down knowledge into parts and then understand the relationships, or features (Harmon & Jones, 2005).

2.11.5 Synthesis

It is state that the students need to make a new thing from different parts by together them. This level also need the higher level of understanding for example making a research proposal etc(O'Connor, 2006).

2.11.6 Evaluation

In the hierarchy of cognitive domain this is at the highest position because all the elements include in it. In which student have the ability to judge the concepts internally as well externally. It shows the conceptual understanding(O'Connor, 2006).

2.12 Conceptual Understanding in Mathematics

Conceptual understanding in mathematics is a significant focus aimed at mathematical education. Because mathematical concepts are very important to being clear concepts. It is very essential in the mathematical education sphere-wise.

Many researches have been conducted on the conceptual understandings of different mathematical concepts. For instance in the South Africa many work has been

done on the conceptual understanding in Sothern African Association For Research In Mathematics Science and Technology Education (Vithal, Adler & Keitel, 2005).

Reseaches shows that in the United States of America 33% of teachers' concentrations is on conceptual understanding in mathematics. Similarley in China the 31% chines teachers emphasized on conceptual understanding (Leung, Graf & Real, 2006).

Mathematics is basically about the conceptual knowledge and understanding about the area of concepts. Because if the students have conceptual understanding about the concepts then they know that how they can apply the knowledge into the new situation e.g. knowledge about numbers etc(Littleton, Vood & Staarman, 2010). It is about students that have understanding about concepts: with the passage of time it become stronger. Many reserches' results shows that realm of concepts understanding about different subject matter provide guide lines to teachers that how they can plan lessons according to the understanding of students (Berliner & Calfee, 2009).

Resnick and Ford (2008) expalined that Bruner, Wertheimer and Piaget agreed on that the mathematical understanding of concepts about the mathematical problems make the performance of students smooth. So the teachers can teach in the way to make students' concepts clear. Lot of researches on the word problem and algebra shows results that the representation of the problems can also affect the efforts for solutions.

So there are lots of reseach works on the understanding, attitude, achievement and anxiety etc. There are many reason that students are not understand the concepts e.g. math phobia, anxiety etc. So the basic reasons are not explored for the understanding of

concepts that students are properly understanding the concepts or not. There are many ways to explore the understanding e.g.bi-polar dimentions on an idea and Structural Communication Grid etc (Jhonstone&Macguire, 1987).

Structural Communication Grid is a tool through which is basically used to assess the students' conceptual understanding. It is a grid in which data is presented in the form of numbered network and student select the appropriate boxes and then arrange them into a logical sequence. While making it the answer of the question would be spread in the grid, then for the next question it is nessessory that it should have a part from the previous question in the grid.The suitable size of grid can be selected according to the stage of students. For instance for the secondary grade, students the grid will be 3×3 boxes that is 9 and for the college level students it will be 4×3 that is 12 boxes : many researchers used this design(Johnstone, Bahar & Hansell, 2000).

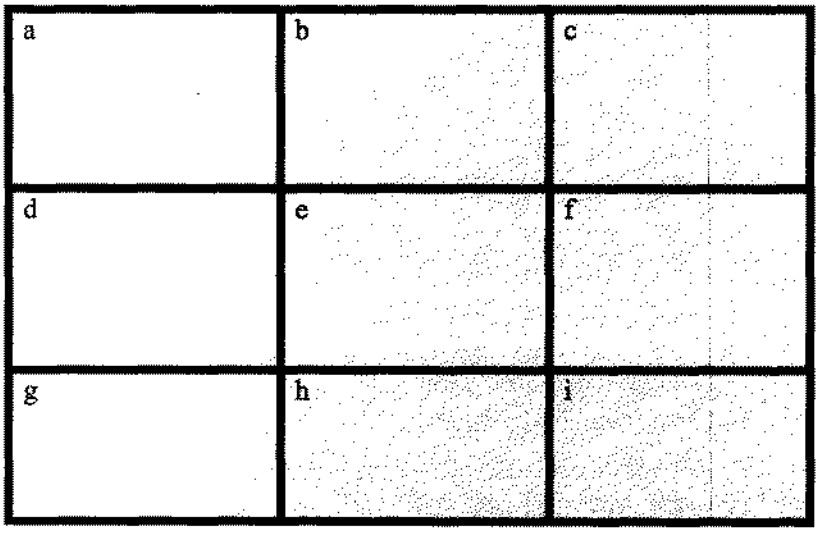

Figure # 2.4: Basic Structure of Structural Communication Grid

(Johnstone, Bahar & Hansell, 2000).

Structural communication grid (SCG) make clear about the student's conceptual understanding about the concepts in any subject. It indicates that how much students understand the concepts. The closer the student to the box it will specify that he/she iscloserto the concept (Jhonstone&Macguire, 1987).

CHAPTER 3

Research Methodology

This chapter consists of methods and procedures of the research that have been used in this research for achieving the objectives. The research objectives were: to explore the conceptual understanding of students in algebra, to measure the attitude of students towards algebra, to find out the relationship between students' conceptual understanding in algebra and their attitude towards algebra, to find out the difference between the mean scores of male and female students' conceptual understanding in algebra and to find out the difference between the mean scores of male and female students' attitude towards algebra.

3.1 Methods and Procedures of the Study

The study wasquantitative in nature. Moreover, this study was a correlational study because it determined the relationship of the students' conceptual understanding in algebra with their attitude towards algebra. Study also compared thegender wise difference in attitude towards algebra and the conceptual understanding in algebra of the students.

3.2 Population

The population of the current study was the secondary school students of Islamabad. Total number of secondary level students in the public sector schools was 30003 in which there were 15109 female students and 14894 male students (FDE, 2013).

3.3 Sample and Sampling Technique

Stratified random sampling technique was used for selecting sample. According toL.R.Gay (2011), if the population size is too large, then the smaller percentage is required for the representative sample of the population. For instance, if the population is 5,000 or more than it, then the sample would be 400 or 500. Therefore,the sample of this study was 500 students of secondary level from the public sector schools of Islamabad. However, the students involved in the pilot testing were not included in the final data collection.

Table # 3.1 Division of Sample

Male	Female
250	250
Total= 500	

3.4 Instrumentation

On the basis of literature review researcher developed two instruments for this study, the researcher have used two instruments: one for measuring attitude towards algebra and the second for exploring the students' conceptual understanding in algebra. The attitude of the secondary schools' students towards Algebrawas measured by using a self-developed Attitudescale. The scale was consisted upon twenty statements. It was five point likert scales ranging from strongly agree (S.A)to strongly disagree (S.D)(as attached in appendix A).The second instrument was Structural Communication Grid for measuring the students' conceptual understanding in Algebra. The researcher developed it. The grid was consisted upon3×3that is nine boxes for secondary level students. In

which there were two questions. In the first question, there were five sub-questions and in the second question, there were four sub-questions. In which students had tochoose boxes as many as they can for the right answer of the given question(as attached in appendix B).

In the sample of 500: in the students' attitude towards algebra "60" was the midpoint in which the students having the scores above 60 had the positive attitude towards algebra and the students having scores below the midpoint (60)had the negative attitude towards algebra. Moreover in the conceptual understanding of students in algebra "55" was the midpoint in which students having scores above "55" had higher conceptual understanding in algebra and the students having scores below the midpoint had lower conceptual understanding in algebra.

Table # 3.2 Instruments of the Study

Number of instruments	Name of Instrument	Number of Statements/Questions
1	Attitude Scale	20 Statements
2	Structural Communication Grid	2 Questions

3.5 Pilot Testing

Both instruments were tested before final data collection. Forthis, purpose both instruments: Attitude Scale and Structural Communication Grid were given to 50 students of secondary level in a school of Islamabad.Stratified Random Sampling technique was used for pilot testing. Researcher herself visited to the school and requested to the students to respond. The respondents felt no difficulty in the understanding of the language of both instruments. The respondents of this school were not included in the sample of final data collection.

For the research tool,validation expert opinion was used. There were four experts for the tool validation. Among these experts, one expert was director of female campus of IIUI and Head of Department of Education in IIUI who was Post Doc in Education, had a great knowledge and expertise in the field of research and education. The second person was expert in mathematics education from the education department of IIUI. The third person was the expert of educational psychology from the psychology department of IIUI. The forth expert was the language expert from the Department of English IIUI.

For reliability of the research tool, it was calculated on the basis of pilot testing data through SPSS by using formula Cronbach's Alpha.

Table # 3.3Reliability Analysis

Scale	Cronbach's alpha
Attitude towards Algebra	.843

3.6 Data Collection

For data collection, researcher personally visited the sample schools during the study hours of secondary level students. Researcher administered the research tools and requested to the respondents to respond.

3.7 Data Analysis

The scoringwas done on the responses of both instruments through SPSS. Mean and Standard deviation of scores was calculatedon both variables. To determine the

relationship between student's conceptual understanding in algebra and attitude towards algebrathe Pearson product momentcorrelation coefficient was used and to see the gender wise significant difference t-test was used.

$H_0$1	Pearson Product Moment Correlation Coefficient
H_0 2	Pearson Product Moment Correlation Coefficient
$H_0$3	Pearson Product Moment Correlation Coefficient
$H_0$4	Pearson Product Moment Correlation Coefficient
$H_0$5	Pearson Product Moment Correlation Coefficient
H_0 6	Pearson Product Moment Correlation Coefficient
H_0 7	Pearson Product Moment Correlation Coefficient
H_0 8	t-test
H_0 9	t-test

CHAPTER 4

ANALYSIS AND INTERPRETATION OF DATA

The overall objective of the study were, to explore the conceptual understanding of students in algebra, to measure the attitude of students towards algebra, to find the relationship between students' conceptual understanding in algebra and their attitude towards algebra, to find out the difference between the mean scores of male and female students' conceptual understanding in algebra and to find out the difference between the mean scores of male and female students' attitude towards algebra.The sample size was 500 secondary school students (male & female). The researcher collected the data. In this study, there were two instruments, one was the attitude scale for the measurement of students' attitude towards algebra and the second was the test (Structural Communication grid) for exploring the conceptual understating of students in algebra. The Mean, Standard Deviation, Pearson Product Moment Correlation Coefficient and t-test were applied to analyze the data through SPSS. The entirehypotheses were studied on 0.05 level of confidence.

Section **A** presents descriptive statistics of Attitude towards algebra and conceptual understanding in algebra and Section **B** deals with the testing of null hypotheses.

SECTION A

DESCRIPTIVE STATISTICS

Table # 4.1Gender wise distribution of Sample

Male Students	Female Students
250	250
Total = 500	

Table # 4.1 shows that the total sample size of the study and its distribution according to the stratified random sampling technique. There were 500 secondary schools students including male and female. All were from the public sector secondary schools of Islamabad.

Table # 4.2Descriptive of Attitude

Gender	N	Mean	Std. Deviation
Male	250	68.52	9.79394
Female	250	65.72	9.49834

Table # 4.2 shows that the Mean scores of male students' attitude towards algebra (68.52) was greater than the Mean scores of female students' attitude towards algebra (65.72). The values of standard deviation shows that scores of female students on attitude towards algebra are more dispersed than male.

Majority (68%) of the male have scores between ±1 SD (78.31394-58.72606).

Table # 4.3 Descriptive of Conceptual understanding

Gender	N	Mean	Std. Deviation
Male	250	63.96	12.28504
Female	250	59.04	13.04450

Table # 4.3 shows that the Mean score of male students' conceptual understanding in algebra was (63.96) greater than the Mean score of female students' conceptual understanding in algebra (59.04).

The value of standard deviation shows that scores of female on conceptual understanding in algebra are more dispersedthan male. Majority (68%) of the male have scores between ±1 SD (76.24504-51.67496).

So that the male students had more conceptual understanding in algebra as compare to female students.

Table # 4.4Exploring the conceptual understanding in Algebra

Number of Questions	Number of students attempted questions in a proper sequence	Number of students attempted questions in a proper sequence in %	Number of students attempted questions in an improper sequence	Number of students attempted questions in an improper sequence in %
Q1.1: Exploring the students' conceptual understanding of algebraic sentence	**475**	**95%**	**25**	**5%**
Q1.2: Exploring the students' conceptual understanding of a true sentence	**314**	**62.8%**	**186**	**37.2%**
Q 1.3: Exploring the students' conceptual understanding of a false sentence	**284**	**56.8%**	**216**	**43.2%**
Q1.4: Exploring the students' conceptual understanding of an open sentence	**250**	**50%**	**250**	**50%**
Q1.5: Exploring the students' conceptual understanding	**458**	**91.6%**	**42**	**8.4%**

of an Equation				
Q 2.1: Exploring the students' conceptual understanding an In-Equation	358	71.6%	142	28.4%
Q 2.2: Exploring the students' conceptual understanding of a Linear Equation	316	63.2%	184	36.8%
Q 2.3: Exploring the students' conceptual understanding of a Radical Equation	316	63.2%	184	36.8%
Q2.4: Exploring the students' conceptual understanding of Simple linear equation	344	68.8%	156	31.2%

Table 4.4 shows that the students' conceptual understanding in algebra. In the test for exploring the students' conceptual understanding in algebra there were two questions: in question number one there were five parts and in the second question there were four parts.

Q 1.1 was for exploring the students' conceptual understanding of'algebraic sentence' this question was attempted by all students who was in the sample but in which 95% students attempted this question in a proper sequence and 5% attempted in an improper sequence.

Q1.2 was for exploring the students' conceptual understanding of a 'true sentence' this question was attempted in a proper sequence by **62.8%** students and **37.2%** studentsattempted in an improper sequence and had no conceptual understanding of a true sentence.

Q 1.3 was for exploring the students' conceptual understanding of a 'false sentence' this question was attempted **56.8%**students in a proper sequence and had conceptual understanding of a 'false sentence'. **43.2%**students attempted it in an improper sequence and showed no conceptual understanding in 'false sentence'.

Q 1.4 was for exploring the conceptual understanding of an 'open sentence'**50%** students were attempted it in a proper sequence and had conceptual understanding of an 'open sentence' and **50%**students were attempted it in an improper sequence and had no conceptual understanding of an 'open sentence'.

Q 1.5 was for exploring the students' conceptual understanding of 'Equation' **91.6%** students attempted this question in a proper sequence and had conceptual understanding of an 'Equation'. **8.4%** students attempted this question in an improper sequence and had no conceptual understanding in 'Equation'

Q 2.1 was for exploring the conceptual understanding of 'In- Equation'. This question was attempted by **71.6%** students in a proper sequence as and had a conceptual

understanding of an 'In- Equation'. **28.4%** students attempted this question in an improper sequence and had no conceptual understanding of an 'In- Equation'.

Q 2.2 was for exploring the conceptual understanding of a 'Linear Equation'. This question was attempted by **63.2%** studentsin a proper sequenceand had conceptual understanding of a 'Linear Equation '. **36.8%**students attempted this question in an improper sequence and had no conceptual understanding of a 'Linear Equation'.

Q 2.3 was for exploring the conceptual understanding of a 'Radical Equation'. This question was attempted by **63.2%** students in a proper sequence and had conceptual understanding of a 'Radical Equation'. **36.8%** students attempted this question in an improper sequence and had no conceptual understanding of a 'Radical Equation'.

Q 2.4 was for exploring the conceptual understanding of 'Simple Linear Equation'. This question was attempted by **68.8%** students in a proper sequence and had a conceptual understanding of 'Simple Linear Equation'. **31.2%**students attempted this question in an improper sequence and had no conceptual understanding of 'Simple Linear Equation'.

SECTION B

This section presents the testing of null hypotheses.

All hypotheses were tested at 0.05 level of significance.

$H_0$1. There is no significant relationship between students' conceptual understanding in algebra and their attitude towards algebra.

This hypothesis was tested through Pearson Product Moment Correlation Coefficient

Table # 4.5Relationship between students' conceptual understanding in algebra and their attitude towards algebra

Variables		Number 'n'	Pearson 'r'	p-value
1	**Attitude towards Algebra**	500	.038	.399
2	**Conceptual Understanding in Algebra**			

Table # 4.5 shows that the value of correlation coefficient is (.038) and corresponding p-value is (.399) shows that there is a positive weak but non-significant relationship between students' conceptual understanding in algebra and their attitude towards algebra. So the null hypothesis was accepted.

H_0 2. There is no significant relationship between male students' conceptual understanding in algebra and their attitude towards algebra.

Table# 4.6Relationship between male students' conceptual understanding in algebra and their attitude towards algebra

Variables		Number "n"	Pearson "r"	P-value
1	**Attitude towards algebra**	250	.062	.329
2	**Conceptual Understanding in algebra**			

Table # 4.6 shows that the value of correlation coefficient is (.062) and the parallel p-value is (.329) show that there is a positive weak but non-significant relationship between male students' conceptual understanding in algebra and their attitude towards algebra. So the null hypothesis is accepted.

H_0 3. There is no significant relationship between female students' conceptual understanding in algebra and their attitude towards algebra.

Table # 4.7 Relationship between female students' conceptual understanding in algebra and their attitude towards algebra

Variables		Number "n"	Pearson "r"	P-value
1	**Attitude towards algebra**	250	-.039	.538
2	**Conceptual Understanding in algebra**			

Table # 4.7 shows that the value of correlation coefficient is (-.039) and the corresponding p-value is (.538) shows that there is a negative weak and non-significant relationship between the female students' conceptual understanding in algebra and their attitude towards algebra. So the null hypothesis is accepted.

H_0 4. There is no significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having positive attitude towards algebra.

Table # 4.8Relationship between the conceptual understanding in algebra and the attitudetowards algebra of the students having positive attitude

Variables		Number "n"	Pearson "r"	p-value
1	**Positive attitude towards algebra**	369	.009	.867
2	**Conceptual understanding in algebra**			

Table # 4.8 shows that the value of correlation coefficient is (.009) and the corresponding p-value is (.867) show that there is positive weak but non-significant relationship between the conceptual understanding and the attitude towards algebra of the students having positive attitude towards algebra. So the null hypothesis is accepted.

H_0 5. There is no significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having negative attitude towards algebra.

Table # 4.9 Relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having negative attitude towards algebra

Variables		Number "n"	Pearson "r"	p-value
1	**Negative attitude towards algebra**	131	.017	.847
2	**Conceptual understanding in algebra**			

Table # 4.9 shows that the value of correlation coefficient is (.017) and the parallel p-value is (.847) show that there is positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having negative attitude towards algebra. So the null hypothesis is accepted.

H_0 6. There is no significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having high conceptual understanding in algebra

Table # 4.10Relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having higher conceptual understanding in algebra

Variables		Number "n"	Pearson "r"	P-value
1	**Attitude towards algebra**	360	.045	.398
2	**High conceptual understanding in algebra**			

Table # 4.10 shows that the value of correlation coefficient is (.045) and the corresponding p-value is (.398) show that there is positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having high conceptual understanding in algebra. So the null hypothesis is accepted.

H_0 7. There is no significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having low conceptual understanding towards algebra.

Table # 4.11Relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having lower conceptual understanding in algebra

Variables		Number "n"	Pearson "r"	p-value
1	**Attitude towards algebra**	140	.093	.272
2	**Low conceptual understanding in algebra**			

Table # 4.11 shows that the value of correlation coefficient is (.093) and the corresponding p-value is (.272) show that there is a positive strong but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having negative attitude towards algebra. So the null hypothesis is accepted.

H_0 8. There is no significant difference between the mean scores of male and female students' conceptual understanding in algebra.

Table # 4.12Difference between male and female students' conceptual understanding in algebra

Gender	N	Mean	T	df	p-value
Male	250	63.96	4.341	498	.000
Female	250	59.04			

Table # 4.12 shows that the t value (4.341) and the p-value (.000) indicates that there was a significant difference between the mean scores of male and female students' conceptual understanding in algebra so the null hypothesis was rejected.

The Mean scores of male students' conceptual understanding was (63.96) greater than the Mean scores of female students' conceptual understanding in algebra (59.04).

H_0 9. There is no significant difference between the mean scores of male and female students' attitude towards algebra.

Table # 4.13 Difference between male and female students' attitude towards algebra

Gender	N	Mean	T	Df	p-value
Male	250	68.52	3.245	498	.001
Female	250	65.72			

Table # 4.13 shows that the t value (3.245) and the p-value (.001) indicates that there was a significant difference between the mean scores of male and female students' attitude towards algebra so the null hypothesis was rejected.

The Mean scores of male students' attitude towards algebra (68.52) was greater than the Mean scores of female students' attitude towards algebra (65.72).

CHAPTER 5

SUMMARY, FINDINGS, CONCLUSION, DISCUSSION AND RECOMMENDATIONS

5.1 Summary

The title of research was, "Relationship between Secondary School Students' Conceptual Understanding and Attitude towards Algebra". This study had the following objectives: to explore the conceptual understanding of students in algebra, to measure the attitude of students towards algebra, to find out the relationship between students' conceptual understanding in algebra and their attitude towards algebra, find out the difference between the mean scores of male and female students' conceptual understanding in algebra and to find out the difference between the mean scores of male and female students' attitude towards algebra.The sample of the study consisted upon 500 male and female students of the secondary schools of Islamabad. Stratified random sampling technique was used. Two research tools were used ;one for the measurement of attitude of students towards algebra and the second for the students' conceptual understanding in algebra. Both tools were self-developed. Pearson Product Moment Correlation Coefficient was used to see the significant relationship while to see the gender wise difference between two groups t-test was used trough SPSS.

5.2 Findings

The following findings were drawn from the analysis and interpretation of data:

1. The mean score of male students' attitude towards algebra was (68.52) greater than the Mean score of female students' attitude towards algebra (65.72). (Table # 4.2)
2. The Mean scores of male students' conceptual understanding in algebra was (63.96) greater than the Mean scores of female students' conceptual understanding in algebra (59.04). (Table # 4.3)
3. The male students had more conceptual understanding in algebra as compare to the female students' conceptual understating in algebra. (Table # 4.3)
4. In attempting the "algebraic sentence" 95% students were attempted it in a proper sequence and had conceptual understanding of an algebraic sentence while the remaining 5% had no conceptual understanding. (Table # 4.4)
5. The "true sentence" 62.8 % students were attempted it in a proper sequence and had conceptual understanding of a "true sentence" while the remaining 37.2 % students were not attempted it in a proper sequence and had no conceptual understanding of a "true sentence". (Table # 4.4)
6. The "false sentence" 91.6 % students attempted it in a proper sequence and had conceptual understanding of a"false sentence" while the remaining 8.4 % students were notattempted, it in a proper sequence and had no conceptual understanding of a "false sentence". (Table # 4.4)
7. The "open sentence" 50% students were attempted it in a proper sequence and had conceptual understanding. While the remaining 50 % students attempted it in

an improper, sequence and had no conceptual understanding of an "open sentence". (Table # 4.4)

8. An "Equation" 91.6 % students were attempted it in a proper sequenceand had conceptual understanding of an "Equation". While the remaining 8.4% students were attempted it in an improper sequence and had no conceptual understanding of an "Equation". (Table # 4.4)
9. The "In- Equation" in which 71.6% students were attempted it in a proper sequence and had conceptual understanding of an "In-Equation". While the remaining 28.4% students were attempted it in an improper sequence and had no conceptual understanding of an "In-Equation". (Table # 4.4)
10. In "Linear Equation" 63.2 % students were attempted it in a proper sequence and had a conceptual understanding about a "Linear Equation". While the remaining 36.8 % students were attempted it in an improper sequence and had no conceptual understanding about a "Linear Equation". (Table # 4.4)
11. The "Radical Equation" 63.2 % students were attempted it in a proper sequence and had a conceptual understanding of a "Radical Equation". While 36.8 % students were attempted it in an improper sequence and had no conceptual understanding about a "Radical Equation". (Table # 4.4)
12. "Simplelinear equation" 68.8 % students attempted it in a proper sequence and had a conceptual understanding of a "simple linear equation". While the remaining 31.2 % students were attempted it in an improper sequence and had no conceptual understating of a "simple linear equation". (Table # 4.4)

13. There was a positive weak but non-significant relationship between students' conceptual understanding in algebra and their attitude towards algebra. (Table # 4.5)
14. There was a positive weak but non-significant relationship between male students' conceptual understanding in algebra and their attitude towards algebra (Table # 4.6)
15. There was a negative weak but non-significant relationship between female students' conceptual understanding in algebra and their attitude towards algebra. (Table # 4.7)
16. There was a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having positive attitude towards algebra. (Table # 4.8)
17. There was a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having negative attitude towards algebra. (Table # 4.9)
18. There was a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having higher conceptual understanding in algebra. (Table # 4.10)
19. There was a positive strong but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having lower conceptual understanding in algebra. (Table # 4.11)
20. There was a significant difference between the mean scores of male and female students' conceptual understanding in algebra. (Table # 4.12)

21. There was a significant difference between the mean scores of male and female students' attitude towards algebra. (Table # 4.13)

5.3 Conclusion

On the basis of findings, following conclusions were drawn

1. It is concluded that the Mean scores of male students attitude towards algebra is (68.52) greater than the Mean scores of female students' attitude towards algebra (65.72). (Findings # 1)
2. It is concluded that the Mean scores of male students' conceptual understanding in algebra (63.96) is greater than the Mean scores of female students 'conceptual understanding in algebra (59.04).(Findings # 2)
3. It is concluded that there is a positive weak but non-significant relationship between the students' conceptual understanding in algebra and their attitude towards algebra. (Findings # 13)
4. It is concluded that there is a positive weak but non-significant relationship between male students' conceptual understanding in algebra and their attitude towards algebra. (Findings # 14)
5. It is concluded that there is a negative weak but non-significant relationship between female students' conceptual understanding in algebra and their attitude towards algebra. (Findings # 15)
6. It is concluded that there is a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having positive attitude towards algebra. (Findings # 16)

7. It is concluded that there is a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having negative attitude towards algebra. (Findings # 17)
8. It is concluded that there is a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having higher conceptual understanding in algebra. (Findings # 18)
9. It is concluded that there is a positive strong but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having lower conceptual understanding in algebra. (Findings # 19)
10. It is concluded that there is a significant difference between the mean scores of male and female students' conceptual understanding in algebra. (Findings # 20)
11. It is concluded that there is a significant difference between the mean scores of male and female students' attitude towards algebra. (Findings # 21)

5.4 Discussion

There were two variables in this study: students' conceptual understanding in algebra and their attitude towards algebra. Stratified random sampling technique was used. From the population, the 500 secondary school's students of Islamabadwas taken as a sample of the study. On the basis of literature researcher developed two instruments by herself for this study: in which one was the attitude (towards algebra) scale and the second wasStructural communication grid (for exploring the conceptual understanding of students).

Generally, the prevailing conditions in our classrooms are not satisfactory. Majority of the classrooms in the educational institutes have the environment where mostly the memorization of the accurate information is preferred instead of the conceptual clarity of the concepts. In which the students are just memorizing the knowledge instead of having conceptual understanding of the concepts of mathematics.

It was found that there was a positive weak but non-significant relationship between the students' conceptual understanding in algebra and their attitude towards algebra. It was found that there was a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having higher conceptual understanding in algebra.It was found that there was a positive strong but not significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having low conceptual understanding in algebra.

Conceptual understanding can affect the attitude of students towards some object, some concept or some subject etc. Therefore, if the students have understanding of any subject even a bit then there is possibility of a positive attitude towards something. On the other hand, those students who have lower conceptual understanding but their attitude is positive in this case their understanding can be improve with may be changing the teaching methods, strategies. The students who have positive attitude but with lower conceptual understanding may be want to clear their mathematical concepts but there may be certain reasons that are working as hurdles. Ali (2011) found those hurdles in the improvement of the mathematical understanding i.e. poor subject knowledge of teachers,

lack of pedagogical competences of teachers, lack of awareness of students' mathematical knowledge

In this study, students' attitude had positive but weak relationship with their conceptual understanding in algebra.In addition, specifically male students' attitude had positive weak but non-significant relationship with their conceptual understanding in algebra.These findings of the study are supported by the findings of Jennison&Beswick (2010) that understanding is positively affecting to the attitude of students towards mathematics. Because if there is a better conceptual understanding the automatically it would drag the students' attitude towards positivity.

There might be many reasons for these types of results: may be students are taking mathematics like other subjects and are not showing the interest for it. There may be a reason that they do not understand the language of mathematics because it is a different subject that needs more time and attention.In general, with the improvement of understanding, students can show positive attitude or if they do not understand the concepts and do not have conceptual understanding, then it can affect their attitude and in that case there may be a possibility of the negative attitude. Similarly, in the case of mathematics (algebra) here students had even miner conceptual understanding in algebra and showed positive attitude towards algebra. So for the improved positive attitude towards any object the conceptual understanding is a very fundamental thing.

It was found that there was a significant difference between the male and female students' conceptual understanding in algebra. There was a negative weak but non-significant relationship of the female students' conceptual understanding in algebra and

their attitude towards algebra.Moreover, male students had more conceptual understanding in algebra as comparing with the female students.

Therefore, it might be discussed here that both male and female students were performing and had conceptual understanding in algebra but the male students had more conceptual understanding in algebra than the female students. Because the female students were showing less, interest in mathematics and had negative relationship between their conceptual understanding in algebra and their attitude towards algebra.This finding is supported bythe meta-analysis by Hyde, Fennema and Lamon (1990)that male and female students are giving their performance but with the difference. It was found that there was a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having positive attitude towards algebra.

It was also found that there was a positive weak but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having negative attitude towards algebra. These findings are supported by the Mohamed &Waheed (2011) that although students had positive attitude towards mathematics but there is still a need to improvement in different areas that for developing a positive attitude towards mathematics. In this study, students had positive attitude towards algebra but with less conceptual understanding in it.

It was found that there was a significant difference between the mean scores of male and female students' attitude towards algebra. Therefore, in this study there was a

significant difference between the mean scores of the attitudes of both male and female students.

This finding of the study supported by the Norton &Rennie (1998) that the male students had more positive attitude than the female students. There might be many reasons for this result that female students had less positive attitude: e.g. disliking of mathematics, less attention, and less understanding in the concepts of mathematics etc.

This finding of the study also supported by Mahanta& Islam (2010) and Khaliq& Rodrigues (2012) that there was a significant difference between the attitudes of male and female students' attitude towards mathematics. Therefore, the male students showed more positive attitude towards mathematics as comparing with the female students' attitude. According to Stipek&Granlinski (1991) the girls have always less expectation from themselves that they are not good in mathematics and then do not believe this that they can perform good in mathematics. Therefore, this thing can also be effective on their mathematical abilities.

Although there was a relationship between students' conceptual understanding in algebra and their attitude towards algebra but weak and non-significant but gender wise, there was a difference between students' conceptual understanding in algebra and their attitude towards algebra.

5.5 Recommendations

On the basis of findings and conclusions, it was recommended that:

1. Based on the findings and conclusions that there was a positive weak but non-significant relationship between students' conceptual understanding in algebra and their attitude towards algebra.Therefore, students may develop their conceptual understanding well in the concepts of mathematics (algebra) by taking interest in it and by giving it more time and attention. Therefore, in this wayteachers may adopt different interesting creative methods of teaching so that students may develop their interest, conceptual understanding so in this way students might be showed positive attitude towards algebra.
2. Findings showed that there was a positive strong but non-significant relationship between the conceptual understanding in algebra and the attitude towards algebra of the students having lower conceptual understanding in algebra. As a result of this, there may be ways to develop the conceptual understanding of the students e.g. by giving them extra time, attention, motivation, because they had positive attitude towards algebra. So in this way they might be developed their conceptual understanding better with the positive attitude.
3. Conclusions showed that there was a significant difference between male and female students' attitude towards algebra. Therefore, there may be some dealings through which the female students can show more positive attitude towards algebra. For instance, teachers may give more attentions to the female students. There might be a moral support and encouragement for the female students that

they can do it and can give their best in algebra. This would enable them to do their best.

4. Findings and conclusions showed that there was a negative weak but non-significant difference between female students' conceptual understanding in algebra and their attitude towards algebra. As a result of this there may be possible ways to develop female students' conceptual understanding in algebra. For this purpose teachers may give extra time to the female students for the clarity of concepts. Teachers may motivate female students to develop their positive attitude towards algebra so in this way it would enhance their conceptual understanding in algebra.
5. On the basis of findings 50% students did not have the conceptual understanding of an open sentence, 43.2% students did not have conceptual understanding of a false sentence, 37.2% did not have the conceptual understanding of a true sentence, 36.8% did not have the conceptual understanding of a radical equation, 31.2% students did not have the conceptual understanding of a simple linear equation.Therefore there may be some interesting methods of teaching to these algebraic concepts that students can easily understand it. For example, teachers may use algebraic puzzles: it would enhance their conceptual understanding. There may bea continues encouragement for students by their teachers.

5.6 Recommendations for Further Researches

Following recommendations may be follow for further researches:

1. Researcher may conduct this study at primary level or at middle level. However, another study can be conducted at the university level too.
2. This research was done only on the public sector secondary schools; other studies may involve the private sector schools as well.
3. This research was done only on the public sectors schools; other studies may involve the comparison of the public and private sector secondary schools.
4. This research was delimited to the algebra; other studies may engage the geometry, trigonometry etc.

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Appendix

Appendix- A

ATTITUDE TOWARDS ALGEBRA

I am student of International Islamic University from the program of MS Education. I need your cooperation for the completion of my research. Kindly provide the following information.

Gender M/F (Tick the following)

Name _____

Name of school_____

Class_____

Please indicate the extent to which you agree or disagree with the following statements by using these keys.

5. **Strongly Agree**

4. **Agree**

3. **Neutral**

2. **Disagree**

1. **Strongly Disagree**

S.No	Statement	S.A	A	N	DA	S.DA
1	I am good in algebra.					
2	I like to understand the questions related to algebra.					
3	It gives me happiness when I am busy in solving algebraic questions.					
4	I usually enjoy algebra.					
5	When my friends say they don't like algebra then I used to support it.					
6	I feel good when I get good marks in algebra.					
7	I don't like algebra.					
8	I want to hide it that I am good in algebra					
9	I don't like to talk with others about algebra.					
10	I think it is wastage of time to spend too much time in solving algebraic questions.					
11	It makes me uncomfortable when other people know about my ability in algebra.					
12	I don't like to join discussions related to algebra.					
13	I feel lucky as I can solve difficult algebraic questions.					
14	It makes me feel proud when I get good marks in algebra.					
15	I am good in algebra that is why I am not giving proper attention to other subjects.					
16	I think algebra is a difficult portion of mathematics.					
17	I like to solve algebraic questions.					
18	I do not feel happy when my teachers ask questions related to algebra.					

19	I like to join discussions related to algebra.					
20	My classmates think that it is unusual to be good in algebra.					

Thank you for your cooperation

Appendix-B

For 10th class

STRUCTURAL COMMUNICATION GRID

ALGEBRA (Sentences and Equations)

Name_____ Roll No._____

Answer the following questions by arranging the boxes in a sequence from the grid. Write only the box name in a sequence given at the left hand upper corner at the box.One box may be used more than one time, and you can use more than one box to complete your answer.

Q.1.

a) **3×**	**b)** **+2**	**c)** **=**
d) **11**	**e)** **3**	**f)** **5**
g) **6**	**h)** **<**	**i)** **3Z+2/2**

I. Look at the grid and write an algebraic sentence

_____

II. Write a True Sentence by using the grid

_____

III. Write a False Sentence by using the grid

_____

IV. Look at the grid and write an Open Sentence

_____

V. According to the given grid give an example of an "Equation"

_____

Q.2

a) **3×**	b) **+2**	c) **<**
d) **5**	e) **5y**	f) **=**
g) **0**	h) **√x**	i) **x**

I. Look at the grid and give an example of In-Equation

_____

II. Write a Linear Equation in two variables by using the grid

_____

III. Write a Radical Equation by using the grid

_____

IV. Look at the grid and give an example of Simple Linear Equation?

_____

_____

Request for Permission to Conduct Research in Model Colleges of Islamabad

To whom it may concern

My name is Beanish Safa, and I am a student of MS Education at the International Islamic University Islamabad. The research I wish to conduct for my MS thesis titled "Relationship between Secondary School Students' Conceptual Understanding and Attitude towards Algebra". This project will be conducted under the supervision of Dr.Shamsa Aziz.

I am hereby seeking your consent to give me permission to approach number of model colleges in Islamabad to provide me participants for this research work.
Attached herewith the abstract of my purposed research work

Thank you for your time and consideration in this matter.

Researcher: Beanish Safa

Supervisor: Dr.Shamsa Aziz

Abstract

The present research will be conducted to study the relationship of secondary school students' conceptual understanding in algebra and attitude towards algebra. The purpose of this study will be to explore the conceptual understanding of students in algebra and measure the attitude towards algebra. In this study, the quantitative approach will be used. Population of this study will be the students of public sector secondary schools of Islamabad, which are 30003 in number. The sample will be 500 students (male and female). Two instruments will be used for data collection. The first instrument will be Attitude scale for Algebra that is self-developed. It is a five point likert scale and consists of twenty statements as attached in annexure I. The second instrument will be for exploring the conceptual understanding of students in algebra i.e. Structural Communication Grid (SCG) that is also self-developed as attached in annexure II. Data will be collected through survey and will be analysed through the Pearson product moment correlation formula.

No. F. 2-14/2012(Coord) FDE
Government of Pakistan
Federal Directorate of Education
****

Islamabad the 29th October, 2014

The Principals,
Islamabad Model College for Boys, I-8/3, Islamabad.
Islamabad Model College for Girls, I-8/3, Islamabad.
Islamabad Model College for Boys, G-9/4, Islamabad.
Islamabad Model College for Boys (VI-XII), St. 17, I-10/1, Islamabad.
Islamabad Model College for Girls, G-9/2, Islamabad.
Islamabad Model College for Girls, I-9/1, Islamabad.
Federal Directorate of Education,
Islamabad.

Subject: - **PERMISSION TO COLLECT DATA FROM SECONDARY LEVEL SCHOOLS.**

I am directed to say that Ms. Beanish Safa is a student of MS Education at International Islamic University, Islamabad. She is conducting a research titles "Relationship between Secondary School Students' Conceptual Understanding and Attitude towards Algebra" under the supervision of Dr. Shamsa Aziz. It is assured that data will be kept confidential and will not be used other than research purpose and it will pose no harm to the children. Moreover they will have complete right to quit the study at any point due to any reason.

2. In this connection, you are requested to allow the student concerned to collect data relates to her thesis whenever she needs for his research from adolescents.

(M. TAHIR ALIAS SHAHID)
Deputy Director (Media & Coord)

C.C: -

- A.P.S to Director (Admn & Finance).
- A.P.S to Director Schools (Male).
- A.P.S to Director Schools (Female).
- A.P.S to Director (Model Colleges).
- Ms. Beanish Safa is a student of MS Education at International Islamic University, Islamabad with the request to submit the feedback/thesis.